

Development of the Biosphere Reserve Network

Under the

UNESCO Man and the Biosphere Program

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Paper presented at the
Thirty-second Annual Meeting
of the
American Institute of Biological Sciences
Indiana University
Bloomington, Indiana
August 16-21, 1981

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INTRODUCTION

It is a pleasure to participate in this discussion about developments in the field of ecology, especially on the establishment of a network of protected natural areas and their use in research, and in the tribute to Professor W. Frank Blair. Dr. Blair was a great influence in the development of the United States' involvement in the International Biological Program (IBP), and this program had a significant effect in shaping the ideas and activities around which the Man and the Biosphere Program (MAB) was built.

It is interesting to read Dr. Blair's account of "Big Biology---The US/IBP,"¹ but it is also discouraging to realize that, time and again, far-sighted individuals have long recognized the world's natural resource and environmental problems, and have initiated programs to do something about them; but inevitably the problems grow faster than the solutions and require ever more massive remedial action. We are all only too well aware of the potentially awesome ecological and socioeconomic consequences of tropical deforestation, the desertification process, atmospheric contamination, reduced productivity of the world's arable lands, and a host of other growing problems associated with the increasing demands exploding human populations are placing on the material resources of the biosphere.

On the other hand, even though we still face these problems, we are in a much better position to face them intelligently because of individuals such as Frank Blair, who have devoted their efforts to developing the "large scale ecology" exemplified by the IBP. Because of these individuals, whose ideas and programs have revolutionized and energized the science of ecology, we have seen the

emergence of a broad, holistic approach to research and training, which is resulting in exponential growth in our knowledge of the structure and functions of ecosystems and a corresponding improvement in our capability to use and manage them wisely. The MAB Program is dedicated to the expanded use of this holistic approach in providing the basis for intelligent and sustainable conservation of the biosphere. Its conceptual framework, objectives, and global scope are, in many respects, a legacy of the IBP and, for this reason, MAB may be viewed as an appropriate successor to this effort.

PURPOSE OF THIS PAPER

This paper describes the beginning, the development, and the current status of the UNESCO MAB Project 8 on "Conservation of Natural Areas and the Genetic Material They Contain." The purpose of this project is to promote the conservation of the world's biological and genetic diversity by providing the scientific basis for establishing and managing protected natural areas. A key part of the project is the establishment of a global network of biosphere reserves, which provide secure protection for self-sustaining ecosystems representative of each of the world's biomes and equally secure sites for long-term ecosystem research and related education, demonstration, and training activities. This network presently consists of 193 UNESCO-designated areas in 50 countries.

Describing the evolution of a program as complex as this one is not an easy task, for so many individuals and previous programs have had an important influence. Nevertheless, we will attempt to mention some of the individuals, ideas, and events which have shaped the MAB Project, and ask the reader's forbearance for any unintentional omissions.

INTERNATIONAL EFFORTS RELATED TO THE BEGINNING OF MAB

During the 1960's, a growing diversity of ideas and recommendations related to natural resource conservation, research, and management began to be translated

into programs of international action. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) played a major role in establishing the climate for making such programs possible. Sir Julian Huxley, eminent naturalist and first Director General of UNESCO, was the key r^oponent of an international conference, convened jointly by UNESCO and the French Government in 1948, which resulted in the founding of the International Union for the Conservation of Nature and Natural Resources (IUCN). This organization, now a major force in world conservation, was later to play a pivotal role in the planning and development of MAB Project 8, and today maintains an active involvement in its continuing evolution.

During the 1950's and 1960's, two UNESCO scientists exerted particularly important influence on the field of natural resources conservation and research. One was Dr. Pierre Auger, a physicist who headed UNESCO's Science Department until 1958 and later became Director-General of the European Space Research Organization. During the period between these two posts, he carried out a survey of the main trends of inquiry in the natural sciences as a special consultant for the United Nations and UNESCO. The survey, published in 1961, included this recommendation on the conservation and use of natural resources:

The systematic exploration...of the planet...should yield a thorough and accurate knowledge of the different environments forming the earth, the atmosphere, fresh and salt water, and the soil. A necessary outcome of such knowledge, however, must be an activity of benefit to mankind--that of seeking to preserve these environments in the best possible condition, either by ensuring their prudent and rational use, or by repairing the damage they have already suffered, or by improving them so as to bring them close to an optimum which can be determined by scientific means.

This activity is the national duty of every country so far as its own territory is concerned, and an international duty in the case of general environments common to several or all nations.

The problems of the pollution of the upper and lower atmospheres and of sea and river water, those of extracting and diverting surface and ground water and, lastly, those of preserving and reclaiming arable land are among the most urgent.

The increasingly intensive use made of these common environments in industry and agriculture seriously threatens the potential development of human life on the earth's surface. Fundamental decisions to safeguard these environments should be considered and adopted.²

Dr. Auger was followed at UNESCO by Professor Victor Kovda, a leading soil scientist from the Soviet Union, who was responsible for significant expansion of UNESCO's natural science activities during the 1960's, which helped make UNESCO's later involvement in developing MAB possible. Major international programs were launched to deal with the growing problems of arid zones and the humid tropics, which today are priority fields of emphasis in the MAB Program

In the United States, the 1960's were years of significant effort on the part of many distinguished individuals to provide the basis for international research and conservation. Dr. Stanley A. Cain, a plant ecologist who played a prominent role in shaping U.S. involvement in the IBP and later in the development of MAB, was one of these. In 1962, the Neotropical Botany Conference in St. Augustine, where the Association for Tropical Biology was formed, adopted much of Dr. Cain's thinking in calling for an international program very similar to MAB Project 8. Such a program would emphasize conservation of natural vegetation, of areas for endangered species, and of areas maintained by biotic activity, such as by ungulates--as well as conservation of physiographically active areas, such as beaches, dunes, marshes, and cliffs. It would promote studies at the species, community, and ecosystem level. Finally, it would include the establishment of protected areas for maintaining gene pools, for carrying out experimental investigations, and to serve as outdoor laboratories for education --all of which later became basic objectives of the biosphere reserves network.

Dr. Cain subsequently chaired several key committees dealing with conservation and natural area research, notably the ad hoc committee for the planning of the IBP (from November 1963 to August 1964) and the Natural Science Advisory Committee for the National Park Service (NPS). After his appointment as Assistant Secretary of the Interior for Fish and Wildlife and Parks in 1965, he asked Dr. George Sprugel, then NPS Chief Scientist, to inventory natural areas within

Interior which were managed for research purposes. Dr. Sprugel organized a committee of representatives from Interior's land managing bureaus in early 1966, which soon was expanded to include all Federal land managing agencies. The group, which called itself the Federal Committee on Research Natural Areas, established the framework for a national network of protected natural areas for observational scientific study,³ and also was the principal arm of IBP's Conservation of Ecosystems Project for the inventory, survey, and designation of these areas on Federal land. Working in close association with the IBP project, committee representatives vigorously pursued development of the Research Natural Area network until 1970, when it became inactive, after its principal sponsor, the Office of Science and Technology, was abolished.⁴

The Committee remained inactive until 1975, when it was reconstituted as the Federal Committee on Ecological Reserves. At this time, its area of concern was expanded to include the development of a network of Experimental Ecological Areas to be set aside for manipulative research--a network which is now in the final stages of completion. During the mid-1970's, the revitalized committee provided a valuable forum for matters relating to the planning and development of the global network of biosphere reserves.

The major impetus for establishing the MAB Program was the so-called "Biosphere Conference" held at UNESCO in Paris from September 4-13, 1968. Attended by 238 delegates from 63 member states and more than 100 representatives from United Nations and other organizations, the purpose of the conference was to formulate a coordinated international program to combat growing environmental problems. Reports by member states and review papers were circulated well in advance to participants. As Dan Behrman, who was a science writer for UNESCO during this period, put it:

The success of the conference was a foregone conclusion. Leading authorities had been asked to write papers on certain topics, the papers were circulated for criticism before the conference to all who might have had comments to make, the comments were added and the papers came before the delegates already debated and amended. Quite an exercise in conferencemanship....⁵

The delegates concluded the conference by agreeing upon a score of recommendations, several dealing with ecosystem research, as well as conservation and use of natural areas. Most importantly, they agreed on the need "to launch a long-term program in 1970-72, thereby making provision for a follow-up and adequate extension of the IBP and for additional work on the part of the various United Nations Institutions and non-governmental organizations."⁶

Just after the Biosphere Conference, the UNESCO General Conference in 1968 officially supported these recommendations and approved plans for further action.

PLANNING AND IMPLEMENTATION OF THE MAB PROGRAM: THE 1970'S

In the two years following the Biosphere Conference, UNESCO convened a number of international working groups of scientists to develop a practical approach to carrying out the Conference resolution. Considering the results of these deliberations, the UNESCO General Conference in November 1970 decided to officially launch "a long-term intergovernmental and interdisciplinary program on Man and the Biosphere focusing on the general study of the structure and functioning of the biosphere and its ecological regions, on the systematic observation of the changes brought about by man in the biosphere and its resources, on the study of the overall effects of these changes upon the human species itself, and on the education and information to be provided on these subjects." The Conference also invited member states to establish national committees for participation in the program. Charged with implementing the Conference's decision, MAB's policy-making organ, called the International Coordination Council (ICC), conducted its first session, in November 1971.⁷

Dr. Donald R. King, of the Office of Environmental Affairs, Department of State, along with Dr. Ted Byerly, the Assistant Director, Science and Education, at the Department of Agriculture, led the U.S. delegation at this important first session of the Council.

The Council proposed thirteen projects or themes for research, which, although flexible in content and approach, would retain a primary focus on the interactions between man and the biosphere. Project 8, it concluded, was to be directed toward (1) establishing a coordinated, world-wide network of protected areas, and (2) supporting effective conservation of animals and plants, including micro-organisms.

Additionally, the Council recommended that panels of highly qualified specialists be convened to elaborate the scientific content of the MAB projects. This was done in short order for several projects. However, the decision to convene a MAB-8 panel was not made until the Council's second session in April 1973, following a request from IUCN.⁸ In the meantime, however, the MAB-8 concept had received considerable support at the United Nations Conference on the Human Environment, held in Stockholm in June 1972, which endorsed an international program to preserve the world's genetic resources and a "world-wide network of protected areas to preserve representative examples of the world's ecosystems" (Recommendations 107-120).

Russell Train documented a major event of the conference as follows:

The U.S. Delegation proposed that Sir Otto Frankel, an outstanding world authority on conservation of genetic resources, be asked to elucidate the topic briefly. Sir Otto was present on the podium as a conference expert advisor.

He was received with generous applause, spoke briefly and brilliantly, and was again warmly applauded at the close of his remarks. Recommendations 107-120 were then accepted enthusiastically.

This program is likely to be one of the major contributions of the Conference and was a U.S. initiative in substantial part.

Approved by acclamation.⁹

Sir Otto Frankel later was a great help to a MAB-8 expert panel convened at the invitation of IUCN in 1973 for developing the concepts and content of Project 8. This panel clarified the role of the reserves in baseline and other scientific studies, and as benchmark areas for ecosystem monitoring.¹⁰ It recommended that a special group be convened to prepare guidelines for the choice and establishment of biosphere reserves, on the basis of ecological and genetic principles of nature conservation. The panel also noted that a comprehensive inventory of world biomes would be required to provide a framework for selection, and recommended that a classification system should be prepared.

As a result, UNESCO let a contract to IUCN to expand its previous work in defining biotic provinces, and to survey the provinces to identify sites most suitable as biosphere reserves.

In September 1974, IUCN published its report, entitled Biotic Provinces of the World.¹¹ The document defined the broad natural regions so as to provide a broad basis for global natural area protection, yet still allow for refinement to consider biotic and environmental variation within the provinces. It indicated that, of the 198 biotic provinces listed, 53 of them had no reserves or national parks and 45 of them had only one or two reserves. At the same time, it recognized that international funds required for establishing biosphere reserves or other protected areas would always be limited, and advised that efforts be concentrated on those biotic provinces where little or nothing had been accomplished.

The classification of the world's biotic provinces was refined for IUCN in 1975 by Professor Miklos D. F. Udvardy, California State University, whose classification of the world's terrestrial areas into biogeographic provinces remains in use today to guide selection of biosphere reserves.¹²

After considerable planning, a special task force was jointly organized by UNESCO and UNEP, and held in Paris in May 1974, to elaborate "criteria and guide-

lines for the choice and establishment of biosphere reserves."¹³ With these criteria developed, work could now begin to encourage governments to establish areas as biosphere reserves. It had taken several years of planning to get this far, and there had been a great deal of consultation between UNESCO, UNEP, IUCN, and FAO. In fact, in early 1974, the MAB Secretariat submitted a proposal to UNEP for a six-year program to develop the international network of biosphere reserves. Although the proposal was seemingly well received initially, when the project was ready to be implemented, UNEP officials indicated that all funds for ecosystem conservation had been expended and there were no funds available to get this project started.

Given this situation, it was recognized that the developed countries would have to take the lead if the project was ever to get underway; so the MAB secretariat suggested that the United States consider designating a few existing protected areas meeting the criteria, as biosphere reserves. It was also suggested that the subject of support for MAB and cooperation in developing the biosphere reserve network be taken up at a scheduled summit conference between the U.S. and the U.S.S.R. Fortunately, this was arranged; and the U.S. and the U.S.S.R. agreed to support the implementation of this MAB project. The following is an extract from the Moscow summit communique issued in Moscow, July 3, 1974.

Desiring to expand cooperation in the field of environmental protection, which is being successfully carried out under the U.S.-U.S.S.R. agreement signed on May 23, 1972, and to contribute to the implementation of the "man and the biosphere" international programme conducted on the initiative of the United Nations Educational, Scientific and Cultural Organization (UNESCO), both sides agreed to designate in the territories of their respective countries certain natural areas as biosphere reserves for protecting valuable plant and animal genetic strains and ecosystems, and for conducting scientific research needed for more effective actions concerned with global environmental protection. Appropriate work for the implementation of this undertaking will be conducted in conformity with the goals of the UNESCO programme and under the auspices of the previously established U.S.-U.S.S.R. joint committee on co-operation in the field of environmental protection.

This agreement brought attention to the MAB Program and provided impetus to plans for developing the network of biosphere reserves. Since the third ICC session was to be held in Washington, D.C., just three months after the summit communique, and it was hoped that the designations of the first biosphere reserves would be announced at this meeting, a great deal of work had to be done in a hurry. Cables were sent from the Department of State to U.S. embassies in the twenty-five countries that were members of the MAB Council to request that they communicate to appropriate ministries the United States' intention to announce the designation of biosphere reserves at the Council meeting, and to suggest that these countries also consider designating reserves according to the criteria developed by the MAB-8 Task Force in May.

Dr. Jerry F. Franklin, chief plant ecologist at the Forest Service's Pacific Northwest Forest and Range Experiment Station, was U.S. chairman of the Biosphere Reserve Project under the U.S.-U.S.S.R. Environmental Agreement, and was instrumental--along with Dr. Theodore Sudia, Chief Scientist of the National Park Service--in obtaining the support of these key land managing agencies for the project.

Operating under the severe time limitation, the U.S. MAB-8 Committee placed emphasis on selecting securely protected sites with a history of experimental ecological research, mostly under Forest Service management, which were paired wherever possible with large conservation areas, mostly under NPS management.^{14,15} The selections were made in the majority of the nation's biotic provinces and were announced--along with others in Austria, France, the Philippines, and the United Kingdom--at the third ICC meeting in September 1974.¹⁶ Immediately following this session, representatives from 13 Latin American countries attending a MAB regional meeting in Mexico City announced plans to select biosphere reserves. Subsequent regional and subregional MAB meetings in 1975 recorded the

decisions of more nations to establish biosphere reserves. The growing network of biosphere reserves had assumed its place in the global system of protected areas.

By 1975, it had become obvious that a consistent procedure for nominating and recording information on the biosphere reserves was urgently required, and this was accomplished utilizing the experience gained in IBP's Conservation of Ecosystems project. The procedure was adopted at the ICC's fourth session in November 1975,¹⁷ and still provides the basis for nomination of reserves by national MAB committees and their official designation by UNESCO.

The flurry of efforts to establish biosphere reserves revealed widespread confusion as to how this new project related to other conservation efforts. To deal with this problem, IUCN and UNESCO began work on a publication to explain the biosphere reserve concept and its relationship to other protected areas throughout the world. Begun in 1975, this significant report was finally published in 1979.¹⁸

The confusion about MAB-8 also brought out the need for structured communication among UNESCO, IUCN, FAO, and UNEP in discussing objectives and plans in the general area of ecosystem conservation and research. The lack of inter-institutional coordination was posing a continuing risk of duplication of efforts, and sometimes caused conflict over funding of international conservation activities. To help remedy the situation, UNESCO proposed that the four international organizations form an official group to help coordinate their efforts. After agreement was reached, the first meeting of the new coordinating body, called the Ecosystem Conservation Group, was held at the IUCN headquarters in Morges, Switzerland, in May 1975. Relative to biosphere reserves, the group agreed that:¹⁹

1. The biosphere reserve concept was a useful addition to the various categories of protected areas, and that establishment of protected areas and establishment of biosphere reserves were important elements in achieving global conservation objectives;

2. Surveys to select potential reserves would be a joint effort of the group;
3. Dissemination of information at the country level was essential to avoid confusion as to the relationship of the biosphere reserves and other protected areas; and
4. The status of the network would be examined at semi-annual meetings of the group, and the initial focus of selection would be on areas which could contribute the most effectively to the MAB Program.

There has been little indication that the Ecosystem Conservation Group has functioned as originally intended, especially regarding the cooperative activities for the developing of the network. However, it has provided a mechanism for communications in this field, and some cooperation has resulted. The new Director-General of IUCN, Dr. Lee Talbot, who previously participated in the development of MAB-8 in the U.S., considers that, with a more specific focus, the Ecosystem Conservation Group can perform a useful function.²⁰

DEVELOPING A STRATEGIC PROGRAM FOR MAB PROJECT 8

As the biosphere reserve concept has matured and the number of designated units has continued to increase rapidly, efforts to develop strategic, long-range programs for MAB Project 8 have been undertaken in many parts of the world. Because of major differences in natural and socioeconomic conditions in different regions, the composition and management focus of selected sites will vary, particularly with regard to the role of human populations and their activities. For this reason, planning has proceeded primarily at the regional and national levels --and sometimes at the bilateral level--under the general objectives and guidelines laid down by UNESCO. Under this approach, many nations have developed their own procedures for systematic identification, evaluation, and selection of biosphere reserves, among them Canada (1975),²¹ Mediterranean countries (1977),²² Australia and New Zealand (1977),²³ and the U.S. (1981).^{24,25}

More importantly, many nations, through their MAB committees, have held conferences and workshops to develop strategies for using the biosphere reserves

more effectively in addressing significant conservation and land use problems.

From 1976 through 1978, the United States MAB-8 Committee held five regional workshops, which brought together scientific and administrative personnel from biosphere reserves, agencies, universities, and other institutions for the purpose of identifying needs, objectives, and specific projects for individual reserves, and for coordinating the activities of the reserves at the regional, national, and international levels.²⁶⁻³⁰ Separate workgroups developed recommendations to enhance the role of the reserves in conservation of genetic diversity, research and monitoring, as well as education and training; and suggestions for completion of the network were presented. The workshops substantially increased understanding of the MAB Biosphere Reserves Project within both the public and private sectors; and many of the more than 100 recommended projects were subsequently implemented by reserve administrators or carried out in the reserves by outside investigators.

The regional workshops were followed by additional MAB conferences aimed at improving specific biosphere reserve functions. Key among these functions is long-term ecological monitoring, which began to receive considerable attention in the late 1970's with the sponsorship of a series of multidisciplinary conferences by the National Science Foundation.^{31,32} These conferences resulted in the preparation of recommendations for a pilot program, outlining a monitoring strategy for terrestrial, fresh water, and marine ecosystems, as well as the identification of suitable implementation sites, which included most of the biosphere reserves existing at that time (1978).

Utilizing the results of these conferences as background, US-MAB convened an international workshop on long-term ecological monitoring in biosphere reserves in October 1978.³³ The workshop, involving 45 scientists from ten nations, produced a flexible plan for listing biosphere reserves to obtain comparable data

for assessing regional, national, and global trends in environmental conditions, and biological processes. It recommended a core of chemical, geophysical, biological, and anthropological factors as the focus of a basic monitoring program in all biosphere reserves. Additional factors were recommended for consideration in developing an understanding of ecosystem structure and function, and in assessing particular environmental trends, with special emphasis on parameters such as toxic substances which have known or suspected effects on human health and well-being. The workshop provided support for implementing a system for monitoring pollutant levels in air, water, vegetation, litter, and soil, using the Great Smoky Mountains and Olympic Biosphere Reserves as the initial study sites,^{34,35} and for the integration of all National Park Service biosphere reserves into the National Atmospheric Deposition Program.

Another major function of biosphere reserves is the long-term protection of genetic diversity. In this area, MAB-8 is undertaking an initiative to apply the recent advances in evolutionary biology, biosystematics, silviculture, livestock genetics, and other fields toward more effective management of plant and animal species in protected natural areas. As the genetic populations of these areas become progressively more isolated due to land use changes and other changes which impair traditional genetic exchange between protected areas and their surroundings, more active management will be required to maintain genetic diversity, prevent extinctions, and perpetuate healthy populations.

A MAB conference bringing together leading authorities in applied genetics will be held in Washington, D.C., in October 1982. The conference will demonstrate to policy-makers, resource managers, and field scientists how the theory and practices of genetics may be used to advantage in developing scientific and management programs for protected natural areas. The proposed event has received broad endorsement from numerous agencies and institutions concerned with the

protection and management of genetic resources.

The above workshop will follow closely on the heels of a conference on genetics sponsored by the Agency for International Development in Washington, D.C., scheduled for October 1981. The objectives of the conference are to summarize the known and potential socioeconomic value of the world's genetic resources, to assess the ramifications of their rapid loss for the United States and the world, and to develop a U.S. strategy to promote their protection both domestically and internationally. Modelled upon the interagency task force effort which produced a landmark 1980 report on tropical forests,³⁶ the conference is intended to provide a framework for effective Government action in the years immediately ahead.

In addition, US-MAB, in cooperation with the National Park Service, will soon publish a major report by Margery Lee Oldfield on the use and conservation of genetic resources. This important work clearly delineates the socioeconomic significance of genetic resources, and the probable future benefits to be obtained from their wise stewardship.

The important biosphere reserve function of public communication was substantially advanced through a MAB-sponsored workshop held in July 1981. The participating communications specialists and scientists developed a cost-effective plan for using the biosphere reserve network to enhance public awareness of major environmental issues and how scientific studies are providing new perspectives needed to deal with them. In addition, the workshop recommendations include a variety of provisions to create broad public recognition of the significance of the biosphere reserve network in conserving genetic resources, assessing environmental trends, and developing methods for improving environmental quality and the well-being of human populations.

Besides these MAB efforts, the National Park Service is making a major effort to solicit the involvement of the scientific community, in natural science

programs and NPS facilities, in its fifteen biosphere reserve areas. This initiative involves preparation of a comprehensive annotated bibliography and a summary of information in text and tabular form to describe the objectives, scope, timeframe, importance, and other characteristics of past and on-going scientific activities pertaining to major areas of inquiry, as well as information on existing facilities, collections, and data management systems. Authorities on the area's ecological resources are then requested to evaluate this material from a disciplinary perspective, with particular attention to identifying omissions, assessing the quality of the scientific work, and recommending actions for the bureau's consideration in developing the reserve's science program.

Once the disciplinary responses have been received, a workshop is held in which the perspectives of different disciplines are brought to bear on the preparation of a plan identifying the most important immediate and long-range needs for scientific information and the most cost-effective strategies for obtaining it. Improved use of the reserve as a scientific resource, through better integration of scientific activities in the reserve with other activities at the regional, national, and international levels, is a major objective. Upon completion of the effort, each reserve will have a comprehensive reference for use by scientists, resource managers, interpreters, and other specialists requiring background information on the status of the reserve's science program. The bureau will have authoritative support for obtaining the resources it needs to develop an integrated, multidisciplinary science program for each reserve.

This multipisciplinary approach is also being used in the completion of the United States' network of biosphere reserves. Under new selection procedures,^{37,38} future biosphere reserves will be nominated on the basis of a comprehensive review of a particular biogeographic province or coastal region by an ad hoc committee of scientists and resource managers convened for this purpose.

The committee's thorough familiarity with the physical and biological resources of the study region has proven invaluable in identifying candidate sites and the factors most appropriate to use in describing the sites to be evaluated against UNESCO selection criteria, as well as in reaching decisions on the number and boundaries of areas to be selected. Recent testing of selection procedures in the Austroriparian (southeastern forest) Biogeographic Province has shown that a well-informed committee can readily reach agreement on the subdivision of the study region, and the ecosystem types which should be represented. In this province, the committee identified 26 ecosystem types to be represented in the province's biosphere reserve system. It is expected that completion of the system in this presently unrepresented province will involve designation of five biosphere reserves, containing from 3 to 12 sites each, with many of the sites managed by different administrators.

Assuming that modest funding (about \$5,000 per selection area), from government or nongovernment sources, can be made available to support the work of the committees, it should be possible to review all 19 biogeographic provinces and 12 coastal regions in the United States and its territories within the next two or three years, and to substantially complete the U.S. system by 1984. Although it is difficult to predict the ultimate size of the U.S. system, it is clear that protection of a representative diversity of major biotic communities will require designation of multiple reserves in most, if not all, selection areas. In many cases, the individual reserves will themselves consist of two or more sites. A not-unreasonable average of three reserves per biogeographic province and one per coastal region would yield a total U.S. system of 69 units, or about twice the size of the present system.

Although conferences, workshops, and publications have all provided important direction for MAB-8, strategic integration of the various MAB projects

into an overall US-MAB program was accomplished through the publication of a national plan in November 1980. Prepared in response to a 1979 request from the Office of Management and Budget and the Office of Science and Technology Policy, the plan presents a coordinated strategy for utilizing MAB to deal with the growing global problems described in the "Global 2000 Report to the President,"³⁹ as well as other problems present at the national, regional, and local levels. The plan's \$6.6 million, two-year budget provides for initiation of 43 projects in 12 of MAB's 14 major fields of research. Significantly, the plan includes a budgetary increase from the present \$480,000 to \$1.5 million per year for the MAB Consortium, US-MAB's research institution, chartered in 1980, which annually awards grants to support multidisciplinary research projects--many of them collaborative with other nations, and all of them directed toward providing new perspectives on major environmental and ecosystem management problems.⁴⁰

Unfortunately, although the plan was favorably reviewed by OMB, funding relies on the positive response of MAB's 19 participating agencies, which have shown little inclination to take full advantage of MAB's multidisciplinary scientific capability in carrying out their sectorial missions. Funding to enable the program to continue operating even at the approximately \$1 million FY 1981 level is uncertain, and the outlook for a major expansion to carry out the strategic plan is notably dim. As the problems the plan addresses are not likely to diminish appreciably in the near future, the plan will remain current and suitable for implementation should the fiscal climate and agency perception of the desirability of using the MAB structure improve.

CONCLUSION

Next month, the Man and the Biosphere Program will mark its tenth anniversary with a major conference on the applications of ecology in developing a scientific basis for land management in a world increasingly dominated by

Homo sapiens. MAB's first decade has been witness to the rapid intensification of a growing array of interrelated ecological and socioeconomic problems which are progressively affecting the material and spiritual well-being of us all. MAB has not solved these problems, although it is now contributing significantly to addressing many of them, through the cooperative association of the 101 nations now participating in the program. The program is now an important force in encouraging interdisciplinary and international communication within the scientific community, and in encouraging communication between that community and those who stand to benefit from the wise use of scientific information. Through the network of biosphere reserves, it is also playing an important role in providing secure sites for conservation, long-term monitoring, and experimental research. Most importantly, it is becoming a major force in communicating and demonstrating the value of the ecosystem approach--which is the legacy of the IBP--and in putting it to work for the sustainable conservation of the biosphere and the progressive advancement of human civilization.

LITERATURE CITED

1. Blair, W. F. 1977. Big Biology - The US/IBP. Dowden, Hutchinson, and Ross, Inc. Stroudsburg, Pennsylvania.
2. International Union for Conservation of Nature and Natural Resources. 1980. World Conservation Strategy. Prepared in cooperation with UNEP and UNESCO. I.U.C.N., Gland, Switzerland.
3. Behrman, D. 1973. In Partnership with Nature - UNESCO and the Environment. UNESCO, Paris, France.
4. Darnell, R. M. 1976. Natural area preservation: the US/IBP Conservation of Ecosystems Program. *Bioscience* 26(2):
5. Behrman, D. 1973. In Partnership with Nature - UNESCO and the Environment. UNESCO, Paris, France.
6. UNESCO. 1968. Proceedings of the Intergovernmental Conference of Experts on the Scientific Basis for Rational Use and Conservation of the Resources of the Biosphere. Paris, France. September 4-13, 1968. UNESCO, Paris.
7. UNESCO. 1971. International Coordinating Council of the Programme on Man and the Biosphere, First Session. Paris, France. November 9-19, 1971. UNESCO Report Series No.1. UNESCO, Paris.
8. UNESCO, 1973. International Coordinating Council of the Programme on Man and the Biosphere, Second Session. Paris, France. April 10-19, 1973. UNESCO Report Series No.10. UNESCO, Paris.
9. Train, R. E. 1972. Report of the United States Delegation to the United Nations Conference on the Human Environment, Stockholm, Sweden. June 5-16, 1972. Submitted to the Secretary of State on June 20, 1972.
10. UNESCO, 1973. Programme on Man and the Biosphere (MAB), Expert Panel on Project 8: Conservation of natural areas and the genetic material they contain. Morges, Switzerland. September 25-27, 1973. UNESCO Report Series No.12. UNESCO, Paris.
11. International Union for Conservation of Nature and Natural Resources. 1974. Biotic provinces of the world. IUCN Occasional Paper No. 9. IUCN, Morges, Switzerland.
12. Udvardy, M. D. F. 1975. A classification of the biogeographical provinces of the world. IUCN Occasional Paper No.18. IUCN, Morges, Switzerland.
13. UNESCO. 1974. Programme on Man and the Biosphere (MAB), Task Force on: Criteria and Guidelines for the Choice and Establishment of Biosphere Reserves. Paris, France. May 22-24, 1974. UNESCO Report No.22. UNESCO, Paris.
14. U.S. Department of Agriculture, Forest Service. 1979. Selection, management, and utilization of biosphere reserves. Proceedings of the US-USSR Symposium on Biosphere Reserves. Moscow, USSR. May, 1976. U.S.D.A. Forest Service General Technical Report PNW-82.
15. Franklin, J. F. 1977. The biosphere reserve program in the United States. *Science* 195:262-7.

16. UNESCO. 1974. International Coordinating Council of the Programme on Man and the Biosphere (MAB), Third Session. Washington, D.C. September 17-29, 1974. MAB Report No.27. UNESCO, Paris.
17. UNESCO. 1975. International Coordinating Council of the Programme on Man and the Biosphere (MAB), Fourth Session. Paris, France. November 18-26, 1975. MAB Report No.38. UNESCO, Paris.
18. International Union for Conservation of Nature and Natural Resources. 1979. The biosphere reserve and its relationship to other protected areas. IUCN, Morges, Switzerland.
19. International Union for Conservation of Nature and Natural Resources. 1975. Minutes of the First Meeting of the Ecosystem Conservation Group. IUCN, Morges, Switzerland.
20. Gilbert, V. C. 1981. Personal communication with Dr. Lee Talbot, IUCN.
21. MAB CANADA. 1975. Guidelines for selecting biosphere reserves in Canada. Report No.6. Department of the Environment, Ottawa, Canada.
22. UNESCO. 1977. Workshop on biosphere reserves in the Mediterranean region: development of a conceptual basis and a plan for the establishment of a regional network. Side, Turkey. June 6-11, 1977. MAB Report No.45. UNESCO, Paris.
23. UNESCO. 1977. UNESCO regional workshop on techniques for selection of biosphere reserves, Australia and New Zealand. Published by the National Commissions for UNESCO of Australia and New Zealand.
24. Ray, G. Carleton, et al. 1981. Interim guidelines for identification and selection of coastal biosphere reserves. A report to the US-MAB Directorate on Biosphere Reserves (MAB-8). National Park Service, Office of Science and Technology, Washington, D.C. 20240.
25. Fernald, E. A., et al. 1981. Guidelines for identification, evaluation, and selection of biosphere reserves in the United States. United States Man and the Biosphere Program, Project 8 (Biosphere Reserves). National Park Service, Office of Science and Technology, Washington, D.C. 20240.
26. U.S. National Committee for MAB. 1976. Report of the first regional workshop on research and monitoring in U.S. biosphere reserves, Gatlinburg, Tennessee. November 3-5, 1976. Unpublished ms. U.S. National Committee for MAB, Department of State, Washington, D.C. 20520. 3pp.
27. U.S. National Committee for MAB. 1977. U.S. Man and the Biosphere: Pacific northwest biosphere reserve workshop. Corvallis, Oregon. May 12-14, 1977. Unpublished ms. U.S. National Committee for MAB, Department of State, Washington, D.C. 20520. 22pp.
28. U.S. National Committee for MAB. 1977. Southwest biosphere reserves workshop. Tucson, Arizona. March 30-April 2, 1977. Unpublished ms. U.S. National Committee for MAB, Department of State, Washington, D.C. 20520. 9pp.

29. U.S. National Committee for MAB. 1977. Biosphere reserve project: Rocky Mountain biosphere reserve workshop. Boulder, Colorado. November 16-18, 1977. Unpublished ms. U.S. National Committee for MAB, Department of State, Washington, D.C. 20520. 29pp.
30. U.S. National Committee for MAB. 1978. Pacific southwest biosphere reserve workshop. Santa Barbara, California. Unpublished ms. U.S. National Committee for MAB, Department of State, Washington, D.C. 20520.
31. Botkin, D.B., et al. 1977. Long-term ecological measurements: report of a conference: Woods Hole, Massachusetts. March 16-18, 1977. The National Science Foundation, Division of Environmental Biology, Washington, D.C. 26pp.
32. Botkin, D.B., et al. 1978. A pilot program for long-term observation and study of ecosystems in the United States: report of a second conference on long-term ecological measurements. Woods Hole, Massachusetts. February 6-10, 1978. The National Science Foundation, Division of Environmental Biology, Washington, D.C. 27pp.
33. U.S. National Committee for MAB. 1979. Long-term ecological monitoring in biosphere reserves. U.S. National Committee for MAB, Department of State, Washington, D.C. 20520. 31pp.
34. Wiersma, G.B., K.W. Brown, and A.B. Crockett. 1978. Development of a pollutant monitoring system for biosphere reserves and results of the Great Smoky Mountains pilot study. Pp. 451-456. In Proceedings of the Fourth Conference on Sensing of Environmental Pollutants. American Chemical Society, Washington, D.C.
35. Brown, Kenneth W. 1981. Pollutant Monitoring in the Olympic National Park Biosphere Reserve. Environmental Monitoring and Assessment 1(1):37-47.
36. U.S. Interagency Task Force on Tropical Forests. 1980. The world's tropical forests: a policy, strategy, and program for the United States. Department of State Publication #9117, International Organization and Conference Series 145. U.S. Government Printing Office, Washington, D.C. 20402. 53pp.
37. Ray, op. cit.
38. Fernald, op. cit.
39. U.S. National Committee for MAB. 1980. The U.S. Man and the Biosphere Program. U.S. National Committee for MAB, Department of State, Washington, D.C. 20520. 34pp.
40. U.S. National Committee for MAB. 1980. Charter for a Consortium for the Study of Man's Relationship with the Global Environment. Unpublished ms. U.S. National Committee for MAB, Department of State, Washington, D.C. 20520.