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THE INTERNATIONAL NETWORK OF BIOSPHERE RESERVES: A NEW DIMENSION IN GLOBAL CONSERVATION

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ABSTRACT

The International Network of Biosphere Reserves is being established under UNESCO's Man and the Biosphere Program to conserve representative examples of the world's ecosystems and to make these areas available for basic and applied research, education, demonstration, and training. Since UNESCO first designated biosphere reserves in 1976, the network has grown to include 226 sites in 62 countries (December 1983 data), and is becoming a significant factor in efforts to achieve harmonious relationships between human societies and the ecosystems on which they depend. The biosphere reserves provide a symbolic and practical framework for human cooperation at the local, regional, and international levels to find solutions to interrelated environmental, land use, and socioeconomic problems. They also provide a basis for developing and coordinating scientific, educational, and management functions performed individually or severally by various types of legally protected areas. The evolution of the biosphere reserve project is discussed, with emphasis on its role in putting protected areas to work in developing the knowledge, skills, and human value systems required for sustainable conservation of the world's ecosystems.

1. PROTECTED AREAS AND THE CHALLENGES OF THE MODERN AGE

The establishment of national systems of parks and protected areas in nearly every country of the world is properly regarded as one of the most significant achievements of human civilization. The systematic protection of the natural and cultural heritage of nations is a uniquely modern concept which has, during the current century, become an integral part of the identity of a growing number of nation-states. National parks and equivalent reserves contribute increasingly to a sense of national pride and cohesiveness. They often protect cherished national symbols which are sources of inspiration for the people. In addition, their substantial direct benefits from recreation and tourism are major factors in the economies of scores of nations, particularly in developing countries. A positive symbolism having both personal and national dimensions, in combination with new

sources of revenue, have fueled the protected area movement for more than fifty years.

An important element in the development of protected area systems has been the perception that, without intervention by government or public interest organizations, public benefits would be irretrievably foregone as important resources are threatened, damaged, and lost through relentless human exploitation. There can be no question that actions in the public interest to acquire these areas or regulate the uses and activities on them have saved many areas from imminent damage or destruction, especially from conversion to alternative uses, such as forestry, agriculture, urbanization, or mining. However, the reprieve has often been short lived. In case after case, what once appeared securely protected is increasingly beset by a litany of threats from within and without. The litany is long and growing, as human demands for commodities and the impacts of population growth, technology, and changing human value systems create challenges for protected area administrators and for human society itself which would have been unimaginable even a few years ago.

The laws governing the establishment and management of protected areas usually provide good protection from large-scale land use conversions for development and other activities requiring government authorization. However, these instruments are less effective in dealing with the growing cumulative impacts of the activities of individual people, such as illegal harvesting of plants and animals, the introduction of pests and exotic species, or damage from recreational uses. Many of these impacts have long received the attention of protected area administrators. However, they are becoming more widespread, more intense, and more difficult to address with limited budgets and staff. In many developing countries, protected areas are increasingly used for subsistence activities by local people, who often benefit little from the establishment of such areas.

Also of concern is the fact that, throughout the world, existing laws and regulations are proving inadequate to address a broad range of uniquely modern environmental threats which result from regional development or extraregional environmental changes, the effects of which often transcend national boundaries. In particular, regional pollution and the effects of inappropriate regional land use are adversely affecting protected areas, just as they are the well-being of the people. Efforts to address these types of problems frequently become mired in attempts to maximize the self-interest of individual nations or economic sectors. Overcoming such impediments requires objective information on the problem itself, preferably from multiple locations, and a willingness to work collectively to develop equitable and practical solutions. A record of cooperation to develop balanced, interdisciplinary and international perspectives has become increasingly important, as unilateral action by individual nations and sectors in dealing with these problems and reducing associated conflicts has become less effective.

In many countries, special constituencies have developed around a particular category of protected area, and organizations have been established to serve the interests of particular users,

such as recreationists, naturalists, and ranchers. These constituencies often spearhead efforts to raise public awareness on major environmental problems, and their ability to influence the management priorities of protected areas is well documented. However, developing the role of protected areas as centers for developing the knowledge and skills needed to solve these problems has rarely been a part of their agenda.

In recent years, threats, such as acid precipitation, pollution of regional seas, tropical deforestation, and desertification have increased the amount of communication among nations and sectors with vastly different interests. Although protected areas have an important stake in these discussions and can contribute materially to cooperative solutions, their role has been largely unrecognized, in spite of their well-documented record in providing scientific information relating to such threats. I believe that this is due to the fact that the symbolic identity of most categories of protected areas was established during an earlier period when such problems either did not exist or were not considered important. National parks, for example, are generally perceived as significant parts of a nation's natural heritage and, in most cases, as centers for public recreation and public education. The important role of certain national parks notwithstanding, the symbolic identity of national parks as a group is not closely associated with scientific study, human cooperation, training, and other activities necessary for addressing modern environmental problems. Although their purposes would differ, the same could be said for nature sanctuaries, national monuments, multiple use areas, and other protected area categories, even though some individual sites have made important contributions to knowledge and technology relating to these problems. For most categories, research has traditionally been a secondary activity focused narrowly on achieving the immediate objectives of an individual protected area. Integrated regional or international research programs involving two or more protected areas have been rare indeed. The idea that protected areas should help provide the scientific basis for sustainable conservation at the local, regional, and global levels is not at all well appreciated.

The continuing failure to recognize the multiple roles protected areas can play in regional economic development has the dual effect of reducing the security of the protected area while foregoing opportunities to improve the sustainability of development. Because they represent permanently dedicated landscapes, protected areas can increase the probability that development will be successful by

- providing benchmarks of regional environmental quality against which to assess the impacts of the development and enable undesirable consequences to be addressed at the earliest possible time,

- providing sites for applied research to develop land use and management methods uniquely suited to the ecological and socioeconomic conditions of the region, the traditions of local people, and the capabilities of responsible agencies and institutions,

- helping maintain the sustainability of the development process through local/regional initiatives after the initial development has been completed, and

° providing a focus for cooperation among conservation and development constituencies within the region, thereby reducing conflicts and associated costs.

On the other hand, successful integration of protected areas and regional economic development can benefit the protected area by making available additional funding from domestic and international sources for enforcement, training, research, and educational activities; and by fostering local support for conserving protected area resources as the economic well-being of the local people improves. Unless this integration is accomplished, both development and protected areas will become less sustainable, especially in developing countries.

What is needed is a new symbolism and practical framework to establish the role of protected areas as centers for scientific study and human cooperation to solve interrelated environmental, land use, and socioeconomic problems. The symbolism must reinforce the purposes of existing categories of protected areas and have the potential to motivate large numbers of people on its behalf. The framework must enhance the role of protected areas in the progressive advancement of human civilization by helping people to solve problems at the local, regional, and global levels. The International Network of Biosphere Reserves, launched in 1971 under the auspices of UNESCO as part of the Man and the Biosphere Program (MAB), establishes this symbolism and framework. In so doing, it can provide a new dimension in global conservation.

2. Biosphere Reserves: Protected Areas as Informational Resources

The need for an international network of protected research sites for the study of the world's ecosystems has been recognized for more than 20 years. During the 1960's, the idea influenced the planning and development of the Conservation of Ecosystems Project in the International Biological Program, the immediate forerunner of MAB. It bore fruit in 1971, when UNESCO's newly established MAB Program approved the establishment of such a network. In 1972, the idea was strongly endorsed in Stockholm at the United Nations Conference on the Human Environment. After several years of planning, the first protected areas were officially designated as biosphere reserves by the Director-General of UNESCO in 1976.

A unique dimension of the biosphere reserve concept is the recognition of the value of protected areas in providing information for the benefit of people. The purpose of the network is to conserve a representative sample of the world's major ecosystems, and the genetic material they contain. Ecosystems and their genetic resources are recognized as informational resources, which yield their information through the process of scientific investigation. By investigating ecological relationships and uses of genetic resources, we are able to develop sustainable systems of land use which enable the ecosystems of individual biogeographic regions to furnish the widest possible range of amenities and commodities. The concept thus acknowledges that natural ecosystems and their genetic resources represent

storehouses of information of unlimited value to people, and the systematic exploitation of these information resources through scientific study represents one of the highest missions of protected areas which receive the biosphere reserve designation.

3. An Ecosystem Approach

Biosphere reserves are effective conservation areas which protect large landscape units (usually watersheds) suitable for the study of natural and managed ecosystems, using the holistic approaches of modern ecology. Indeed, many of the world's leading centers for developing the theory and practice of ecosystem study have been designated as biosphere reserves. The particular emphasis on conservation and study at the ecosystem level is another unique dimension of the mission of biosphere reserves. Ideally, each biosphere reserve should include large self-sustaining ecosystems which provide for the natural evolution of species, including upper level predators and other species requiring the availability of expansive habitat. It should also be large enough to provide places for developing sustainable human use systems and for rehabilitating degraded areas, through research, demonstration, and training. In this respect, biosphere reserves provide models for management and sustainable development of the ecosystems of a biogeographic region.

Based on a 1983 report (IUCN 1983), existing biosphere reserves range in size from a 70-million-hectare site in Greenland to a 60-hectare marine park in Italy. Only the largest of the reserves are clearly adequate for conserving self-sustaining ecosystems and allowing for the natural evolution of their genetic resources. Most of the reserves contain watersheds or similar areas suitable for ecosystem study, but, in the long run, are probably not large enough to conserve genetic diversity, and wide-ranging species in particular, without management intervention. About two-thirds are smaller than 100,000 hectares, and 37% are smaller than 10,000 hectares. Long-term conservation of these areas will require cooperative natural resource management programs usually involving various administrators within and sometimes outside the biogeographic region. As zones of cooperation are established, the effective size of the biosphere reserve increases until the limitations of the reserve, as originally esignated, are substantially overcome.

4. A Network Approach

Biosphere reserves are linked regionally and globally to form networks for cooperation. Although the benefits of these networks have yet to be fully realized, a framework is being developed which will

- enable better coordination of research and and educational activities within particular biogeographic regions,

- facilitate scientific cooperation between protected areas on problems of common interest, and

°improve coordination of efforts to monitor regional and planetary changes in air, water, and land components of the biosphere.

A unique dimension of the biosphere reserve designation is its ability link ecologically and functionally complementary sites under different administrators within the same biogeographic regions. In Costa Rica, La Amistad Biosphere Reserve has recently been established by uniting several contiguous land management units, which collectively fulfill all of the purposes of the reserve. In California, the California Coast Ranges Biosphere Reserve contains three geographically separate units with sites under six different administrators. The sites collectively conserve all but one of the region's representative ecosystems and perform all of the required biosphere reserve functions. Along the border between the United States and Canada, efforts are underway to develop biosphere reserves linking complementary sites in each country within the same biogeographic region. In the Lesser Antilles, the feasibility of a multi-site biosphere reserve involving several of the island nations and dependencies is being explored.

At the present time, the biosphere reserve provides the only means of developing symbolic linkages to provide a focus for coordinating the activities of a number of protected areas within a biogeographic region.

5. A Voluntary Approach

In most countries, there are no independent legal authorities for establishing and administering biosphere reserves. According to a recent estimate (Miller 1983), eighty-four percent of biosphere reserves have the same boundaries as existing national parks or other protected areas. In these areas, acceptance of the biosphere reserve designation, and implementation of biosphere reserve functions, are voluntary administrative decisions which rely on existing legal authorities. Fortunately, these authorities usually are adequate if used effectively and innovatively.

The advantages of the voluntary approach often outweigh any disadvantages associated with lack of legally enforceable standards. In countries such as the United States where legal and administrative requirements relating to protected areas are many and complex, the absence of specific laws and regulations relating to biosphere reserves has been key to the acceptance of the designation by site administrators. The U.S. practice of combining sites under different administrators to form biosphere reserves bearing the name of a biogeographic region would be impossible to execute in a formal legal way, yet is easily accomplished voluntarily because the associations provide opportunities without compromising the administrator's ability to carry out the purpose and objectives of a particular protected area. The voluntary nature of the program allows the biosphere reserve network to be developed rapidly in countries having many large protected areas as candidate sites. It also allows flexibility in tailoring biosphere reserve activities to meet the needs of a particular biogeographic region.

Biosphere reserves are developed opportunistically. Rarely does a biosphere reserve conserve all of a region's representative ecosystems or carry our all biosphere reserve functions at the time it is established. However, as the reserve's functions are developed and its importance to the people of the region becomes appreciated, possibilities for including additional sites and expanding functions, particularly through cooperative activities, will become apparent.

The moral force of international recognition of the scientific importance of particular protected areas, and their role in future progress of civilization, is not inconsequential. Although the benefits remain to be fully realized, biosphere reserve status can be expected to improve the security of protected ecosystems as administrators develop new ways to implement the biosphere reserve concept. Interest in biosphere reserves has soared in recent years. In the United States, this is reflected in a managers' initiative to convene the first conference on the management of biosphere reserves, which will be held in November 1984 as part of the 50th anniversary celebration for Great Smoky Mountains National Park, one of the country's leading biosphere reserves. Such voluntary efforts to improve the contributions of biosphere reserves are certain to increase as the concept becomes better understood.

Finally, it is worth noting that a few developing countries, such as Mexico and Honduras, give biosphere reserves separate legal status. Because biosphere reserves are perceived as playing an important role in the sustainable development of these countries, and because other protected area systems are not so well entrenched as to preclude the addition of a new protected area category, the legal establishment of biosphere reserves has been possible. As more developing countries consider the advantages of biosphere reserves in planning national protected area programs, the number of countries adopting this alternative should increase.

6. The Functions of Biosphere Reserves

Biosphere reserves are dynamic natural and human systems, constantly adjusting to changes in natural conditions and the expectations of people. All biosphere reserve functions are dedicated to the service of humanity, and specifically to fostering productive and sustainable relationships between people and their environment. The functions are interdependent, and the success of a reserve is determined largely on the basis of how effectively they are integrated to improve the health of a region's ecosystems and the well-being its people.

In essence, biosphere reserves carry out five basic functions: conservation, monitoring, research, education, and cooperation.

6.1 Conservation

The International Network of Biosphere Reserves is a global conservation initiative designed to conserve examples of the

world's ecosystems as large, self-sustaining landscape units. Using a biogeographic classification developed in 1975 and recently revised (Udvardy 1975), the goal is to include representation from each of the world's 193 biogeographic regions. As of January 1984, biosphere reserves had been designated in 90.

The biosphere reserve project emphasizes inclusion of very large areas containing **representative** rather than unique features. It thus complements national and international efforts aimed at conserving significant natural resources and small-scale features, including locally distributed natural communities and populations of special scientific interest.

Because they contain a substantial proportion of the indigenous flora and fauna of a biogeographic region, biosphere reserves are important reservoirs of genetic material. These resources increasingly are finding application in developing improved strains of commercially important species, and in developing new pharmaceuticals, industrial chemicals, building materials, food sources, pest control agents, and other products to improve human well-being. The genetic resources of biosphere reserves also provide material for reestablishing indigenous species in areas where they have been extirpated, thereby enhancing the stability and diversity of regional ecosystems.

A unique aspect of biosphere reserves is the inclusion, where practicable, of traditional land use systems illustrating harmonious relationships between indigenous populations and the environment. These systems often reflect centuries of human experience and can provide information of immense value in improving the productivity and sustainabilty of modern land use and management practices. In addition to providing important sites for scientific study, the inclusion of such areas can help foster pride on the part of local populations in their traditions, and provide the basis for improving their means of sustenance through the judicious use of science and technology in ways which respect these traditions.

6.2. The Monitoring Function

Because of their secure protection, generally large size and remote location, and the inclusion of areas free from significant human impact, biosphere reserves typically provide ideal sites for monitoring changes in the physical and biological components of the biosphere. Most biosphere reserves have at least a minimal monitoring program, and many are among the world's preeminent sites for long-term ecological measurement. Some of the latter have data bases spanning more than a century. Some were sites for the study of ecosystems in the International Biological Program, and amassed large interdisciplinary data bases of immense scientific value. Still others are world centers for the development of new concepts and methodologies, and have played leading roles in the development of modern ecology and other scientific disciplines.

Their protection and scientific mission make biosphere reserves particularly attractive sites for gathering scientific information. Scientists can have more confidence than in most

other areas that the integrity of study sites will be respected, and that collected data will contribute to a growing data bank of increasing scientific significance. As land use changes and human impacts progressively decrease the availability of suitable monitoring sites, scientific interest in biosphere reserves is certain to increase.

Monitoring in biosphere reserves is still primarily directed toward meeting the management needs of the particular protected area (Gregg and Goigel 1983). For this reason, the network's potential value as a framework for coordinated monitoring of regional and global environmental cycles and trends has not yet been realized. However, interest in developing this function is increasing. Canada, in cooperation with other northern countries, is exploring the feasibility of developing a network of biosphere reserves for integrated monitoring and comparative research in the circumpolar north. The United States and the U.S.S.R. are coordinating the monitoring of pollutants and their effects using similar methods in paired biosphere reserves. Through the Global Environmental Monitoring System of the United Nations Environment Programme, these linkages are now being expanded to include biosphere reserves in Chile. The National Aeronautical and Space Administration, in cooperation with US-MAB, is developing a program to utilize biosphere reserves as ground stations in concert with remote sensing technologies to improve our understanding of regional and global cycles and trends in the biosphere, as well as provide geographic information systems to support better use and management of regional ecosystems. These efforts are indicative of the growing use of biosphere reserves for coordinated monitoring targeted on major environmental problems, such as the effects of air pollutants and acid precipitation.

6.3. The Research Function

In most protected areas, research is a secondary function which is intended to provide information to enable effective response to immediate resource management problems. This situation has generally persisted after protected areas become biosphere reserves. Interdisciplinary research programs involving the natural and social sciences, of the kind envisioned by MAB to develop models for sustainable conservation of a region's ecosystems, do not usually become part of the research agenda as an immediate result of biosphere reserve designation. Expansion and reorientation of research programs is likely to occur slowly as the other functions of the biosphere reserve are developed.

Part of the problem is due to the fact that most existing biosphere reserves are incomplete in terms of the research functions they are capable of performing under existing laws and regulations. For example, national parks in the U.S. are legally prohibited from carrying out manipulative research to improve the productivity of forest ecosystems. On the other hand, research priorities for experimental forests may preclude much work on conservation of biological diversity. When such areas become biosphere reserves, these constraints usually remain. Cooperation between administrators of nonmanipulative and manipulative research areas may

someday overcome such limitations, but examples of such efforts to date have been relatively few.

In a 1980 survey of U.S. biosphere reserves, research programs were judged adequate to provide information for science and management programs for only five of the 38 units surveyed (Gregg and Goigel 1983). Although the staffing and funding of research is improving, they fall well short of requirements for developing models for sustainable ecosystem conservation.

In a recent paper, I underscored the importance of using biosphere reserves for coordinated research on topics having particular relevance to the advancement of human civilization (Gregg, in press). Examples include research to determine requirements for conserving biological diversity (to maintain our options for future development of genetic resources), to assess the impacts of pollution on the structure and functions of ecosystems (to provide the basis for scientifically supportable policies for compatible development), to evaluate the effects of traditional and modern land use practices on ecosystem processes (to improve the sustainability of development), and to develop sustainable production systems for degraded areas (to improve the productivity of regional ecosystems and the economic well-being of regional people). A few reserves have substantial programs in such areas, and many have limited programs focused on narrowly defined problems. Better understanding of the purpose of biosphere reserves and a more general acknowledgement of their role in addressing regional and global environmental and socioeconomic problems will be required before coordinated research initiatives are likely to receive substantial support.

Before leaving the subject of research, it is worth mentioning that the international network provides a framework for comparative studies of similar problems in different parts of the world, for testing and transferring new methodologies, and for coordinating the development of information management systems. These areas are beginning to receive some attention, but the potentials remain to be developed fully.

6.4. The Education Function

Biosphere reserves can serve as important field centers for the education of scientists, resource managers, protected area administrators, visitors, and local people. The biosphere reserve's strong emphasis on developing educational programs is unique among protected area categories. The nature of these programs depends on the particular conditions, capabilities, and needs of the biosphere reserve and the surrounding region. However, the following kinds of activities are being developed in many reserves:

Academic and Professional Training includes a range of activities designed to improve the knowledge and skills of students, scientists, resource managers, and protected area administrators. Seminars, workshops, university field courses, work-study programs, details and exchanges of professional personnel, government-sponsored training programs, and similar activities are used in many reserves to provide training in particular professional

fields and in the use of available technologies. A number of biosphere reserves are centers for professional training in the management and use of protected areas or particular types of habitats, such as mountains, tropical forests, and wetlands.

Environmental Education covers activities designed primarily for visitors and local people to foster improved understanding of the relationship between people and their environment. Communicating the role of science in general, and the biosphere reserve in particular, in providing the basis for harmonious relationships is an important aspect. A long-term goal in many reserves is the development of a conservation ethic among local people, in which environmental education can play an important role by showing how intelligent stewardship of the region's resources is relevant to the well-being of its people. For visitors to biosphere reserves, environmental education programs can, by pointing out the similarity of environmental problems in different parts of the world, contribute to the development of a world view and public support for building cooperative relationships for finding practical and equitable solutions to these problems.

Demonstration and Extension provide the means of transferring technology and communicating the results of research activities for the practical benefit of local people. In developing countries, these activities, in concert with environmental education, must often receive priority attention in order to build local support for the biosphere reserve. Demonstration projects in agriculture, forestry, rehabilitation of degraded landscapes, health, development of environmentally compatible cottage industries, energy conservation, and similar areas improve socio-economic stability and provide the basis for integrated development of regional ecosystems. In Mexico, the development of demonstration projects and extension services for agricultural development and range management were the main factors in fostering public support for the establishment and effective protection of the Mapimí Biosphere Reserve, which conserves a significant population of the endangered desert tortoise (Halffter 1981). In developed countries, extension services for regional users of renewable resources are an important component of the educational function. In the United States, these services are provided by a number of experimental forests and rangelands administered by the Department of Agriculture.

Job Training for Local People is an important part of the education function in some biosphere reserves, especially in developing countries. The employment of local people in the protection and management of the biosphere reserve is a practical way to promote local support.

6.5. The Cooperation Function

Cooperation not only serves as the master integrator of the other functions, but also provides the moral force behind the symbolism of the biosphere reserve concept. It is the cornerstone of a successful biosphere reserve, and failure to develop it is the principal impediment to general recognition of the value of the biosphere reserve concept. Biosphere reserve status can provide a framework for improving cooperation at the local,

regional, and international level. However, the objectives of cooperative activities must be clear, and effective institutional mechanisms made operational if progress is to be made.

Cooperation is increasingly regarded as an aspect of good management for all categories of protected areas. However, biosphere reserves are distinguished from other protected area categories in several ways.

First, cooperation has been embodied, specifically and visibly, in the biosphere reserve concept from its inception. Unlike other protected area categories, it is an essential part of the symbolism, and a key factor in fostering personal commitment on the part of growing numbers of people.

Second, cooperation is envisioned as exceptionally broad, involving diverse interests and people with very different perspectives. Efforts are directed toward finding practical and sustainable strategies for dealing with complex and interrelated environmental, land use, and socioeconomic problems affecting a particular biogeographic region. For this reason, the range of interests involved in planning and implementing the biosphere reserve concept typically includes biosphere reserve administrators, natural and social scientists, resource managers, environmental and development interests, government bureaucrats and politicians, and local people. Communication among these groups, some of which may have been traditional adversaries, must be based on acceptance of the need to integrate conservation and development within the biogeographic region, and on recognition of the value of a securely protected and fully functional biosphere reserve in meeting this need. The administrators and staff of the biosphere reserve must build the initial communication linkages through personal initiatives. Through these efforts, a zone of cooperation around the biosphere reserve can eventually develop which, in effect, represents a zone of influence where cooperative activities are implemented. The spatial dimensions of this zone will expand as more participants join the local network. Developing the network of cooperation for carrying out the mission of the biosphere reserve will take many years, and is an open-ended process.

A third aspect involves the multiple levels on which cooperation in biosphere reserves operates. Although most cooperative activities are local and directly support sustainable conservation of the biosphere reserve and its immediate vicinity, cooperation on regional and international levels will become an important factor in the future. All biosphere reserves are part of an international network, which provides a framework for communication within and among biogeographic regions. This communication is generally scientific, and involves the sharing of technology and information, and the development of coordinated research projects. to provide better perspective on problems of common interest. Cooperation within the network is best illustrated in monitoring atmospheric pollutants and their effects on natural ecosystems, and in developing and applying improved methods for managing and restoring tropical forests. To date, the number of cooperative projects involving multiple biosphere reserves has been small, owing to limitations on funding, especially

for bilateral activities, and the tendency of reserve administrators to give priority to projects conducted within the reserve's boundaries. As the influences on protected areas continue to shift from the local to the regional and global, the incentive for coordinated scientific use of biosphere reserves will increase. Should an anticipated substantial increase in funding for the United States Man and the Biosphere Program materialize in 1985, expect to see a significant increase in the use of biosphere reserves as sites for coordinated scientific activities.

During the past five years, biosphere reserves have made significant strides in promoting cooperation at all levels. In Canada, Mexico, and Africa, the biosphere reserves have provided the framework for new approaches to involve local people in developing research programs and strategies for integrated development (Bull 1984, Halffter 1981, Gilbert 1983). In the United States, biosphere reserves have provided the catalyst for establishing new institutions to marshall the professional capabilities of government agencies and academic institutions to provide perspective on the ecosystem use and management problems of the Southern Appalachians and the Virgin Islands. Mexico and the United States have a longstanding project on watershed and wildlife management in woodland ecosystems in the Sonoran Desert region. In many developing countries, biosphere reserves have served as sites for north-south cooperation to improve the standard of resource management and, in a some cases, the economic well-being of local people. Such examples are evidence that the biosphere reserve concept is beginning to become a positive force in international scientific cooperation and technology transfer. However, if the biosphere reserves are to realize their potential in demonstrating the practical benefits of integrating protected area conservation and ecosystem development, the concept must be understood and supported by national governments and by international institutions in the conservation, scientific, economic development, and human services sectors, which must be willing to give priority to projects involving biosphere reserves.

The development of the biosphere reserve as a cooperation concept can appropriately be done by planning and implementing cooperative regional demonstration projects, through which biosphere reserves are used to demonstrate solutions to the complex land use and management problems of particular biogeographic regions. A recent proposal by the U.S. Agency for International Development for such a project in northwest Rwanda (U.S. A.I.D. 1983) provides an integrated approach for pooling financial, technical, and professional capabilities of many agencies and organizations to develop the data bases, institutions, knowledge, and skills needed to plan and manage development in the region while protecting the Volcanoes National Park Biosphere Reserve and its population of the highly endangered mountain gorilla.

7. DEVELOPED VS DEVELOPING COUNTRY MODELS

The First International Congress on Biosphere Reserves, sponsored by UNEP, UNESCO, and IUCN was held in the Soviet Union

in September 1983. It brought together representatives from more than 50 nations to review the first decade of the biosphere reserve project, and to develop an action plan for the future. In their presentations, the representatives made it clear that the emphasis being placed on the various biosphere reserve functions varies markedly depending on the conditions prevailing in particular countries. Although these differences make it difficult to establish a uniform management identity for biosphere reserves, the flexibility of the concept in meeting a wide variety of needs remains a major strength.

In the differences between developed and developing countries can be seen distinct biosphere reserve models. In developed countries, the number and variety of protected areas is large. The legal basis for different categories of protected areas is firmly established. There are many influential constituencies to promote effective protection. Institutions are structured, sectorial, and numerous at the local, regional, and national level. Scientific and technological capabilities are well developed. In these countries, conservation, monitoring and research functions receive particular attention. Indeed, the network in these countries contains many of the world's outstanding national parks as well as leading centers for research on natural and managed ecosystems. In these areas, there is increasing interest in translating biosphere reserve status into more effective protected area management.

In developed countries, emphasis is likely to be placed on scientific use, environmental education, and regional cooperation including the development of new institutions for dealing with environmental problems and integrating the protected areas into the surrounding ecological and socioeconomic region. In the United States and Canada, biosphere reserve designation is being used to link together ecologically and functionally complementary protected areas under different administrators within a particular biogeographic region. The voluntary biosphere reserve associations can be a significant moral force for cooperation in land use and management.

In developing countries, protected area systems, institutions, a conservation ethic, conservation constituencies, and technical capabilities are often either lacking or weakly developed. Biosphere reserves can assume a major role in offsetting these deficiencies and in marshalling domestic and international resources to put protected areas to work for the benefit of people. In these countries, the success of the biosphere reserve concept will depend on whether it can be used as a framework for integrated rural development projects which simultaneously achieve conservation and economic development objectives. Improving the land management skills, hygiene, and general economic well-being of local people, as well as fostering a conservation ethic through education and involvement in all aspects of the biosphere reserve project, will provide the foundation for local support. Monitoring and research functions, and related training, will normally have to rely heavily on the involvement of outside specialists until domestic capabilities are developed. Education, demonstration, and training functions in biosphere reserves will be particularly important in developing professional and

technical capabilities relating to the stewardship of protected areas and in sustaining the benefits from integrated rural development programs.

8. CONCLUSIONS

During the eight years since the first biosphere reserves were officially designated by UNESCO, the biosphere reserve concept has journeyed from obscurity to an important, if not yet commanding, position in the world lexicon of protected areas. It draws its growing influence from its capability to integrate the functions performed individually or severally by existing categories of protected areas, and from a unique positive symbolism which has the capacity to motivate people around the world to put protected areas to work to help address the interrelated ecological and human problems of an increasingly interconnected world civilization. It uniquely recognizes and exploits the value of protected natural ecosystems as unlimited archives of information to support the well-being of people.

The success of the biosphere reserve concept has at once been exceptional and limited. The rapid growth of the international network has been remarkable, yet development of the multiple functions of the designated areas has been much slower to materialize. There remains much uncertainty as to how the biosphere reserve designation should affect management. Yet, there is a growing willingness--even enthusiasm--for exploring the dimensions of this still evolving concept. The outcome of this exploration will vary depending on the particular problems, capabilities, and needs of particular nations or biogeographic regions. Yet, regardless of the outcome, there seems little doubt that application of the biosphere reserve concept will strengthen the justification for protecting the designated areas, broaden their constituencies, and generally improve their security.

Although biosphere reserves have been used successfully to improve the economy of rural communities in developing countries, major demonstration projects await increased interest in the biosphere reserve project by agencies and nongovernmental organizations responsible for funding development in these countries. Because of their permanent protection and scientific mission, biosphere reserves can provide a suitable framework for evaluation, objective reassessment, and appropriate redirection of development activities to ensure that they are ecologically sustainable. In many instances, it should be possible to improve the economic justification for rural development projects by integrating them with a biosphere reserve.

The biosphere reserve concept provides a dynamic framework for integrating protected area conservation and economic development, as envisioned in the World Conservation Strategy developed by the IUCN as the basis for global ecosystem conservation (IUCN 1980). The biosphere reserves can, and should, be developed as centers for carrying out this strategy. They can serve as important catalysts for human cooperation to develop models for the rational use of the ecosystems in each of the world's biogeographic regions. They can be focal points for developing

new mechanisms and institutions for marshalling the scientific, technological, and financial resources needed to improve the productivity and sustainability of land use systems while maintaining the biological diversity of regional ecosystems. As educational resources, they can make major contributions in training protected area managers, scientists, technicians, and local people. They can provide continuing demonstration of the relevance of conservation in the lives of people, and build a conservation ethic which helps underwrite the security of protected areas. These missions await the full attention of the world community. However, their promise is immense, and their fulfillment will represent a new dimension in global conservation and a major contribution toward restoring and maintaining harmonious relationships between man and the biosphere.

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