

RECENT PROGRESS IN U.S. BIOSPHERE RESERVES

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This paper describes the purposes of Man and the Biosphere (MAB) Project 8 in the United States, the extent to which those purposes have been fulfilled and plans for the next few years. The Man and the Biosphere Program is only 8 years old and U.S. MAB Project 8 is only 6 years old. The methods, and to some extent the concepts, are still evolving. I will attempt to present here the current stage of that evolution.

I. The Nature and Purpose of Biosphere Reserves

Project 8 in the MAB Program is titled "Conservation of Natural Areas and of the Genetic Material They Contain." This title, however, describes only part of the project's aims. The other main purposes are to provide sites for environmental monitoring, research on ecosystems and their responses to human use, and education concerning use of these ecosystems. These purposes are carried out largely in and through a network of biosphere reserves, which also serve as sites for much of the research in other MAB project areas.

A biosphere reserve, according to MAB guidelines, may be a natural area representing a major biotic division of the world, a natural area with unique features of exceptional interest, or a man-modified landscape in a region where natural conditions no longer exist (UNESCO 1974). A biotic classification of the world developed by Miklos Udvardy for the International Union for Conservation of Nature and Natural Resources (IUCN), is being used as a basis for selecting representative Biosphere Reserves (Udvardy 1975). Biosphere Reserves must also be large enough to be effective conservation units and must have adequate legal protection from nonconforming uses. Most biosphere reserves thus far designated are areas previously established as national parks, experimental forests, or for other similar purposes. Biosphere reserve status extends and broadens their uses and responsibilities. A few areas, however, such as those in Mexico and Honduras, have begun as biosphere reserves; the fact that a broad spectrum of uses is allowed appeals to many developing countries. The major effort initially in Project 8 is to establish biosphere reserves in each of the biogeographic provinces and their major subdivisions and to develop in these reserves programs of research and environmental monitoring.

At present there are 177 biosphere reserves in 46 countries, including 33 in the United States. Of the latter, 14 are administered by the U.S. Forest Service, 13 by the National Park Service, 2 by the Department of Agriculture's Science and Education Administration, 1 by the U.S. Fish and Wildlife Service, and 3 by private organizations.

To carry out all its purposes, a biosphere reserve ideally should have a large undisturbed "core" in which ecosystems and their species are conserved and which serves as a control area, and a "buffer" zone which shields the core and in which manipulative research can be conducted to determine responses of these ecosystems to various kinds of use (UNESCO 1974). Areas

suitable for both purposes are difficult to find, however. In the United States this problem has been solved by establishing in ecologically similar terrain reserve pairs or clusters, in which one or more area is a conservation unit such as a national park and one or more is an experimental area such as those operated by the Forest Service (Franklin 1977). Great Smoky Mountains National Park/Coweeta Experimental Forest, and Rocky Mountain National Park/Fraser Experimental Forest/Niwot Ridge Wilderness are examples of such multiple reserves.

The first 29 U.S. biosphere reserves were selected by the U.S. MAB-8 Committee. Using the IUCN biogeographic classification, with some additional subdivision, the committee was able to find suitable candidates in most of these regions. The latest four reserves were proposed by the administering organizations themselves. Paul Risser and Kathy Cornelison of the University of Oklahoma have systematically described, compared, and analyzed the characteristics of the first 27 U.S. biosphere reserves (Risser and Cornelison 1979). This report provides a foundation for planning MAB uses of the reserves and for identifying gaps in the network.

What would constitute a complete network of biosphere reserves in the U.S.? This question has not been answered definitively, but a first goal is the establishment of at least two reserves, including between them both conservation and experimental areas, in each biogeographic province or subdivision (U.S. MAB Publication No. 1). The ultimate number of representative reserves would be a function of the heterogeneity of each biogeographic province. Beyond that, selection of additional unique or man-modified sites is possible. At present, the following provinces have no U.S. representation in the network: Sitkan, Great Basin (north), Sonoran (Mohave), Tamaulipan, Canadian Taiga, Austroriparian, Great Lakes, Hawaiian, and Micronesian. Suitable candidates have been identified for some of these but have not yet been designated.

Many people contend that zones of transition or interface between biotic regions are of equal or greater importance than areas within regions. Coastal zones, in particular, are mentioned. A classification of coastal zones, for purposes of selecting biosphere reserves, is a high priority need. Several reserves border on the Atlantic or Pacific coast, but these represent only a small part of the existing coastal variety.

II. MAB Uses of U.S. Biosphere Reserves

Now that a substantial number of biosphere reserves have been established in the U.S., how are they being used to fulfill their main purposes: conservation of genetic resources, environmental monitoring, research on ecosystems, and education? Since most of our biosphere reserves were being used for such purposes before they received this international designation, we should refine our question and ask: How are these purposes being fulfilled from a MAB point of view; that is, how is such use of these areas being broadened to help solve local, regional, national, and international environmental problems?

The biosphere reserve network, by conserving representative samples of major ecosystems, protects a significant portion of our planet's genetic resources, but lets much of the biotic variety slip through this very large

mesh net. The biogeographic classification used in selecting reserves sometimes includes within a province a large number of subtypes that cannot all be represented within a single biosphere reserve. For example, using the potential natural vegetation classification system of Kuchler (1966), one finds that large samples of only about one-third of his 116 vegetation types occur in existing U.S. biosphere reserves (Risser and Cornelison 1979).

However, the biosphere reserve network was never intended to do the whole job of conserving Earth's genetic diversity. National parks, botanical gardens, and other safeguarding methods must do the rest.

Establishment of biosphere reserves is not the only way MAB Project 8 works for conservation of genetic diversity, however; publicizing this need is another important part of the effort currently being addressed. Funded by the National Park Service, Margery Oldfield of the University of Texas recently wrote a report on the value of conservation of genetic resources, synthesizing the results of much recent research and emphasizing case histories of plants that have made important contributions to human welfare. Publication of the report is planned for 1981.

A second important purpose of biosphere reserves is their use as sites for environmental monitoring. In 1978 a pilot pollutant monitoring program was developed in Great Smoky Mountains National Park by the Environmental Protection Agency and the National Park Service. The Program is now being initiated in Olympic National Park and is expected to be extended to the other national park biosphere reserves in the next few years. These measurements will help to show base levels of pollutants in "pristine" areas, sources of pollutants and direction of transport, and global trends in pollutant levels. Under a recent U.S.-U.S.S.R. agreement, the Soviets will set up this same pollutant monitoring system in a Soviet biosphere reserve similar to the Smokies and will share the data with us.

Other data, especially on acid rain, are being collected in national park biosphere reserves through the National Atmospheric Deposition Program. Wet-fall and dryfall collectors are expected to be installed in 13 national parks by June 1980. The evidence gathered so far indicates that even remote park areas are being affected by acid rain.

Biosphere reserves are also serving as sites for study of ecosystems and their responses to various kinds of human use. The conservation units of our biosphere reserve network are intended to serve as examples of essentially undisturbed ecosystems and as control areas for manipulative research conducted on experimental units of the network. Most of these conservation units are national parks, where research in the past has focused largely on immediate problems of park management rather than long-term studies of ecosystems. Biosphere reserve status should promote more of the latter type of work.

Most experimental units of the network are range or forest areas run by USDA's Forest Service or Science and Education Administration. These have well served their original purpose of developing and demonstrating good management practices on grasslands, deserts, and forests. Ecosystem level studies have been conducted on some of these areas, particularly those that were sites for the International Biological Program.

The fourth main function of biosphere reserves is to serve as sites for education concerning natural resources. Most units of the network have, at least to some extent, provided such education in the past. Biosphere reserve status should bring an increase of this type of use, particularly with regard to education resource managers, policy makers, and students, both U.S. and foreign.

Thus far we have considered conservation and experimental units of the biosphere reserve network separately. Where conservation units have been paired with experimental units, the possibilities multiply. Few U.S. biosphere reserve pairs or clusters have as yet actually begun cooperative research and education, but of those that have, the Southern Appalachian units are probably the most active and most illustrative of how the idea is supposed to work.

The Southern Appalachian cluster consists of Great Smoky Mountains National Park, administered by the National Park Service, and Coweeta Experimental Forest, administered by the U.S. Forest Service. Oak Ridge National Laboratories, administered by the Department of Energy, cooperates with the other two units. These areas are all situated in Appalachian forests composed mostly of oaks. Together they offer the opportunity to learn how these forest ecosystems work and what forestry practices and what types and degree of recreational use they are suited for.

Great Smoky Mountains National Park serves as an ecological benchmark for the region. Monitoring here of certain parameters of air, water, vegetation, and soil and of plant and animal populations indicates the characteristics of minimally disturbed areas in this region for comparison with environmental conditions on forestry, agricultural, and urban lands.

At Coweeta Hydrologic Laboratory, south of the national park, research has been conducted over the past 40 years to determine the effects of forest management practices on the quantity, timing, and quality of streamflow and mitigating impacts. However, it is a much smaller area than Great Smokies (2,185 hectares vs. 208,403 hectares), and does not encompass the range of species and forest types that the national park does.

Oak Ridge National Laboratories cooperates with Great Smokies and Coweeta by providing computer and storage facilities for information generated on the other two areas. It also has conducted ecological research in forests similar to those on the other two areas.

Thus, the three areas together encompass large samples of Southern Appalachian forest types; research on undisturbed and manipulated watersheds; a large data base; facilities for storing, analyzing, and disseminating the information gained; and experience in on-site teaching. The possibilities of mutual cooperation are just beginning to be realized. For example, Coweeta's experience with soil erosion research is now being put to use in the Great Smokies in a comparative study of erosion on watersheds with and without wild hogs, which are a serious problem in the park.

Environmental problems of the Southern Appalachian region include air pollution, soil erosion, and recreational overuse of backcountry areas. Measurement and analysis of airborne pollutants in both Great Smokies and Coweeta are helping to determine sources and quantitative trends. Coweeta's research has done much to show how the region's forests can be managed with least amounts of soil erosion. And experience with management of backcountry camping in Great Smoky Mountains National Park will be helpful to other public areas in the region that provide this kind of recreation.

Use of both Great Smoky Mountains National Park and Coweeta Hydrologic Laboratory as educational areas is beginning to increase as a result of their becoming biosphere reserves. For instance, MAB recently signed a contract with the University of Tennessee to conduct an ecological inventory and monitoring workshop for foreign students, using the Southern Appalachian biosphere reserves as training grounds. These students will be selected from developing countries and the methods taught will be tailored to application in humid tropical environments.

Thus far, the only other major cooperative biosphere reserve activity on this continent is that of the Forest Services's Beaver Creek Experimental Watershed in Arizona and La Michilia Biosphere Reserve in Durango, Mexico. Cooperative research in these reserves is aimed at determining the best management practices in dry mountain forests of southwestern North America under the different cultural conditions represented.

In summary, a sizeable network of biosphere reserves has been established in the United States. The primary results so far are establishment of pollutant and air monitoring sites in several reserves, and cooperative research and training in the Southern Appalachians and the Southwest. Most importantly, perhaps, a mechanism has been established for cooperation between government agencies, universities and other groups in using biosphere reserves for joint research and education concerning environmental problems.

III. Current Plans

The future uses of U.S. biosphere reserves, as well as other aspects of Project 8, are addressed in a plan being prepared for the U.S. Man and the Biosphere Program. The major proposals regarding Project 8 are:

- 1) Completion of the biosphere reserve network, including coastal reserves.
- 2) Conducting resource base inventories in biosphere reserves, as baseline information for monitoring, research, management of reserves and education.
- 3) Initiation of new, site-specific research and monitoring activities. An annual conference is proposed to discuss research projects and plan common data acquisition and data reporting systems.
- 4) Expansion of education and training of policy makers, scientists, managers, and the general public. This would include 2-week summer institutes, during which selected biosphere reserves would be visited and questions appropriate to the participants would be examined.

- 5) Dissemination of information resulting from research in biosphere reserves. This would include establishment of a central location and a data management system.
- 6) Increased coordination between organizations in use of biosphere reserves.
- 7) Further development of plans for an Ecosystem Conservation Atlas of the World.

The total first year costs for these activities is estimated at \$1,280,000. Some of these costs are expected to be absorbed by participating agencies where their current activities partially address MAB objectives. Financial support for the still young U.S. Man and the Biosphere Program is growing, so it is reasonable to expect that most of these plans will be carried out. With the interest and involvement of the scientific community, our biosphere reserves should achieve full usefulness in the international effort to keep our planet habitable.

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