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ON ENVIRONMENTAL POLICY, SUSTAINABLE SOCIETIES, AND BIOSPHERE RESERVES

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A distinguishing characteristic of the closing years of the twentieth century is the universal recognition among the peoples of the world of the need for an ethic of sustainability. For example, the Rio Declaration, adopted by the member states of the United Nations at the 1992 United Nations Conference on Environment and Development, reflects broad agreement on the principles that must guide efforts to achieve harmony between human activities and the earth's environment (1). The Declaration recognizes the ecological unity of the planet, the global interdependence of human activities and natural processes, the relationship between long-term economic progress and environmental protection, and the right of all people to "a healthy and productive life in harmony with nature". Widespread acceptance of the such principles has fostered international cooperation in formulating and implementing treaties on biological diversity, forests, climate change, desertification, stratospheric ozone, marine pollution, and other environmental issues. At the national level, this ethic is reflected in policies that encourage multi sector cooperation in balancing environmental, economic, and cultural considerations in achieving sustainable development. Government agencies and other interests concerned with natural resources have initiated cooperative programs, and expanded ongoing efforts, to manage resources holistically on an ecosystem basis. At regional scales, effective cooperation among diverse interests is now being demonstrated in large geographic areas, such as air sheds, watersheds, regional planning districts, ecoregions, and landscapes. The extent of these areas depends on the spatial and temporal scales of the particular issues of concern and the goals of the cooperating agencies and organizations. Locally, the ethic is motivating the cooperative efforts of neighborhoods and communities in managing their small areas of the planet to sustain a healthy environment that meets the needs of local people.

For more than two decades, UNESCO's Man and the Biosphere Program (MAB) has been facilitating cooperation among policy makers, resource users, and natural and social scientists to foster sustainability at scales from local to global. To demonstrate the benefits of this cooperation, MAB is building a global network of biosphere reserves. Biosphere reserves focus attention on geographic areas that can serve as models for integrating conservation and sustainable development locally, while providing relevant information, technologies and experience to help solve regional and global environmental problems (2, 3).

Origins of MAB and the Biosphere Reserve Concept

The Man and the Biosphere Program (MAB) was launched by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) in 1970 to facilitate intergovernmental cooperation in fostering harmonious relationships between humans and the biosphere. MAB was the first deliberate international initiative to find ways to achieve sustainable development (4).

The Program's broad goal was to "develop the basis within the natural and social sciences for the rational use and conservation of the resources of the biosphere and for the improvement of the global relationship between man and the environment: to predict the consequences of today's actions on tomorrow's world and thereby to increase man's ability to manage efficiently the natural resources of the biosphere." (5)

The establishment of MAB was a manifestation of increasing public concern in the developed countries about the cumulative impacts of human activities on the environment. During the 1960's and early 1970s, the United States launched serious and wide-ranging efforts to protect environmental values. Federal laws were enacted to safeguard air, water, endangered species, wilderness, coastal environments, and other natural resources. New agencies and programs were established to monitor, assess, regulate and maintain environmental quality. Private organizations were formed to provide channels for citizen advocacy and action. New policies and programs, and an increasing share of agency budgets, were directed toward preventing, mitigating, and redressing environmental impacts. The National Environmental Policy Act of 1969 (NEPA) established a national policy on the role of the Federal government in sustaining the environment. This visionary law commits the national government to "use all practicable means .... to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations." To carry out this policy, NEPA requires the Federal government to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and decision making which may have an impact on man's environment." This policy, and the required integrative approach, enabled the United States to aggressively support the establishment of the international MAB program within UNESCO. It subsequently became one of the first nations, in 1974, to establish a national MAB organization to facilitate the participation of many agencies and institutions as partners in implementing MAB goals.

At its first meeting in 1971, MAB's International Coordinating Council identified 13 international scientific projects as the initial framework for coordinating the activities of countries, intergovernmental bodies, and nongovernmental organizations participating in MAB (5). These projects focused on human impacts on forests, grasslands, arid lands, mountains and islands and other widely distributed ecosystems; the management of croplands, engineering works, urban ecosystems, and demographic change; and human perceptions of environmental quality. In each of these areas, MAB sought to encourage interdisciplinary research through the integration of the natural and social sciences. MAB's architects recognized the value of protected areas in meeting the scientific, educational, recreational, cultural and economic needs of human societies, and foresaw an important role for these areas in facilitating the overall research program. They therefore included a project on conservation of natural areas, through which MAB would seek to support the establishment of a coordinated world-wide network of reserves, protected and managed in various ways. These sites would facilitate ecosystem research, the monitoring of environmental change, education and training, and the "means for maintaining the gene pools of plants, animals, and micro-organisms in all of their diversity." The project called for the designation of such areas as biosphere reserves in order to recognize their importance to humankind and foster international concern for their long-term conservation. The concept of a

global network of protected areas for these purposes was endorsed in 1972 at the first global environmental conference ("Stockholm Conference on the Human Environment ") (6).

In an annex to the Nixon-Brezhnev Summit Agreement of 1974, the U.S. and the former Soviet Union gave momentum to building the network by agreeing to establish biosphere reserves on their respective territories. Later that year, the U.S. and several other countries did, in fact, unilaterally establish biosphere reserves, including 16 in the U.S. UNESCO subsequently convened a special task force, which set forth general criteria for use by national MAB organizations in nominating areas for designation by UNESCO as biosphere reserves (7). The U.S. and the U.S.S.R. further honored their summit commitments by convening a joint symposium on biosphere reserves, which launched a bilateral program of ecological monitoring in paired biosphere reserves which, with minor interruptions due to the changing climate of the countries' relationship, has facilitated cooperation for 20 years (8, 9,10)

Biosphere Reserves Defined. The UNESCO criteria, as developed in 1974 and subsequently refined, encourage the nomination of areas that include a mosaic of ecological systems representative of a major biogeographical region, including a gradation of human interventions; that are significant for biodiversity conservation; and that offer opportunities to explore and demonstrate approaches to sustainable development on a regional scale (11, 12, 13, 14). Its size and configuration should be sufficient to carry out three basic functions of biosphere reserves:

o to contribute to the conservation of landscapes, ecosystems, species, and genetic variation

o to foster ecologically, socially and culturally sustainable development

o to provide logistic support for environmental education, training, demonstration projects, monitoring and research relating to local, regional, national, and global issues of conservation and sustainable development.

To carry out these functions, the biosphere reserve should include one or more legally protected core areas managed to sustain indigenous biota and natural processes according to established conservation objectives, and of sufficient size and appropriate configuration to achieve these objectives. The core area provides important opportunities for conservation, long-term observational studies, and environmental education and serves as a regional benchmark of ecological health. The biosphere reserve should also include one or more legally or administratively established buffer zones (also referred in the U.S. as managed use areas) that typically adjoin or surround the core area (s). These areas are managed for uses and activities consistent with conservation objectives. An important purpose of these zones is to develop and demonstrate approaches for managing and using natural resources while maintaining natural processes and biota. Buffer zones frequently provide areas for experimental research, education, demonstrations of sustainable production systems and appropriate technologies, and public recreation. The biosphere reserve should also recognize a transition area (also referred to in the U.S. as a cooperative area). The transition area surrounds the core area(s) and buffer zone(s) and supports a variety of resource uses and human activities characteristic of the larger region. The transition area serves as a zone of influence where the parties involved in the core areas and

buffer zones of the biosphere reserve work with surrounding communities and other regional interests to communicate the lessons learned and help promote sustainable resource management. The transition area is open ended and usually not delineated on a map. Its functional dimensions may vary in space and time depending on the scale of the issues being addressed cooperatively by biosphere reserve stakeholders. Within this spatial configuration, UNESCO's latest criteria specifically encourage organizational arrangements to involve public agencies, private organizations, local communities, and other interests in planning and implementing the biosphere reserve functions (14).

The zonation categories were developed to describe, in general terms, the functional roles of the existing protected conservation areas and other legally established management units, which comprise the internationally designated units of the biosphere reserve, and the surrounding "biogeocultural" area in which cooperative activities are especially encouraged. In the U.S. and most other countries, the categories involve no legal or administrative requirements. They merely serve to aid the parties in their voluntary efforts to implement the biosphere reserve concept.

By encouraging research, education, and demonstration activities within internationally recognized areas containing various ownerships, resource uses and management strategies, UNESCO offered biosphere reserves as a new approach for demonstrating conservation and sustainable uses of ecosystems. However, in the early 1970s, there was little experience to draw upon for implementing such an approach. Recognizing this, UNESCO encouraged national MAB organizations to use flexibility in adapting UNESCO's general guidance to their particular situations. The implementation of the biosphere reserve concept would rely on the existing legal and administrative authorities, frameworks, and processes in each country. UNESCO's role would be to facilitate the sharing of information and experience from biosphere reserves, provide guidance and technical assistance, encourage international cooperation, and encourage financial and technical support for biosphere reserves from governments, other United Nations agencies and international organizations.

Since he began his career with the Department of the Interior in 1971, the author has followed the development of MAB's biosphere reserve network, initially as an interested observer and, since 1980, as a member of the U.S. MAB organization, representing first the National Park Service and later the National Biological Service, which in 1996 became the Biological Resources Division of the U.S. Geological Survey. During this time, many factors, events, and trends have influenced the development of U.S. biosphere reserve network, which, as of early 1997, included 47 units (Figure 1). The remainder of this chapter highlights several stages in the evolution of the U.S. network, and the challenges in making biosphere reserves standard-bearers for demonstrating the ecosystem approach.

Laying a Foundation of Designated Sites, 1974 - 1980

In view of MAB's mission to facilitate intergovernmental scientific cooperation on natural resource issues, the responsibility for designing the initial U.S. biosphere reserve network fell to scientists in federal land managing agencies, namely the U.S. Department of Agriculture (USDA) and the Department of the Interior (DOI) . These agencies administered securely protected sites

with long histories of research in most of the country's biogeographical provinces. It is therefore logical that the first 27 U.S. biosphere reserves designated through 1978 were either protected conservation areas -- mostly national parks -- managed by DOI or experimental research areas managed by the Forest Service [FS] or Agricultural Research Service [ARS] within USDA However, the architects of the initial U.S. nominations realized the limitations of these Federally protected areas in fulfilling the purposes of biosphere reserves. National parks provided sites of global importance for conservation, baseline studies of natural ecosystems, and improving public awareness of environmental issues . However, they were not suitable sites for manipulative research and development of sustainable economic uses of ecosystems. On the other hand, the USDA sites often had outstanding long-term records in implementing these functions, but were of limited significance as conservation areas. In biogeographical provinces containing both types of sites, the architects decided to pair separately designated biosphere reserves in the hope of facilitating cooperation in carrying out biosphere reserve functions within the province (15).

Designation of the early biosphere reserves was noncontroversial. Administering Federal agencies viewed the international recognition as a means to encourage greater scientific use of the designated sites and to increase scientific cooperation on important natural resource issues. Designation involved no legal or financial obligations, did not require changes in planning or local management practices, and encouraged activities of a strictly scientific, technical and educational nature. Early designations therefore generated little public interest, and there were no pressures for public involvement in the nomination process.

In 1974, the USMAB National Committee established Directorates of natural and social scientists from the Federal agencies and the private sector to plan and implement interdisciplinary research on particular topics (e.g., environmental pollution, human perception of environmental quality) and ecosystems (e.g., mountains, aridlands, islands, temperate forests, tropical forests). A separate directorate, with representatives from land managing agencies and organizations, was established to facilitate and support activities involving biosphere reserves. Between 1976 and 1978, USMAB sponsored workshops in five regions containing a number of paired biosphere reserves (the Eastern Forest, Pacific Northwest, the Southwest, the Pacific Southwest, and the Rocky Mountains). Important resource issues in each region and opportunities for future cooperation involving the region's biosphere reserves were identified. Beginning in 1978, USMAB funded extramural grants to support the Directorates' programs. During the next five years, USMAB's Consortium for the Study of Man's Relationship with the Global Environment supported many cooperative research projects in biosphere reserves, some involving paired sites, on such regional resource issues as acidic deposition in the Southern Appalachians, fire management the northern Rockies, and integrated management of white-tailed deer in Sonoran oak-pine woodlands of paired biosphere reserves in the U.S. and Mexico. In 1978, a national USMAB forum developed a framework for long-term ecological monitoring in biosphere reserves (16). Subsequently, USMAB, in cooperation with the U.N. Environment Programme, launched a multilateral program for monitoring background pollution levels in air, water, and soil involving biosphere reserves in the U.S., Russia, and Chile.

USMAB's initiatives increased interest among protected area administrators in filling gaps in the U.S. network. By the late 1970s, non-federal organizations began to petition for biosphere reserve nomination. In 1979, The Nature Conservancy's Konza Prairie Research Natural Area in Kansas and the University of Michigan's Biological Station became the first non-Federal areas to be designated as biosphere reserves. By 1980, the U.S. network comprised 36 biosphere reserves, located in 16 of the country's 20 biogeographical provinces.

During the Carter Administration (1977 - 1981), the number of Federal agencies participating in U.S. MAB and their funding contributions increased significantly (Figure 2). By the end of the decade, USMAB had become a recognized, respected, and modestly funded framework for applied interdisciplinary research. In 1979, the Office of Management and Budget and the Office of Science and Technology Policy in the Executive Office of the President issued a joint memorandum underscoring the importance of MAB in international cooperation and as a focus for coordinating domestic programs aimed at improving the management of natural resources and the environment. Federal agencies were directed to participate fully in the program. In 1980, USMAB approved a national program plan, which included support for cooperative regional demonstration projects (17). The partnership projects -- the conceptual forerunners of ecosystem initiatives 15 years later -- proposed to use MAB's interdisciplinary research capabilities and biosphere reserves to help address regional resource problems. The plan was favorably received at OMB, which referred the plan to MAB's participating agencies for funding.

As the interest of Federal agencies in MAB increased, concern about threats to protected areas helped focus specific attention on biosphere reserves. In 1980, the National Park Service prepared a report to the Congress on the state of the national parks (18). The report summarized the perceptions of park managers on 53 categories of threats, the majority of which were reported to originate outside park boundaries. Parks designated as biosphere reserves reported particularly large numbers of threats -- perhaps reflecting the strong history of research in these areas which enabled these threats to be documented. The "threats report" reinforced NPS interest in the role of biosphere reserves in obtain information to document and assess threats, particularly external threats requiring expanded cooperation. As the steward of the majority of U.S. biosphere reserves at the time, this interest proved to be an important factor in the development of the U.S. Biosphere Reserve Program during the next decade.

At the international level. increasing global interest in the relationship between conservation and development influenced efforts to expand the unique niche of biosphere reserves. In 1980, the World Conservation Union (IUCN), in cooperation with the World Wildlife Fund and the United Nations Environment Program, issued the World Conservation Strategy, which provided an early conceptual blueprint for integrating conservation and development (19). The strategy set forth an integrated and cooperative approach for maintaining ecological processes and biological diversity within the context of sustainable utilization of ecosystems and species. Although the Strategy makes only a brief reference to biosphere reserves, it helped foster international interest in exploring the role of biosphere reserves in demonstrating the ecosystem approach.

Establishing Multi-Site Linkages, 1981-1989

In 1981, UNESCO held an international conference to review MAB's first ten years and recommend future directions (20). With respect to biosphere reserves, activities generally reflected the objectives of the national parks and research reserves which comprised most of the network at the time. The U.S. reported the many accomplishments of its 36 biosphere reserves in developing information, technology, and scientific capabilities to address resource issues of concern to the managers of the designated sites. However, there was little evidence of effective communication with the public about MAB, biosphere reserves and interrelationships between human activities and the biosphere, and only limited progress in developing regional and international linkages involving the designated sites (21). The U.S.S.R. emphasized environmental monitoring in existing protected areas, but indicated little emphasis on developing most other biosphere reserve functions (22). The conference evoked a general concern regarding the need for more emphasis on development and integration of the functions of biosphere reserves, rather than the designation of sites per se -- i.e., for quality over quantity. The 1981 conference paved the way for the first International Biosphere Reserve Congress, which was held in Minsk, Belarus, in 1983. This forum brought together specialists from scores of countries to produce the first detailed compendium of biosphere reserve case studies, along with numerous recommendations for developing a program framework (23). UNESCO subsequently used these recommendations to develop the Action Plan for Biosphere Reserves, which was adopted in December 1984 (13).

More clearly than any previous guidance from UNESCO, the Action Plan conceptualizes biosphere reserves as models for linking the conservation of ecosystems and biological diversity with regional social and economic development. Although the concepts of "ecosystem management" and "sustainable development" had yet to become widely recognized, the Plan clearly envisions biosphere reserves as cooperative frameworks for demonstrating creative ways to integrate these concepts. The Action Plan stresses the importance of involving local interests, and that biosphere reserves should demonstrate economic and social benefits for local people as well as the relationship between conservation and sustainable development of the wider region. Seen in this context, the internationally designated protected core and buffer areas of the biosphere reserve play key roles in developing the knowledge, skills, and attitudes required to enable many cooperators to integrate ecosystem management and sustainable development functions. The Plan's proposed program framework included objectives and a five-year program of recommended actions for filling gaps in the network; improving the management of designated sites; conserving ecosystems and key species; strengthening monitoring, research, education and training; facilitating local participation and regional planning; and systems for international sharing of information from biosphere reserves. Unfortunately, voluntary contributions from international organizations and governments fell short of the requirements for implementing the ambitious Plan.

In the U.S., the change of national administrations in 1981 significantly affected the fortunes of the U.S. MAB Program. The new administration's concerns over the policies and administrative inefficiencies of United Nations agencies quickly focused on UNESCO. Although these concerns

had little to do with MAB and other programs in UNESCO's science sector, the Administration's disaffection with UNESCO made Federal agencies reluctant to contribute to U.S. MAB. The national program plan was tabled indefinitely. By 1983, U.S. MAB no longer had sufficient funds to award research grants through the MAB Consortium. The Administration signaled its intention to withdraw from UNESCO and reduced funds appropriated to the State Department for UNESCO activities. The National MAB Committee ceased to meet on a regular basis. Only the Forest Service and the State Department were contributing. The proposed U.S. withdrawal from UNESCO sparked Congressional hearings on the effects of the withdrawal on U.S. science. The hearings documented the many benefits of MAB and other UNESCO science programs, and led to discussions within the Government on ways to maintain these benefit. Although the U.S. withdrew from UNESCO at the end of 1984, the Administration subsequently requested and received a legislative appropriation to the Department of State to enable the U.S. to participate in these programs on a country-to-country basis, beginning in FY 1986 (24). The appropriation, in effect, gave these programs a political "clean bill of health". Additional domestic agencies began join USMAB (Figure 2). Based on an independent review of USMAB, the National Committee moved to strengthen MAB's role in integrating the natural and social sciences to address resource policy and management issues. By 1990, the levels of agency participation and funding had returned to nearly those of ten years earlier.

During the 1980s, the National Park Service remained a stalwart supporter of the Biosphere Reserves Directorate, which continued to meet regularly. NPS funded a series of comprehensive bibliographies and histories of scientific studies in NPS biosphere reserves, and a multi disciplinary ecosystem research program on the Virgin Islands Biosphere Reserve. NPS funding and in-kind support enabled the Directorate to begin a systematic review of the nation's biogeographical provinces to fill gaps in biosphere reserves. Under U.S. MAB guidelines (25,26), the U.S. became the first country to launch separate biosphere reserve selection programs for terrestrial and coastal/marine provinces. Nominations focused on sites of particular importance for conserving the characteristic ecosystems of the province, including major ecological communities and the associated gradients, processes, and physical factors. The site's history and potential for observational studies, experimental research, and education were also important considerations. As in the 1970s, only sites that were legally protected and managed for conservation or research objectives were considered. However, the guidelines added an important new provision to allow for nomination of multiple sites as units of the same biosphere reserve. Beginning in the early 1980s, multiple-site biosphere reserves -- often including sites under many different administrators -- became the U.S biosphere reserve model.

Between 1981 and 1986, USMAB panels of scientists reviewed 8 terrestrial and 3 coastal biogeographical provinces. The panels subdivided the provinces based on biogeographical and ecological considerations, and identified the qualified conservation and research areas for nomination in each subprovince. The overall effort recommended 36 multi-site biosphere reserves, containing more than 200 sites. By 1986, 13 new biosphere reserves, containing as many as 13 sites each under Federal, state, local, and private administrators had been designated. The designated configurations of sides included a pair of national parks on adjacent islands in Hawaii (Hawaiian Islands BR); a group of sites managed by NPS as the Big Thicket National

Preserve in southeast Texas; several clusters of national and state parks and research sites in the coast redwood forests of central and northern California; a 5-site complex of Federal and state protected areas in the California Deserts, and clusters of sites under Federal, state, and private ownerships in three coastal embayments of the southeast coast. Others included a single site, with additional sites to be added when conditions would permit. Still others included combinations of large areas under state regulation and protected areas managed to conserve particular ecosystems.

The MAB panels identified highly qualified conservation and research sites. However, they were not asked to assess whether the identified sites would actually cooperate in implementing the biosphere reserve concept. Although the linkages made sense from biogeographic and ecological points of view, sites were sometimes located in areas with very different cultures, histories of resource use, economic conditions, politics, priorities and institutional relationships. Cooperation in such areas following designation proved difficult.

For example, the South Atlantic Coastal Plain Biosphere Reserve, originally designated in 1983, consisted of the state of New Jersey's 438,000-hectare Pinelands National Reserve -- a model for conservation and sustainable development ecosystems at the northern end of a large subprovince -- and the Congaree Swamp National Monument, an outstanding brown water swamp ecosystem in South Carolina, at its southern end. Several protected areas filling gaps in the middle of the subprovince could not be nominated at the time. In 1988, the State of New Jersey, believing the Pinelands unit to fulfill biosphere reserve criteria in its own right and seeing little incentive for cooperation with sites hundreds of miles away, requested and received UNESCO redesignation as the New Jersey Pineland Biosphere Reserve, leaving Congaree Swamp as the sole unit in the South Atlantic Coastal Plain Biosphere Reserve.

Even concerted efforts to foster cooperation among designated sites sometimes proved unsuccessful. In the Carolinian-South Atlantic Province, which extends roughly from Cape Hatteras to Cape Canaveral, the MAB panel recommended a single biosphere reserve containing three clusters of sites. The Carolinian-South Atlantic Biosphere Reserve, designated in 1986, contains 13 sites -- two in the North Carolina's Outer Banks, six in the South Carolina's Santee Delta, and five in Georgia's Sea Islands. The sites include most of the characteristic ecosystems of the Province. Many have substantial histories of research and monitoring. Following designation, the State of South Carolina designated a coordinator to help plan biosphere reserve activities. South Carolina's unit included nearly all the contiguous management units in the Santee River delta -- a former rice-growing area containing large plantations. The Federal, state, and private managers of the Delta cluster were receptive to using the biosphere reserve as a framework for cooperation. However, the State of Georgia was concerned about the possible effect of designation on its prerogatives for managing forests, wetlands, recreation and development in the Sea Islands. The state's lukewarm interest in the biosphere reserve concept, and its refusal to nominate any of its extensive holdings, sapped enthusiasm for participating in the biosphere reserve among managers and other potential partners in Georgia. The small Outer Banks cluster, consisting of a national seashore and an unmanaged marine area some distance offshore, had no previous history of cooperation, and was not in a position to contribute

substantially at the outset. The three areas had vastly different histories, contemporary cultures, economies, and interests. Each proved to be at very different stages of readiness to participate in a biosphere reserve. Two MAB-sponsored workshops failed to produce consensus on a focus or mechanism for cooperation. South Carolina eventually withdrew its coordinator. Had the South Carolina cluster been nominated in its own right as a separate biosphere reserve, the outcome might have been different.

As biosphere reserves began to link protected areas, the first instances of opposition began to be heard from local groups fearing government infringement on traditional resource uses and private property rights. In 1986, a U.S.- Canadian MAB Panel recommended a biosphere reserve linking the existing Isle Royale National Park Biosphere Reserve in Lake Superior, Voyageurs National Park and the Forest Service's Boundary Waters Canoe Area in northern Minnesota, and the Quetico Provincial Park in Ontario. Some local groups saw the proposed "North Woods Biosphere Reserve" as yet another effort by managing agencies to limit traditional recreational uses of Federal lands. Although biosphere reserve designation would not have affected these uses, unconvinced local groups continued to oppose the nomination. The Forest Service withdrew their site from further consideration. However, the NPS submitted the nomination of the two national parks. By the time the nomination reached the U.S. National MAB Committee, the controversy threatened to become an issue in a statewide political campaign. The Committee terminated further U.S. MAB participation in the nomination and recommended public education on MAB goals and benefits. The role of local interests in biosphere reserves would become an increasingly important consideration in the years ahead.

Although some efforts encountered difficulties, others succeeded beyond expectations. A MAB Panel for the Eastern Forest Province recommended that three cooperating sites (the Great Smoky Mountains National Park and Coweeta Biosphere Reserves and the Oak Ridge National Environmental Research Park) in the Southern Appalachian region be redesignated together as the Southern Appalachian Biosphere Reserve, and that other candidate sites be considered for inclusion. After site managers endorsed the concept, a feasibility study was prepared by a local citizen familiar with biosphere reserves. The study identified resource issues of regional concern, as well as many agencies and organizations interested in seeing how MAB and biosphere reserves might help address them. It also recommended establishment of a coordinating mechanism for a Regional MAB Program in the Southern Appalachians. A series of interagency planning meetings eventually led to the establishment of the Southern Appalachian Man and the Biosphere (SAMAB) Cooperative, with Federal and state members, in 1988. The next year, the SAMAB Foundation was chartered to facilitate participation of private organizations and individuals. Among the cooperative's first actions was to nominate five sites as the nucleus of the Southern Appalachian Biosphere Reserve and to describe a region containing parts of five states as SAMAB's principal area of cooperation and expansion within which additional sites could be considered in the future as units of the biosphere reserve. Hubert Hinote's chapter documents SAMAB's many successes as an expanding multi-sector partnership for addressing issues of conservation and development.

Several factors appear to have influenced SAMAB's success. Local interests were in charge. The

emphasis was on solving problems identified by local partners, rather than on designating a biosphere reserve. The stakeholders were able to reach consensus on the limits of the Southern Appalachian region as the principal area of concern and cooperation, based on physical, ecological, historical, cultural, political and institutional considerations. The region made sense to those with access to the intellectual, technical, and financial resources required to enable stakeholders to address a wide range of problems. The stakeholders organized their activities around the broad goals of MAB, rather than on the objective of establishing a biosphere reserve. The biosphere reserve was seen as a tool to help stakeholders achieve their goals, rather than as an end in itself. The linkage of sites was not nominated until the coordinating organization was in place, and stakeholders took time to consider how the candidate sites would contribute to SAMAB's cooperative activities.

SAMAB was the first partnership to take advantage of the synergy between building a cooperative program and the international designation of sites on the basis of their contributions to the program. In this case, existing biosphere reserves were linked to form a regional biosphere reserve, and additional biosphere reserve sites were subsequently nominated to the regional biosphere reserve as conditions permitted. The designation of the additional sites is seen as a way to recognize accomplishments, increase the stake of the sites in the cooperative program, facilitate cooperative management, and increase the support of stakeholders, including the sites' neighboring communities (27) .

Toward the end of the decade, the SAMAB experience was being widely shared with groups in other regions and helped foster and encourage many grassroots efforts to implement biosphere reserve concepts. USMAB provided seed funds to local groups in the Colorado Rockies, the Sonoran Desert, the Central California Coast, the Ozark Highlands, and the Champlain-Adirondack region to assess the feasibility of forming new cooperative programs or expanding cooperation involving existing biosphere reserves. Groups (e.g., in the Catskills) began to explore opportunities on their own initiative.

In 1989, the Biosphere Reserve Directorate prepared revised guidelines for selection and management of biosphere reserves, reflecting the experience of the previous decade (28). Emphasis was placed on the role of biosphere reserves in facilitating cooperation in "biogeocultural" regions, described on the basis of some combination of ecological, physical, economic, cultural, and political factors.

In 1989, the National Committee restructured the USMAB Program. Approval of the guidelines was deferred, pending development of a program strategy for U.S. Biosphere Reserves. The new USMAB consisted of five interdisciplinary research directorates responsible for developing multi year research projects on policy and management issues in high latitude, temperate, tropical, coastal/marine, and human-dominated ecosystems, respectively. The priority areas for the directorates' projects were: global change, arid lands and desertification, aquatic areas and wetlands, biodiversity, cultural diversity, sustainable development, and biosphere reserves. Each directorate included a balanced membership of natural and social scientists from government and academia. A new Coordinating Committee on Biosphere Reserves, replacing the former

Biosphere Reserve Directorate, was established to strengthen the role of biosphere reserves within the overall program.

No discussion of U.S. biosphere reserves in the 1980s would be complete without mention of two major conferences which helped stimulate interest in biosphere reserves among the managers of U.S. Biosphere Reserves. In 1984, U.S. agencies, UNESCO, and MAB-Canada cosponsored the first biosphere reserve managers' workshop in conjunction with the 50th anniversary of Great Smoky Mountains National Park -- one of the initial U.S. Biosphere Reserves. U.S. managers reviewed the international recommendations on the roles and functions of biosphere reserves, considered the merits of the multi-site approach, brainstormed possibilities for using biosphere reserves to encourage cooperation in addressing regional issues, and recommended ways for individual sites to participate more fully in implementing the biosphere reserve concept (29). In 1987, UNESCO, USMAB, MAB-Mexico, and various U.S. agencies cosponsored a symposium on biosphere reserves at the World Wilderness Congress in Colorado, which was attended by the managers of the majority of U.S. biosphere reserves. The symposium included general concept papers, case studies from developed and developing countries, including applications in coastal and marine areas. The proceedings from these conferences provided a window on the implementation of biosphere reserves and continue to served as basic references (30).

Supporting the Harmonization of Conservation and Development: the 1990s

During the 1990's, the interrelated concepts of biodiversity, ecosystem management, and sustainable development have led to significant changes in the principles, policies and practices of conservation and socioeconomic development. Each concept now has an extensive literature, and numerous organizations working to apply the concept at local, regional, national, and international levels. These efforts create important opportunities for using biosphere reserves as model areas for integrating these concepts.

The Convention on Biological Diversity (CBD), opened for signature by national governments in 1992, was an important milestone. The Convention focused world attention on the role of biological diversity to human survival and progress.. It defines biodiversity to include the all levels of biological organization (ecosystems, habitats, species, population, and genetic), establishes broad policy goals for its conservation and sustainable use, and provides a framework for international cooperation. Although President Clinton has signed the Convention, it has not been ratified by the Senate (as of early 1997). In the U.S., the Convention is a catalyst for raising public awareness, improving access to information, and encouraging cooperative management of biodiversity -- particularly at the ecosystem level. The CBD does not specifically mention biosphere reserves. However, a world network of fully functional Biosphere Reserves could become a principal means for achieving many of the Convention's goals.

In 1993, the Clinton Administration established the Interagency Ecosystem Management Task Force in response to a recommendation in the Vice President's National Performance Review, which called upon Federal agencies to implement a proactive approach in managing ecosystems to ensure a sustainable economy and a sustainable environment. The approach is a goal-driven

method for sustaining or restoring natural ecosystems, based on a shared vision of desired future conditions that integrates ecological, economic, and social factors. The emphasis is on sustaining ecosystem functions, including the continuing evolution of biodiversity. (The concept of ecosystem management is now widely accepted, and, in 1996, was endorsed by the parties to the CBD as the principal framework for implementing their activities under the Convention.)

To implement the national policy on ecosystem management, U.S. agencies are coordinating and adapting their activities to respond to the issues facing particular ecosystems, the people who live in them, and the economies based upon them (31). Within these ecosystems, agencies are working to improve and integrate the information they obtain; to make this information widely accessible and available; and to foster communication among scientists, the information managers, and information users. Because of their research capabilities and conservation values, many U.S. biosphere reserves could become important demonstration areas for ecosystem management, provided appropriate mechanisms for linking the designated sites with the surrounding cooperative area are implemented. Several cooperative areas containing biosphere reserves, such as the Southern Appalachians, the Everglades, and the Greater Yellowstone Area, are already recognized for their contributions to ecosystem management.

Biodiversity and ecosystem management concepts have attracted the attention of agencies, organizations, and public interests concerned with conservation and use of natural resources. The concept of sustainable development is similarly attractive to entities concerned with socioeconomic development and related issues, such as human health and welfare, equitable access to resources, environmental justice, and the preservation of cultural traditions.

During the past several years, international forums -- such as the U.N. Conference on Environment and Development (1992) and World Summit for Social Development (1995) -- have focused attention on various aspects of sustainable development. The Commission on Sustainable Development, established by the White House in 1993, provides a focal point within the Federal Government for coordinating U.S. policies and initiatives. In the U.S., scores of cities and communities are developing their own indicators and initiatives to implement the concept of sustainable development.

Many U.S. biosphere reserves continue to reflect the sectorial management objectives of the protected (core) areas and sustainable use areas designated years ago, rather than the broad goals of biosphere reserves, which require extensive interaction with stakeholders in the surrounding cooperative area. Such U.S. Biosphere Reserves generally do not yet incorporate sustainable social and economic development projects involving local communities in their cooperative programs. However, inclusion of such projects has enormous potential for generating goodwill and public support for biosphere reserve objectives.

Establishing a Strategic Framework. In 1994, USMAB approved a Strategic Plan for the U.S. Biosphere Program based on the recommendations of biosphere reserve managers and stakeholders. The program's mission is to establish and support a network of designated biosphere reserves representative of the biogeographical areas of the U.S. and to promote " a

sustainable balance among the conservation of biological diversity, compatible economic use, and cultural values, through public and private partnerships, interdisciplinary research, education, and communication." (32). The Plan set forth goals, objectives, and recommendations for action by USMAB and the biosphere reserves themselves during the next decade. The Plan covers policy and program operations, network development, local participation, research, education, and communication. Within USMAB, the Plan restored momentum for biosphere reserves. The National Committee moved quickly to establish a new Biosphere Reserve Directorate and increase its support for local partnerships.

In 1995, UNESCO sponsored a landmark conference of experts to share experience with biosphere reserves, and develop recommendations which UNESCO incorporated into a strategy for developing effective biosphere reserves. Utilizing a similar format to the U.S. Plan, The "Seville Strategy" set forth goals, objectives and actions for implementation the biosphere reserve concept at the international, national, and biosphere reserve levels. The Strategy includes an extensive checklist of indicators for use in evaluating progress in implementation. The Conference also enabled UNESCO to finalize the "statutory framework of the World Network of Biosphere Reserves" which sets forth definitions, functions, selection criteria, designation and review procedures, as well as guidelines on publicity, participation in the World Network (and regional and thematic subnetworks) and the responsibilities of UNESCO (33). An important new provision in the UNESCO guidance requires states to forward a review of the status of each biosphere reserve every ten years for comments and recommendations by MAB's International Coordinating Council, which may remove areas from the World Network if they do not satisfy the designation criteria.

Together, the conceptual plans and guidance for the U.S. Biosphere Reserve Program and the World Network provide a flexible framework for developing the roles of biosphere reserves in achieving sustainable societies.

Improving Access to Information. In the 1990s, U.S. MAB has played a leadership role in improving access to information on biosphere reserves. In cooperation with EuroMAB -- an organization of European and North American MAB organizations, U.S. MAB compiled a directory of contacts, resource maps, environmental databases, research activities, and existing infrastructure in 175 biosphere reserves in 32 countries (34) . The Directory is available on the World Wide Web.. Using the same protocol, UNESCO subsequently expanded the Directory to included the remaining sites in the World Network. ACCESS 96, a supplement containing metadata on permanent monitoring plots in EuroMAB biosphere reserves, was recently prepared in cooperation with the National MAB Committee of Germany (35). Environmental data continue to be collected in paired biosphere reserves in Russia and U.S., through the bilateral small watershed program.

Through the Biosphere Reserve Integrated Monitoring Program (BRIM), launched by EuroMAB in 1991, a methodology for systematically recording information on records of flora and flora (MABFlora and MABFauna) was widely reviewed and tested in European biosphere reserves

(36). The methodology -- originally developed for U.S. national parks -- was improved and used to develop a self-contained computer program and manual, which is now in use in many EuroMAB and Latin American Biosphere Reserves (through MABNetAmericas, an electronic subnetwork of biosphere reserves launched following the 1994 Summit of the Americas). Initial efforts have focused on birds, mammals, and vascular plants. Data for many biosphere reserves are posted on the Internet. OBSERVE, a flexible computer program for recording observations of flora and fauna, supplements the MABFlora and MABFauna databases and is being tested in a number of biosphere reserves.

BioMon, a database from permanent monitoring plots, was developed through the Smithsonian/MAB Biodiversity Program (37,38). A data collection protocol and self-contained computer program for recording and analyzing data in the field were developed and tested in tropical forest biosphere reserves and similar protected areas in Latin America. The methodology was subsequently tested in tropical forests in Africa, Asia and the Caribbean; and was recently adopted for use in protected forest ecosystems in Canada. A demonstration plot has also been established at Great Smoky Mountains National Park in the Southern Appalachian Biosphere Reserve. The SI/MAB Program provides training courses for foreign specialists, both in-country and in the U.S., on conservation practices and the use of the methodology.

The managers of the MAB's Biodiversity Databases are exploring ways to link the various methodologies and coordinate training efforts, under the broad umbrella of BRIM. The goal is to gradually incorporate other data sets on natural and human systems, to support interdisciplinary assessment and modeling in biosphere reserves.

Building Local Partnerships. The restructuring of U.S. MAB in 1990 reduced the emphasis on designating new biosphere reserves, pending completion of the Strategic Plan. Although sites have been added to several existing reserves, only two new units have been designated in the 1990s -- i.e., the Land Between the Lakes Area in 1991 and the Mammoth Cave Area in 1990. Many local efforts to establish new biosphere reserves -- some initiated as far back as the late 1980s -- have encountered opposition from well organized, but misinformed, groups concerned about future infringement on property rights and traditional uses by government agencies or the United Nations. The opposition prompted a hearing in the 104th Congress on the proposed American Land Sovereignty Protection Act, which includes a sunset provision calling for future termination of most U.S. biosphere reserves unless they are specifically authorized by the Congress. Although national policies have never been more favorable to the biosphere reserve concept, the opposition indicates the need for greater public education on the practical benefits of biosphere reserves to local people and in the nomination process.

Given the current situation, emphasis has been on developing the functions of existing biosphere reserves, including the role of MAB research through the five Research Directorates. In a national workshop in late 1995, biosphere reserve managers stressed the "value added" from cooperation on regional issues through the unifying aegis of MAB and the biosphere reserve concept. A survey just before the workshop indicated that biosphere reserves involved in cooperative programs that identify explicitly with biosphere reserve concepts and goals report

more significant management benefits in more areas than those involved in cooperative programs not identifying with these concepts and goals. The reported benefits were much greater in such areas as ecosystem management, local political support, availability of information on both natural and human systems, international cooperation, environmental awareness and fostering an ethic of sustainability. On average, the former group reported greater levels of participation by 17 of 18 entities in their cooperative activities (there was no difference in participation of Native Americans). Differences between the groups were negligible for the principal cooperators -- universities, federal and state agencies. However, the former group was much more likely to report cooperation with international organizations, and various entities concerned with economic development and local communities (e.g., local governments, schools, and citizen volunteers) goals. The survey appears to confirm the "value added" from linking cooperative activities explicitly with biosphere reserve concepts and goals (39).

In the 1990s, U.S. biosphere reserves became partners in various cooperative mechanisms for implementing biosphere reserve concepts (40). These include a trinational (U.S., Mexico, Tohono O'odham Nation) nonprofit community-based alliance in western Sonoran Desert, a biosphere reserve coordinating committee within a regional economic development authority in the Mammoth Cave Area, a 14-member MAB-affiliated regional cooperative in the Colorado Rockies representing 4 biosphere reserves, informal binational exchanges among biosphere reserves in the Chihuahuan Desert (U.S. - Mexico), and a non-profit biosphere reserve association with associated science, management, and education councils for the 13-unit Central California Coast Biosphere Reserve. Each of these cooperatives provides a mechanism for the partners to plan and implement a wide range of activities relating to biodiversity conservation, ecosystem management, and sustainable development.

Finally, there is the important role of the interdisciplinary projects of the U.S. MAB's ecosystem-based research directorates. Each of these projects addresses policy and management issues of paramount importance in biosphere reserves (e.g, comanagement of caribou populations in Alaska, design and management of coastal/marine biosphere reserves, multi-national sharing of data and information among biosphere reserves in transborder ecosystems, development of GIS-based approaches for using interdisciplinary information in ecosystem management and land use analysis). Each involves one or more biosphere reserves, or potential biosphere reserves; and each is developing practical tools for integrating data and information from the natural and sciences to support cooperative ecosystem management. As the projects are completed, there remains some uncertainly regarding how best to assure that the methods and approaches they have developed continue to help the stakeholders in regional ecosystems and biosphere reserves address complex resource problems. Integration of the biosphere reserve and research components of U.S. MAB is an important challenge that still remains to be fully addressed (41).

Future Directions

Ronald Engel, in his various papers on the symbolic and ethical significance of biosphere reserves, suggests that biosphere reserves embody the "language of community" as distinguished

from the "language of resource management," which characterizes the traditional management practices of agencies and institutions (42,43). The former is concerned with fostering the participation, well-being, cultural values and self awareness of human communities in their relationships with Nature; the latter, with managing nature as a physical resource for human progress and material well-being. Biosphere reserves have associations with both ethical languages, but Engel sees the ethic of community as the more important in motivating action to put the concept into practice.

Biosphere reserves offer an elegant tool for communities to obtain, share, and apply information and technologies. They offer a means to organize cooperation among many stakeholders, and help them identify a cooperative area for conservation and development that makes sense ecologically, culturally, and politically. They offer a framework for cooperation in monitoring and research on natural and human systems, and linking local conditions with regional and global influences. In particular, they help build ties between the internationally designated biosphere reserve sites and the surrounding area, and help discover ways to integrate conservation and community development. They offer the benefits of international cooperation with communities in other areas of the world having similar interests and problems. Realization of these benefits depends upon continuous communication among communities of biosphere reserve stakeholders at scales from local to global.

During the past few years, hundreds -- perhaps thousands -- of partnerships have been formed in the U.S. to implement activities consistent with biosphere reserve goals. In fact, many areas not designated biosphere reserves reflect biosphere reserve goals more fully than existing designated areas.

A significant effort is needed to inform potential stakeholders, including the U.S. Congress, of the accomplishments of U.S. biosphere reserves and the benefits of working toward a U.S. network that is fully implementing biosphere reserve concepts. Through USMAB, successful ecosystem-based partnerships involving existing biosphere reserves and local groups working toward sustainable development in vicinity of existing biosphere reserves should be recognized and encouraged to consider the "value added" of identifying with biosphere reserve goals. In nominating new biosphere reserves, opportunities for cooperation in a "biogeocultural" area that makes sense to local people should be assessed. The nomination of particular sites for inclusion in a biosphere reserve should based on their capabilities and interests in pursuing these opportunities for cooperation. Local partnerships should be encouraged to recommend ways to improve the functionality of existing biosphere reserves, including the option of restructuring existing biosphere reserves through the addition, deletion, or consolidation of designated sites.

Finally, there is a need to strengthen the scientific functions of biosphere reserves as demonstration areas for integrating interdisciplinary research, existing networks for monitoring natural and human systems, and predictive assessment. In this regard, existing and future biosphere reserves could provide an important subregional coordinating framework for the National Science and Technology Council's efforts to integrate the nation's environmental monitoring and research networks and programs (44), and help link this initiative to the efforts of

stakeholders in particular biogeocultural region to plan an ecologically, culturally and economically sustainable future.

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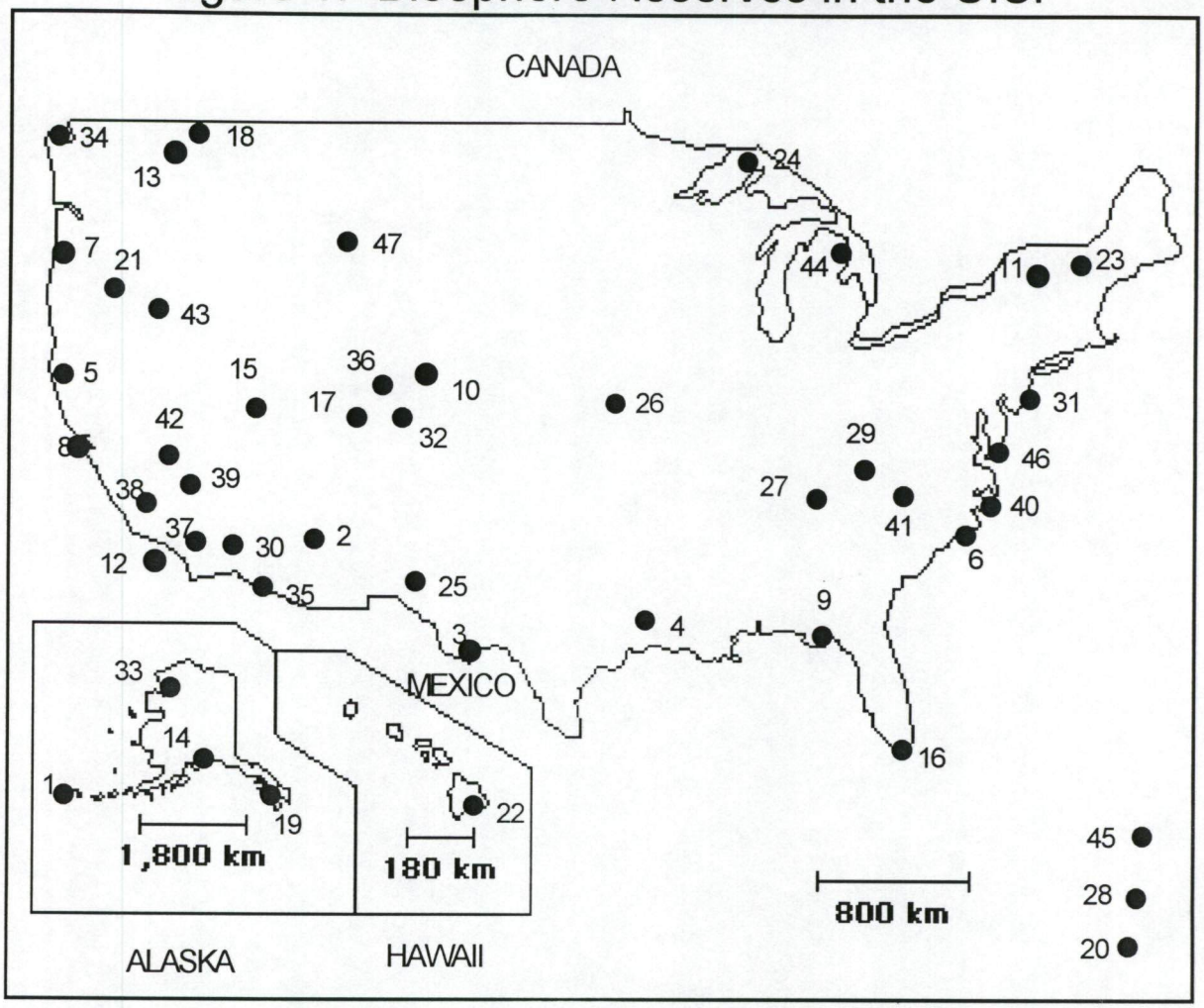
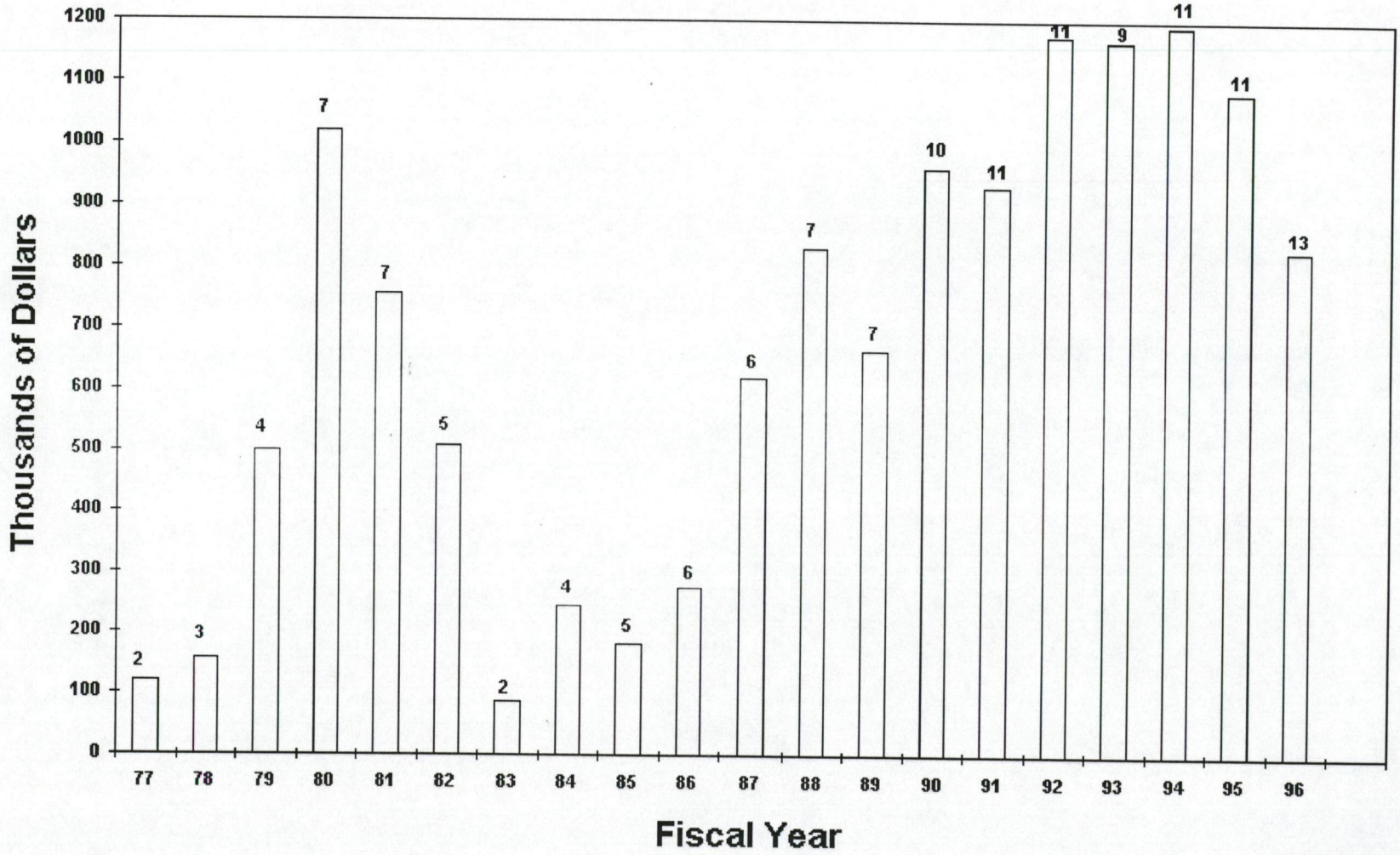
Figure 1. Biosphere Reserves in the U.S.



1. Aleutian Islands
2. Beaver Creek
3. Big Bend
4. Big Thicket
5. California Coast Ranges
6. Carolinian-South Atlantic
7. Cascade Head
8. Central California Coast
9. Central Gulf Coastal Plain
10. Central Plains
11. Champlain-Adirondack
12. Channel Islands
13. Coram
14. Denali
15. Desert
16. Everglades
17. Fraser
18. Glacier
19. Glacier Bay-Admiralty Island
20. Guanica
21. H.J. Andrews
22. Hawaiian Islands
23. Hubbard Brook
24. Isle Royale
25. Jornada
26. Konza Prairie
27. Land Between the Lakes
28. Luquillo
29. Mammoth Cave Area
30. Mojave and Colorado Deserts
31. New Jersey Pinelands
32. Niwot Ridge
33. Noatak
34. Olympic
35. Organ Pipe Cactus
36. Rocky Mountain
37. San Dimas
38. San Joaquin
39. Sequoia-Kings Canyon
40. South Atlantic Coastal Plain
41. Southern Appalachian
42. Stanislaus-Tuolumne
43. Three Sisters
44. University of Michigan
45. Virgin Islands
46. Virginia Coast
47. Yellowstone

Figure 2. U.S. MAB Budget: 1977 - 1996



( ) Number of Agencies Participating