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# Policy and Programs for Ecosystem Management in the Greater Yellowstone Ecosystem: An Analysis

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**Abstract:** *Yellowstone National Park and surrounding lands, known as the Greater Yellowstone Ecosystem, are at the center of a growing debate about the establishment of a region-wide ecosystem management policy, the contents of such a policy, and the administrative arrangements needed to implement it effectively. This paper (1) introduces the major natural resource agencies in the Greater Yellowstone Ecosystem, (2) reviews the problems obstructing improved management and uses case studies to illustrate the effectiveness of existing policies and programs in the ecosystem, and (3) describes and offers options for policy development and*

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**Resumen:** *El Parque Nacional de Yellowstone y las tierras que lo rodean es conocido como el ecosistema de Greater Yellowstone. Este ecosistema está en el centro de un creciente debate acerca del establecimiento de normas de manejo a nivel regional, el contenido de estas normas y los arreglos necesarios para implementarlas efectivamente. Este documento 1) Presenta a las mayores agencias de recursos naturales del ecosistema de Greater Yellowstone; 2) Revisa los problemas que obstruyen el mejoramiento del manejo y utiliza estudios de casos para ilustrar la efectividad de las normas y los programas existentes para el ecosistema de Greater Yellowstone; 3) Describe y ofrece opciones para el desarrollo de reglamentos y para el mejoramiento de la coordinación entre los programas de las agencias. Las actuales entidades*

*improved coordination among agency programs. Current resource management entities, dominated by federal agencies, are highly fragmented and operate under innumerable and often conflicting policies. Numerous problems exist, including the lack of shared problem definition by agencies and others, lack of unifying policy and goals, lack of interagency coordination, lack of data, and inability to use existing data efficiently. Varying recognition of problems by the agencies and their referent groups has led to a number of proposed solutions, which can be grouped as (1) development of consistent and comprehensive conservation policy and specific management goals, (2) generation and use of policy-relevant knowledge, (3) reorganization and better management of agency bureaucracies, and (4) upgrading technical concepts and tools and improving information management. Effective ecosystem-wide coordinated management will ultimately depend upon well-articulated and well-implemented regional policies, standards, and programs.*

## Introduction

Yellowstone National Park (YNP) and surrounding lands, known as the Greater Yellowstone Ecosystem (GYE), are world-renowned for their scenic grandeur, geothermal features, pristine watersheds, and abundant and visible wildlife. This area of more than 6 million hectares is at the center of a growing debate about whether to establish a region-wide ecosystem management policy, what the contents of such a policy should be, and what administrative arrangements are needed to implement it effectively (Clark & Harvey 1988). The debate is over the mix of preservation and development (i.e., values) in the area and whether the agencies can or will develop and implement an ecosystem-wide policy (i.e., process) to coordinate their management activities.

Throughout this paper both the value and process dimensions of ecosystem management are addressed. We view ecosystem management, like democracy, as both a desired value and a way to approach problem-solving. Because the Yellowstone policy debate involves multiple value conflicts as well as disagreements over whether government agencies have the cognitive and administrative process skills to implement ecosystem management, the entire issue is complex, to say the least. To complicate matters further, there is no simple definition of what ecosystem management is or what ecosystem policy should consist of. Regardless of the values ultimately reflected in the overall management

*del manejo de los recursos, dominadas por las agencias federales, están altamente fragmentadas y operan bajo normas innumerables y con frecuencia conflictivas. Existen numerosos problemas, incluyendo la ausencia de una definición del problema común entre las agencias y otras entidades, la ausencia de unión en cuanto a normas y objetivos, la ausencia de coordinación entre las agencias, la ausencia de datos y la falta de habilidad para utilizar eficientemente los datos existentes. Las diferencias en el reconocimiento de problemas entre las agencias y los grupos referidos ha dado lugar a un número de propuestas para solucionar el problema las que se pueden agrupar como sigue: (1) el desarrollo de normas de conservación consistentes y comprensivas junto con el desarrollo de metas específicas de manejo; (2) la producción y el uso de conocimientos relevantes a las normas; (3) la reorganización y el mejor manejo de las agencias burocráticas y; (4) actualizar los conceptos técnicos y las herramientas y, mejorar la información sobre el manejo. El manejo efectivo del ecosistema ampliamente coordinado dependerá en última instancia de la buena articulación entre los programas, los estándares y las normas regionales.*

goals for the region, there is general agreement that improved management processes are needed.

The Greater Yellowstone Ecosystem is generally defined by its geology, climate, physiography, and plant and animal communities, which distinguish it from the surrounding plains. Existing boundary lines between management jurisdictions in the GYE, however, do not reflect the ecological unity of the area. These artificial boundaries result in fragmented and sometimes contradictory management of adjacent land units (Congressional Research Service 1987; Clark & Zaunbrecher 1987; Keiter 1989). Government agencies in this region often lack common management goals, effective communication, and data management capabilities (Varley 1988).

This paper (1) introduces the major natural resource agencies in the GYE, (2) reviews the problems obstructing improved management and uses case studies to illustrate the relative effectiveness of existing policies and programs in the GYE, and (3) describes policy development and offers options for policy development and improved coordination among agency programs.

The public policy debate surrounding the management of the Greater Yellowstone Ecosystem is immensely complex, and therefore any analysis is inherently limited in scope and detail. In an effort to provide an overview of this debate we have highlighted the issues and characterized the positions of some of the major agencies and nongovernmental groups in the region. We asked a wide variety of resource professionals to review the manuscript.

## The Agencies and Interest Groups

More than 28 federal, state, and local governmental entities manage parts of the Greater Yellowstone Ecosystem. Federal agencies manage most of the area, and state fish and game departments play important roles in managing wildlife. These, combined with thousands of private land and business owners, interest groups, and users of the public lands create a dense, highly fragmented, and complex policy arena, making comprehensive, integrated GYE management a challenging task.

The National Park Service (NPS), in the Department of Interior, was established in 1916 to manage national parks and monuments. The NPS is required by its Organic Act to "conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The Forest Service (FS), in the Department of Agriculture, operates under multiple-use policies set forth in the 1897 Organic Act, the Multiple Use-Sustained Yield Act of 1960, the Forest and Rangeland Renewable Resources Planning Act of 1974, and the National Forest Management Act of 1976 (Norse et al. 1986). The national forests are to be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes. Hard-rock mining and mineral leasing also occur on national forest lands. The Fish and Wildlife Service (FWS), in the Department of Interior, had its inception in 1871 and takes its authority from the 1956 Fish and Wildlife Act and the 1966 National Wildlife Refuge Systems Administration Act. It is the lead agency in administering the Endangered Species Act. The Bureau of Land Management (BLM), in the Department of Interior, was established in 1946. The Federal Land Policy and Management Act of 1976 guides management of BLM lands. Policy specialists have studied these federal agencies in many different settings (e.g., Clarke & McCool 1985; Zaslow 1986). The Montana Department of Fish, Wildlife and Parks, the Idaho Department of Fish and Game, and the Wyoming Department of Game and Fish, which are responsible for managing game and nongame fish and wildlife, have not been well studied from a policy perspective.

The major nongovernmental organization (NGO) or "referent group" that serves as watchdog and critic of the agencies is the Greater Yellowstone Coalition (GYC), in Bozeman, Montana (Tober 1989). Established in 1983, the GYC is comprised of 3300 individual members and 75 regional and national member organizations. The Coalition is committed to an ecosystem approach to resource management, based on interagency coordination and a common vision of a sustainable ecosystem. The GYC has worked aggressively to limit logging, road-building, and mineral, energy, and geother-

mal development throughout the region. One major GYC undertaking is the Greater Yellowstone Tomorrow project, a comprehensive protection plan for the GYE, initiated in 1989. The Tomorrow project will develop a vision for the future of Greater Yellowstone based on "a solid understanding of Ecosystem functions, man's impact on these processes, and actions needed to assure long-term protection and restoration" (Glick 1989:13).

Opposing ecosystem management are a variety of multiple-use and commodity-development groups such as regional livestock, timber, and mining associations, off-road vehicle enthusiasts, and agricultural organizations. These groups have not formed a permanent coalition in the GYE, although 39 of them temporarily banded together as the Yellowstone Regional Citizens Coalition in 1990 in vehement opposition to the "Vision for the Future," a federal agency document calling for ecosystem management.

Also in 1990, 35 local conservation districts around Yellowstone National Park formed the Greater Yellowstone Association of Conservation Districts. This association intends to bring competing interests together to seek solutions to resource conflicts in the GYE. State and local politicians and local chambers of commerce also participate vigorously in the ecosystem debate.

## The Problems

Perhaps the biggest obstacle facing advocates of ecosystem management in the GYE is the lack of a shared problem definition and consequently lack of a common definition of what ecosystem management is. The debate can be distilled to two issues: lack of consensus on goals, and lack of ability to reach common goals. Many individuals and organizations are involved in the policy debate, so it is not surprising that many different assessments of the problems exist. Varley (1988) summarized the range of views about current agency performance. Some managers believe that existing administrative arrangements (i.e., processes) are adequate, but could use some fine-tuning, which might include closer coordination. These managers are quick to argue that no administrative boundary changes or involvement by Congress or the president are needed (Tixier 1986; Peterson 1986). Recent agency publications suggest that a more comprehensive shift in management objectives (i.e., goals and values) is needed for the region (GYCC 1990). Conservation groups such as the GYC criticize existing agency objectives and processes, citing widespread and serious cumulative threats to the integrity of the ecosystem and questioning the agencies' long-term commitment to maintaining the GYE (GYC 1988, 1989a).

Before a problem can be solved, it must first be defined accurately (Dery 1985). In fact, the way a problem

is defined is tantamount to prefiguring a solution. Therefore, the first and most important task of the Greater Yellowstone Ecosystem agencies and their critics should be to carry out a thorough, systematic analysis to define problems in order to point out opportunities for improvement. One barrier to such an assessment is that different individuals occupy different positions and possess different values in the policy debate, creating unique vantage points or biases. Additionally, these individuals have different limits of personality, intellect, experience, and access to information. Organizational life and fixed ideologies about land management often preclude recognition of certain types of problems or opportunities (Katz & Kahn 1971; Etheredge 1985). Because of these factors, it is difficult or impossible for all individuals and groups to agree on a common problem definition, planning system, and evaluation procedure.

Other obstacles to ecosystem management include a lack of unifying policy and goals, a lack of interagency coordination, lack of data, and inability to use existing data efficiently.

#### **Lack of Unifying Policy and Goals**

The lack of commonly shared policy and management goals (i.e., values sought) among the federal and state agencies is the single greatest impediment to ecosystem management (Hocker 1979; Reese 1984; McNamee 1987; Varley 1988). Traditional public land use in the western United States has been solidly in favor of natural resource exploitation, and this is largely the policy that guides management in the GYE. But in the last two decades other land-use values (e.g., wildlife, recreation, aesthetics) have been given increased attention in federal policy. The contest between these competing values and management philosophies is highly contentious in the GYE, and the myriad policies under which federal, state, and local agencies operate there are often in conflict. For example, the Forest Service multiple-use policy can and does conflict with National Park Service policy (Sax & Keiter 1987). There is no policy that specifically calls for coordinated ecosystem management in the region (Keiter 1989).

Even if there was an "ecosystem management act" or an executive order to the agencies to manage the GYE cooperatively, passage of legislation or directive is virtually the beginning of the policy process rather than its conclusion. "How policies get twisted, changed, modified, distorted, and even at times successfully executed" by bureaucracies is a subject of intense study (Clarke & McCool 1985:2). Even if appropriate policy direction were unanimously agreed upon and legally enacted, there is no guarantee that it would be implemented as expected. For example, Yaffee (1982), who studied the

Endangered Species Act, found a tremendous amount of discretion in its implementation. In some instances, implementation appears to differ significantly from the expectations of the individuals who formulated the Act. Thus attention must be paid both to defining goals and to clarifying processes for implementing them.

The relationships among the agencies must also be considered. As Lindbloom (1980) observed, the mere size of government organizations can present staggering problems in terms of resolving conflicts and arranging cooperation. In a complex arena such as the GYE, fragmentation of authority and overlapping agency responsibilities can result in cooperation or mutual obstruction. Natural resource policy is really a "series of negotiated settlements resulting from the interaction among competing interest groups, among competing regions, and among agencies competing for the support, interest, and attention of the public" (Dana & Fairfax 1980:xiii). Federal agencies have been addressing coordination problems for some time through several administrative mechanisms, which are examined below. Coordination with state and local governments is even more problematic.

#### **Lack of Interagency Coordination**

The Congressional Research Service (CRS 1987) reported that existing coordinating committees in the GYE lacked comprehensiveness in membership and approach and were inadequate in providing complete, coordinated management. They also noted that existing administrative boundaries and organizations hamper comprehensive, coordinated management and understanding.

In a legal review of land-use policy in the Greater Yellowstone Ecosystem, Keiter (1989:985) concluded that "there is no common approach to land management" and "there is no single entity empowered to assess the larger ecological ramifications of serial or concurrent development activities within the ecosystem." The Forest Service, Keiter (1989) argues, has clear congressional direction to coordinate its land-use planning process with its neighbors under the National Forest Management Act (NFMA) of 1976. But the Act does not define "coordination," and the agency appears to interpret this to mean merely giving notice of its planning processes to other resource management agencies and providing minimal consultation. Coordination is left to the discretion of each forest supervisor. Keiter (1989:991) concludes that unless the coordination requirement of the NFMA is given some real substance, "inter-agency coordination will remain a largely voluntary undertaking, and individual land managers will continue to enjoy virtually unconstrained authority within their

own domains, even when their decisions may negatively impact adjacent lands or shared resources.”

### Lack of Data and Inability to Use Existing Data Efficiently

Adequate information for making systems-wide decisions is essential to ecosystem management. Information and research are lacking on the mosaic of ecological communities, the patterns of behavior in these communities, major subsystems and their interactions, and disturbances that affect the GYE. The CRS (1987) concluded that information on the GYE and on development activities was inadequate to evaluate management choices. Since data will always be in demand for complex systems, the real question is how to make good choices given the lack of “adequate” data.

The way that various federal and state agencies are organized “may contribute to the data problems” (CRS 1987:174). Gale (1987) provided an example of this. Managers realized in the early 1980s that the GYE trumpeter swan (*Cygnus buccinator*) population was in serious trouble. But despite 60 years of study and intense management, no one understood the causes of the population’s decline: “Each agency had studied and attempted to manage the swans and habitats within its own management area, and each knew something about its own piece of the puzzle. But until a crisis was obvious and the loss of the population loomed on the horizon, no one was assigned the job of putting the pieces together in order to understand the population as a whole. It was only when managers began to look at the big picture that the pieces started to fit together and make sense” (Gale 1987:13). Gale indicates that more comprehensive integration and synthesis of data combined with better interagency coordination are keys to improved swan management.

The sheer vastness of the knowledge needed for ecosystem management necessitates specialization. But extraordinary integration of this specialized knowledge is required to sense problems and make wise choices (Brewer 1988a). Existing data need to be aggregated and easily accessible. Mechanisms for “extraordinary integration” are lacking in the GYE. New information is required in some instances. Inventory and monitoring procedures, cumulative effects models, and other information management technology must be improved and applied.

In addition, Varley (1988) noted that agencies’ technical capabilities for dealing with specific management problems can lag behind problem recognition. The problem here is how to design and manage human systems, with adequate staffing and resources, to detect environmental problems early, or better yet, to anticipate and prevent them.

### Three Case Studies

Three cases from the GYE—management for biodiversity on the National Forests, grizzly bear (*Ursus arctos horribilis*) conservation and recovery, and the Greater Yellowstone Coordinating Committee’s recent moves to coordinate National Park Service and Forest Service management—illustrate some of the problems. Additional information on all three cases is available from the authors.

The first case examines conservation of biodiversity on FS lands as mandated by the NFMA. Management of Greater Yellowstone Ecosystem’s seven national forests, which comprise about 73% of its land area, is extremely important to the welfare of GYE’s biodiversity. Whitfield and Clark (1988) analyzed the FS’s ability to implement the biodiversity provisions of the NFMA in the GYE by applying the conceptual framework of Mazmanian and Sabatier (1983).

Four problems are evident in the Forest Service’s biodiversity conservation programs. (1) The FS lacks technical skills to adequately define, measure, monitor, and conserve biodiversity. (2) NFMA implementation is impeded by inadequate understanding of the effects of forest management actions on biodiversity, that is, of the causal theory that would allow a conscious change in agency direction. (3) There is inadequate allocation of resources needed to develop understanding and support a shift in agency management. (4) Major threats to biodiversity ecosystem-wide result from a lack of understanding of wildlife-habitat relationships, a lack of cumulative effects assessments, and a lack of ecosystem coordination among managers.

Our second example looks at grizzly bear management, which has been contentious for the last 20 years. Listed as threatened under the Endangered Species Act in 1975, the grizzly bear clearly illustrates the inherent need for natural resource management on an ecosystem level. Grizzlies range over more than 2 million ha of public and private lands. The history of grizzly bear management has been summarized by Leopold et al. (1969), McNamee (1984), Craighead (1979), Schullery (1986), Interagency Grizzly Bear Committee (1987), Craighead et al. (1988), and Knight et al. (1989). Despite the fact that the Yellowstone grizzly bear population is one of the most intensely studied wildlife populations in North America, its recovery and long-term viability remain in question (Amato & Whittemore 1989; Mattson & Reid 1991).

There have been at least five positive developments since 1973. First, a cooperative effort—the Interagency Grizzly Bear Study Team (IGBST)—was founded in 1973 to research Yellowstone’s grizzly bears. It included officials from most federal and state agencies. However, a 1974 review of the grizzly bear situation by

the National Academy of Sciences, published 9 months into the IGBST program, was critical of agency efforts, including IGBST (NAS 1974). Second, in 1975 the grizzly bear south of the Canadian border was listed as "threatened" under the Endangered Species Act, and the Interagency Steering Committee, consisting of representatives from six agencies, was formed to guide the IGBST. Third, in 1979, five national forests and two national parks completed the Yellowstone Grizzly Bear Guidelines, which are the primary source for management decisions involving grizzlies and their habitat. Fourth, in 1982, the Grizzly Bear Recovery Plan called for an aggressive and concerted program for recovery of the grizzly bear in the lower 48 states. The Plan set a target recovered population in Yellowstone of 301 bears, and recommended a "zero-risk strategy" (no human-caused deaths) for population recovery (USFWS 1982). Fifth, the Interagency Grizzly Bear Committee (IGBC), which included a Yellowstone Ecosystem Subcommittee (YES), was established in 1983 in response to high grizzly mortalities and concern about the viability of the Yellowstone population.

The pace and scale of the grizzly bear management program has increased in recent years because of these five developments. These developments came about because problems existed and because a highly attentive and vocal environmental and scientific community joined those internal advocates within the agencies for grizzly conservation. Recent estimates suggest that there are a minimum of 170–180 grizzlies in the GYE (Knight et al. 1988).

At least three difficulties stand in the way of full recovery. The biggest obstacle to population recovery is annual human-caused mortalities, especially among adult female grizzlies. From 1975 to 1989, there have been 140 known and probable grizzly deaths (including 33 adult females; Knight et al. 1989).

The second difficulty stems from uncertainty over the number of bears (and the amount of habitat) needed to ensure that the population can sustain itself over the long term. The 1982 Grizzly Bear Recovery Plan set a recovery target of 301 bears (USFWS 1982). The draft revision of the recovery plan, released for public review in 1990, uses the number of adult females with cubs of the year (15 per year) and their distribution throughout the recovery zone as its recovery criteria (USFWS 1990). Questions have been raised as to whether this number actually represents a viable population and, if it does, whether sufficient habitat exists in the GYE to support the population over the long term.

The third difficulty deals with habitat and population management. Over 25% of agency-defined occupied grizzly bear habitat is open to development activities (e.g., logging, oil and gas development, livestock grazing, and developed recreation sites) that are known or suspected to adversely affect grizzlies (Amato & Whit-

temore 1989). Considerable debate exists over the extent and degree to which these activities, singularly and cumulatively, impair grizzly recovery efforts (IGBC 1987).

Just as grizzly bears are biological indicator species, perhaps they are also indicators of the failures and successes of policies and management efforts at ecosystem scales. Success in maintaining the GYE will be measured, in part, by our success in managing the Yellowstone grizzly. Recovery will depend on a strong scientific base of knowledge of the long-term biological needs of the population, a public and managerial value system that recognizes the ecological and other values of grizzly bears, and an applied management system that can integrate these two components into an effective recovery policy. There are considerable differences of opinion, however, on the current status of the Yellowstone grizzly bear population and the effectiveness of interagency efforts to ensure its long-term viability.

The third case looks at the agencies' Greater Yellowstone Coordinating Committee (GYCC), established by federal managers in the early 1960s as a forum for discussing coordination in the Greater Yellowstone region (GYCC 1987). The GYCC's membership consists of the Park Service Rocky Mountain regional director, the regional foresters of the Intermountain, Rocky Mountain, and Northern regions, the forest supervisors of six national forests, and the superintendents of Yellowstone and Grand Teton national parks. The GYCC meets a few times a year to coordinate management and public services between the national parks and national forests. While the GYCC was formed to initiate and improve communication and coordination between the national parks and national forests, the GYCC "does not impose decisions" (GYCC 1987), nor does it have decision-making power or authority to direct management activities. Federal coordination efforts and interagency cooperation are largely voluntary, left to the discretion of managers, and can be easily terminated (Keiter 1989).

In response to Congressional oversight hearings in 1985 and the CRS Report, the GYCC stepped up its coordination efforts. In September 1987, as Phase One of its interagency coordination plan, the GYCC published *The Greater Yellowstone Area: An Aggregation of National Park and National Forest Management Plans* (GYCC 1987). The *Aggregation* contained an inventory of Greater Yellowstone's lands and resources and a composite of existing park and forest management plans. The document illustrated the present and future condition of the GYE and projected extensive timber-harvesting and road-building, more oil and gas development, additional mines, and increased fragmentation of the GYE during the next decade.

Critics have concluded from a review of the *Aggregation* that the GYCC has been unsuccessful in coordinating management between the two agencies (GYC

1989b). In response to these external reviews and public opinion and because of increased awareness within the agencies, the GYCC is currently developing a "Vision for the Future" document—Phase Two of the coordination plan—that will establish joint NPS-FS goals and standards to guide the future management and direction of the GYE. The GYCC's first step in creating the "Vision" was to draw up a list of 14 proposed goals for future management of the Yellowstone region, which they released in December 1989 (GYCC 1989). The extensive public comments received in response to this list were used in writing the draft "Vision for the Future" document, which was released in August 1990.

The draft "Vision" proposes three broad goals for the GYE: to conserve the sense of naturalness and maintain ecosystem integrity, to encourage opportunities that are biologically and economically sustainable, and to improve coordination (GYCC 1990). To meet these broad goals, 14 more specific goals, along with "coordinating criteria," are proposed. The "Vision" anticipates that the Greater Yellowstone Ecosystem will continue to provide a diversity of livelihoods based on ranching, logging, recreation, and mineral development on federal lands, but that these activities will be conducted such that they will not disrupt ecological processes or intrude upon the natural landscape.

The draft "Vision" document has become the focus of much controversy in the Yellowstone region. Eight public meetings in late 1990 and early 1991 drew over 2000 participants, of whom over 450 spoke. The GYCC has received thousands of written comments on the draft, and state politicians from Idaho, Montana, and Wyoming have voiced strong opinions. For example, the Wyoming congressional delegation wrote a letter of protest to Interior Secretary Manuel Lujan, saying that the "Vision" could disrupt regional communities and curtail multiple use on public lands. The governors of the three states wrote to the GYCC urging them to redraft the document to clarify its intent. The Wyoming legislature passed a resolution (Wyoming House Joint Resolution 16) petitioning the U.S. Congress to order the departments of Interior and Agriculture to withdraw the document, which they said would "create a de facto Yellowstone National Park management philosophy on adjacent forests, diminishing or totally excluding multiple-use activities." Despite his opposition to the "Vision" document, Governor Sullivan declined to sign this bill. Industry groups have strongly opposed the "Vision," voicing similar concerns about its impacts on local economies and its potential to restrict commodity uses within the GYE.

Environmental organizations in the region have been generally supportive of the "Vision," although they complain that it does not go far enough in reining in environmentally damaging resource management activities and lacks the specificity needed to ensure that its goals

will be implemented. The GYC notes that until implementing criteria and a timetable for action are determined there is no assurance that management practices will actually change (GYC 1989b). The GYCC is evaluating the comments it has received and will release a final "Vision" document in 1991.

Several structural and functional problems with the GYCC may affect the outcome of the "Vision" process. First, the GYCC excludes as formal members agencies such as the Bureau of Land Management, the Fish and Wildlife Service, and state fish and game agencies, all of which play important roles in land management in the GYE. Second, membership of the GYCC is heavily weighted toward the Forest Service, which could result in emphasis on FS values and processes. Third, conservation groups and the public lack confidence in the agencies. For example, Keiter (1989:987) notes that "Thus far . . . the GYCC has not made any substantive policy changes, and it remains to be seen whether this elaborate 'process' will result in meaningful ecosystem-based management." The fourth problem, perhaps one of the most difficult obstacles the GYCC faces, is that the federal agencies may be incapable of looking beyond their own traditions, values, and management processes to translate the ecosystem management goals of the "Vision" document into meaningful policies and practices. Keiter (1989) suggests that legally binding standards rather than discretionary administrative authority may be needed to overcome the agencies' commitment to boundary-based management and managerial discretion.

## The Solutions

The agencies, referent groups, and individuals concerned with the Greater Yellowstone Ecosystem have proposed a variety of solutions to the problems discussed above. Some proposed solutions require shifts in values and goals; others would refine management processes. Agency and nonagency solutions vary considerably in content, degree, and timing of change. In general, agencies see less need for change than do the nonagency conservation groups (GYC 1990). Proposed solutions can be grouped: (1) development of a consistent and comprehensive conservation policy and specific management goals (i.e., values); (2) generation and use of policy-relevant knowledge (i.e., process); (3) reorganization and better management of agency bureaucracies (i.e., process); and (4) upgrading technical concepts and tools and better information management (i.e., process).

### Development of a Consistent and Comprehensive Ecosystem Conservation Policy and Specific Management Goals

New policy is really about setting new visions and aims and reallocating agency responsibilities to achieve

them. Recognition is increasing that a comprehensive ecosystem management policy and specific goals are needed (Keiter 1989; Clark & Zaunbrecher 1987). But what should an ecosystem management policy contain and what goals should it specify? Clark and Zaunbrecher (1987) proposed that ecosystem management means management of natural resources using systems-wide concepts to ensure that all plants and animals in the ecosystem are maintained at viable levels in native habitats, species that have been eliminated by humans are restored, and basic ecosystem processes are perpetuated indefinitely. Major ecological attributes should be monitored (e.g., air and water quality, vegetative dynamics, and wildlife populations). Human economies should be integrated within the ecosystem framework for long-term sustainability.

Improved GYE management may depend on a regional reallocation of decision-making powers. Current problems exist largely because of the fragmentation of the authorities whose pooled decisions affect the system. Rectifying this overall problem should begin with an assessment of historical and current decision-making (Fiering & Holling 1982). Solutions will require institutional change that reflects ecosystem management goals. If that change does not come from within the agencies, it may be imposed by Congressional or judicial intervention (Keiter 1989).

#### **Generating and Using Policy-Relevant Knowledge for Ecosystem Management**

Many difficulties block better creation and use of knowledge essential to policy formation (Brewer 1986). Among these are the complexity of the system involved, differing human perceptions and values, limited theories and weak methodological tools (both scientific and social), and immense uncertainty about the future.

Agencies need to construct, apply, and monitor long-term indicators of environmental quality including a number of ecological and social variables. This policy-relevant knowledge should be used to inform and evaluate policy development and management. Care should be taken not to duplicate some of the large and expensive environmental monitoring programs, which typically overemphasize scientific and technical issues and underrepresent managerial and political ones (Izrael & Munn 1986). Such an approach calls for collaboration among ecologists, social scientists, and policy scientists (Eberhardt 1976).

Brewer (1988b) explored the merits of combining the ecological and policy science approaches to complex problem-solving to help produce and use policy-relevant knowledge. Both sciences seek the integration of diverse and fragmented bits of knowledge to help understand and solve real problems. Ecology does so from a variety of scientific specialties, and the policy

sciences do so from social and behavioral ones. Brewer argued that environmental problem-solving could be maximized by integrating and synthesizing both approaches. Both take on complex problems beyond the grasp of most specialized disciplines. Integrating the natural sciences with the social and policy sciences in the GYE will require an adequate understanding of the policy processes, especially the bureaucratic processes that dominate decision-making. At present, governmental agencies in the GYE appear ill-prepared to follow Brewer's advice.

Ecosystem management requires that we think creatively about very complex environmental and social phenomena that interact and evolve over large scales of time and space. A variety of methods have been employed over the past 2 decades to integrate and synthesize vast bodies of technical and social information about complex problems. These include models, simulations, and games, which Brewer (1986) calls "policy exercises." A series of policy exercises could be focused on clarifying and setting GYE policy and management. The current GYCC "Vision" process and the GYC "Tomorrow" project are variants of policy exercises. But these exercises must be understood as points of observation and not as personal investments to be attacked or defended. Policy exercises should be seriously considered by the agencies as an ongoing mechanism to set policy and goals and design management strategies on an ecosystem-wide scale.

#### **Reorganization and Better Management of Agency Bureaucracies**

Whether policy can be formulated and implemented successfully is directly linked to an organization's structure and management. More flexible and responsive agency structures and cultures, improved interagency coordination, and better use of interagency task forces and project teams could help immensely in developing ecosystem-wide management. Traditional agency bureaucratic structures, cultures, and standard operating procedures fall grossly short of what is needed. More open and participative structures are needed, supported by agency cultures that embrace democratic values (Gruber 1987). The need to "rewire" the management and policy-making system was recognized by Sampson and Deneke (1989:4): "We must build many more bridges between professional disciplines, agencies and institutions. The boundaries built to protect turf impose heavy penalties on society, because they deprive the ultimate users—private land users and public decision-makers—of the full range of integrated and holistic resource information they need."

Several specific suggestions have been offered for improving coordination among agencies in the Greater Yellowstone Ecosystem (Little 1987; Clark & Harvey

1988; GYCC 1990). Examples of these include merging all seven GYE forests into a single FS region, establishing a special "directorship" position with managerial responsibility for the entire GYE, and sharing individual resource management or research positions among several agencies to foster the exchange of technology and information across agency boundaries. Other mechanisms to improve coordination and team performance were described by Clark et al. (1989a), Clark and Westrum (1989), and others. Although coordination is often a key element in ecosystem management, it should not be mistaken for an end in itself. As Agee and Johnson (1988) point out, successful ecosystem management is evidenced by goal attainment and not by the volume of coordination.

#### **Upgrading Technical Concepts and Tools and Making Better Use of Information**

More scientific research is needed, but more importantly, better use of current knowledge is essential. Specifically, research is needed on GYE's boundaries, behavior, environmental functions, subsystem structure and function, and stress and recovery capabilities (International Association for Ecology 1984). A philosophy of adaptive management is essential (Holling 1978; Romesburg 1981).

Agencies can do many things to improve use of information and technical tools. For example, Whitfield and Clark (1988) offered four recommendations for improving management of biodiversity. First, a biodiversity subcommittee should be formed within the GYCC to develop coordinated policy for NFMA implementation. A scientific advisory group, including nonagency authorities, should work with the biodiversity subcommittee to resolve technical problems. Second, a biodiversity management program should be developed for the formal training of field-level professionals; educational programs for the public are also needed. Third, an ecosystem-wide inventory of biodiversity is necessary (Clark et al. 1989b), and ecosystem-wide measures and standards for inventory, vegetation classification, GIS methods, and habitat relationships should be adopted. Fourth, particular areas of importance to species groups or guilds and keystone species should be identified, and appropriate management techniques should be established.

Improvements in GYE management hinge on better use of people by government agencies. Sampson and Deneke (1989:4) noted that:

Truly integrating resource understandings into a "holistic" point of view is hard work, and it takes a lot of people—well-trained and talented people. But it is critical if we are to try to really understand the world and what is happening to it as a result of human activities. We must, therefore, try to train ourselves in two skills at once: a technical skill where we truly understand one

aspect of the natural world; and an integrative skill where we gain the ability to relate that aspect to the rest of the world around it. It may not be a matter of being either a "specialist" or a "generalist," so much as the challenge to be some of each.

Educational programs in ecosystem management are lacking. Programs should be developed to train professionals in systems-wide thinking. As part of this, senior agency officials could be offered several short courses or seminars each year by universities or by governmental and nongovernmental organizations with expertise in different aspects of ecosystem management. Lower-level staff could be offered 1- or 2-year fellowships to attend programs at universities or to visit other sites struggling with ecosystem management. Additionally, a policy of frequent and regular personnel exchange among all agencies, universities, and nongovernmental organizations in the GYE should be instituted at all levels (Clark & Harvey 1988).

#### **Conclusions**

Effective ecosystem-wide coordinated management depends upon well-articulated and implemented regional policies, standards, and programs (Keiter 1989). But there is public doubt that the NPS and FS, acting jointly through the GYCC, are institutionally capable of articulating and implementing a functional, ecosystem-based management policy. The future well-being of the GYE depends on public policy decisions made today (Varley 1988). Because of this, the GYE debate is being followed closely by many interests. The way YNP and surrounding lands are managed not only sets precedents for federal agencies, but also creates a global opportunity for leadership and change in natural resource management.

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