[COMMITTEE PRINT]

CREATION AND UTILIZATION OF A COORDINATED NETWORK OF ENVIRONMENTAL RESEARCH RESERVES

REPORT

PREPARED FOR THE

SUBCOMMITTEE ON THE ENVIRONMENT AND THE ATMOSPHERE

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

NINETY-FIFTH CONGRESS

SECOND SESSION

Serial W

FEBRUARY 1978

Printed for the use of the Committee on Science and Technology

---

U.S. GOVERNMENT PRINTING OFFICE

99-754 WASHINGTON : 1978

COMMITTEE ON SCIENCE AND TECHNOLOGY

OLIN E. TEAGUE, Texas, *Chairman*

DON FUQUA, Florida
WALTER FLOWERS, Alabama
ROBERT A. ROE, New Jersey
MIKE McCORMACK, Washington
GEORGE E. BROWN, Jr., California
DALE MILFORD, Texas
RAY THORNTON, Arkansas
JAMES H. SCHEUER, New York
RICHARD L. OTTINGER, New York
TOM HARKIN, Iowa
JIM LLOYD, California
JEROME A. AMBRO, New York
ROBERT (BOB) KRUEGER, Texas
MARILYN LLOYD, Tennessee
JAMES J. BLANCHARD, Michigan
TIMOTHY E. WIRTH, Colorado
STEPHEN L. NEAL, North Carolina
THOMAS J. DOWNEY, New York
DOUG WALGREN, Pennsylvania
RONNIE G. FLIPPO, Alabama
DAN GLICKMAN, Kansas
BOB GAMMAGE, Texas
ANTHONY C. BEILENSON, California
ALBERT GORE, Jr., Tennsesee
WES WATKINS, Oklahoma
ROBERT A. YOUNG, Missouri

JOHN W. WYDLER, Jr., New York
LARRY WINN, Jr., Kansas
LOUIS FREY, Jr., Florida
BARRY M. GOLDWATER, Jr., California
GARY. A MYERS, Pennsylvania
HAMILTON FISH, Jr., New York
MANUEL LUJAN, Jr., New Mexico
CARL D. PURSELL, Michigan
HAROLD C. HOLLENBECK, New Jersey
ELDON RUDD, Arizona
ROBERT K. DORNAN, California
ROBERT S. WALKER, Pennsylvania
EDWIN B. FORSYTHE, New Jersey

CHARLES A. MOSHER, *Executive Director*
HAROLD A. GOULD, *Deputy Director*
PHILIP B. YEAGER, *Counsel*
JAMES E. WILSON, *Technical Consultant*
WILLIAM G. WELLS, Jr., *Technical Consultant*
RALPH N. READ, *Technical Consultant*
ROBERT C. KETCHAM, *Counsel*
JOHN P. ANDELIN, Jr., *Science Consultant*
JAMES W. SPENSLEY, *Counsel*
REGINA A. DAVIS, *Chief Clerk*
PAUL A. VANDER MYDE, *Minority Staff Director*

SUBCOMMITTEE ON THE ENVIRONMENT AND THE ATMOSPHERE

GEORGE E. BROWN, Jr., California, *Chairman*

TIMOTHY E. WIRTH, Colorado
JEROME A. AMBRO, New York
DOUG WALGREN, Pennsylvania
JAMES H. SCHEUER, New York
ANTHONY C. BEILENSON, California
WES WATKINS, Oklahoma

ROBERT S. WALKER, Pennsylvania
MANUEL LUJAN, Jr., New Mexico
LARRY WINN, Jr., Kansas

JAMES W. SPENSLEY, *Staff Director*
JENNIFER CHRISTY, *Science Fellow*
ALEXIS HOSKINS, *Technical Consultant*

CONTENTS

LETTER OF TRANSMITTAL

House of Rrpresentatives,
Committee on Science and Technology,
Washington, D.C., February, 1978.

Hon. Olin E. Teague,
Chairman, Committee on Science and Technology, House of Representatives, Washington, D.C.

Dear Mr. Chairman: I am herewith transmitting the report "Creation and Utilization of a Coordinated Network of Environmental Research Reserves". Following in-depth hearings on existing and proposed environmental research reserves held by the Subcommittee on the Environment and the Atmosphere, a summary of the witnesses' statements, recommendations, and other materials was prepared by Maria H. Grimes, Analyst, Environment and Natural Resources Policy Division, Congressional Research Service, Library of Congress. The report is based on this summary, and also includes the subcommittee's findings and conclusions.

One of the most important findings is that although several different systems of research reserves have been proposed or established administratively, no method of organizing these distinct components into a comprehensive network of research reserves has been developed. In addition, the areas designated thus far have received no legislative protection, but are subject to the vagaries of the individual administering agencies.

In light of this situation, our subcommittee recommends the establishment of a coordinated network of environmental research reserves to link all the experimental and natural areas by common goals and administrative guidelines. Furthermore, we will continue to work toward inclusion of the goal of preservation of environmental research reserves in compatible legislation.

Mr. Chairman, I commend this stimulating report to you and the other Members.

Sincerely,

George E. Brown, Jr.,
Chairman, Subcommittee on the Environment and the Atmosphere.

Creation and Utilization of a Coordinated Network of Environmental Research Reserves

Subcommittee Findings and Recommendations

THE SUBCOMMITTEE RECOMMENDS THAT A NATIONAL COMPREHENSIVE NETWORK OF ENVIRONMENTAL RESEARCH RESERVES, INCLUDING BOTH NATURAL AND EXPERIMENTAL AREAS FOR ALL MAJOR ECOSYSTEMS, BE ESTABLISHED AND SUPPORTED.

The need for a coordinated and well-established network of environmental research reserves has been recognized by many scientists for a long time. The Department of the Interior and other agencies already have a network of Research Natural Areas—the national parks and forests, wilderness areas, wildlife refuges, et cetera. ERDA has administratively established four experimental research areas on lands surrounding its National Laboratories, called NERP's, which in some cases include natural areas as well. An international network of Biosphere Reserves (including both experimental and natural areas) has been established through the UNESCO-sponsored Man and the Biosphere Program. Most recently, the Federal Committee on Ecological Reserves (FCER) has recommended that an initial national network of Experimental Ecological Reserves be established which complements the existing Research Natural Areas. To date, however, no specific legislation to establish and support these networks has been proposed.

Thus far, as the examples listed above show, separate networks have been established or recommended, one consisting solely of natural areas (RNA's), one mainly of experimental reserves (EER's), and another of international Biosphere Reserves. (While some of the ERDA National Environmental Research Parks (NERP's) may include both types of site, there are too few sites involved in terms of coverage of the major U.S. ecosystems to consider the NERP's a true network.) Although these networks often contain both natural and experimental sites, there has been no proposal to link the sites of the different networks to form a single, all-inclusive (natural and experimental areas) network. Furthermore, the proliferation of diverse site management procedures and policies, both within and among the networks, has been encouraged. This situation is not conducive to the establishment of a systematic, thorough research program based upon standardized observational and experimental data.

The ideal network of environmental research reserves as envisioned by the subcommittee would include ecologically paired or clustered sites representing a continuum of research areas, ranging from natural areas which are to remain undisturbed, to experimental areas which are to be manipulated for scientific purposes.

At one end of the continuum would be the natural areas, in which only nonmanipulative research and monitoring would be allowed.

It is imperative to maintain and strictly protect these undisturbed and irreplaceable systems, since they are necessary as benchmarks or reference areas against which to measure the changes occurring in similar but disturbed ecosystems. The United States is a continuous mosaic of different biological areas and many of the lands held by the Department of the Interior are our best examples of undisturbed ecosystems.

It is also imperative that the network include experimental areas where manipulations of an ecosystem may take place. These manipulations can be in the form of selective sampling of the flora and fauna, addition of different elements to study the response of vegetation to increased nutrients, tracing the flow of heavy metals through the food web, or removing one species and watching the response of its competitors. These are examples of low-intensity research, since there is some manipulation of the habitat or its living components but the area, as a whole, remains intact.

The other end of the research continuum would be represented by high-intensity manipulated areas. Many studies can be conducted on lands which have been greatly disturbed; for example, studies of the reclamation of strip-mined land, the effects of adding heated water from a nuclear reactor to a swamp system or an estuary, and the impacts of clearcutting entire watersheds. Much can be learned by these highly manipulative experiments, both in basic research on how ecosystems respond to and recover from major impacts, and in an applied sense related to land use planning and management.

In order to incorporate as many of the scientifically valuable lands as possible, the network would be a consortium of lands owned by Federal and State governments, universities, and private holdings. However, the establishment of a network would not necessarily change or delete the authority of the local directors for management practices or affect ownership on a particular site.

The network should be managed so as to maximize cooperation among different sites, facilitate information transfer, and insure the protection and integrity of the sites for long-term experiments or monitoring. The main objective of the network is to protect these lands for future research. A land use review process should be built into the organization of the network so that before Government-owned lands could be declared excess and be designated for other uses, there would be a thorough review of their present and future scientific value.

Incorporated in the environmental research reserve network concept should be provisions for long-term monitoring and funding. A single monitoring system should be used by diverse agencies and scientists on the sites so that the data gathered at different sites can be compared. Also, long-term monitoring of basic parameters should be conducted systematically at all sites, in order to acquire a statistically significant body of data against which research results can be compared.

This "ideal" network could be created by linking the Research Natural Areas, Biosphere Reserves, and National Environmental Research Parks with the proposed Experimental Ecological Reserves. While the sites would be administered by the various owners, a single set of standards and policy guidelines for the network would be estab-

lished. To this end, a coordinating group or committee could be established at the national level which includes participating Federal agencies, both landholders and not, state, university and private site owners. One of the group's priorities would be to spur the creation of the EER network. Another would be to establish a standard baseline monitoring system for collecting long-term ecological measurements. In order to establish the EER's however, some form of administrative or legislative action is necessary. It is premature to determine whether the Federal agencies will take the initiative to designate the sites named in the report as Experimental Ecological Reserves. Similarly, the response of State, university and other private owners of proposed EER sites should be determined. However, if the managers or owners of proposed EER sites take no action or act unfavorably toward establishment of a network of EER's, the subcommittee recommends that the FCER's proposal be developed into legislation.

In any case, it is clear from the testimony received that the long-term support and protection of the sites of each of the four networks discussed is unsteady and subject to administrative whim. Therefore, the subcommittee recommends that funds be specifically allocated to the acquisition and support of environmental research reserves in the authorizing legislation of the participating agencies. In addition, a mechanism should be instituted whereby the national committee mentioned above would have to approve any change of site ownership or utilization before it could take place.

The subcommittee strongly supports the concept of protecting and preserving unique habitats and natural diversity, as envisioned by H.R. 6286 and the President's National Heritage Trust program, but recognizes that the Federal Government needs to be more farsighted than to preserve only the natural areas. For example, policy decisions in the future should be based upon a balance of data from both the "control" or natural areas and the experimental areas.

Therefore, the subcommittee recommends that the bill on the preservation of natural diversity (H.R. 6286) be expanded to include preservation of experimental areas. The Office of Nationwide Ecological Reserves, which the bill would establish, could be the centralized office for both natural and experimental areas. If the scope of the bill were enlarged in this manner, the Council on Environmental Quality might be a better "home" for an Office of Nationwide Ecological Reserves than the Department of Interior.

99-754—78——2

Witness List

July 28, 1977—ERDA: National Environmental Research Parks—

Dr. I. Lehr Brisbin, Savannah River Ecology Laboratory.

Dr. James Liverman, Assistant Administrator for Environment and Safety, U.S. Energy Research and Development Administration.

Dr. David Reichle, Environmental Sciences Division, Oak Ridge National Laboratory.

Dr. Burton E. Vaughan, Ecosystems Department, Battelle Memorial Institute, Pacific Northwest Laboratories.

Department of the Interior: Research Natural Areas—

Marcus E. Nelson, Chief, Division of Wildlife Refuges, U.S. Fish and Wildlife Service.

Dr. Theodore W. Sudia, Chief Scientist, National Park Service.

James W. Monroe, Assistant Director of Legislation, Bureau of Land Management.

July 29, 1977—Man and the Biosphere Program—Biosphere Reserves—

Vernon C. Gilbert, Associate Chief Scientist, National Park Service.

Dr. Stanley L. Krugman, Principal Research Forest Geneticist, USDA Forest Service.

Oscar J. Olson, Jr., Executive Director, Man and the Biosphere Progam, Department of State.

Experimental Ecological Reserves—

Dr. Eloise E. Clark, Assistant Director for Biological, Behavioral and Social Sciences, National Science Foundation.

Dr. John L. Brooks, Deputy Division Director, Division of Environmental Biology, National Science Foundation.

Dr. Paul D. Whitson, Staff Associate, Executive Secretary, Federal Committee on Ecological Reserves.

Dr. George H. Lauff, coproject manager, Experimental Ecological Reserves study, and director, W. K. Kellogg Biological Station, Michigan State University.

Overview—

Dr. Paul G. Risser, Oklahoma Biological Survey, University of Oklahoma.

Dr. Jerry F. Franklin, Forestry Sciences Laboratory, Corvallis, Oregon.

Dr. Lee M. Talbot, Assistant to the Chairman for International and Scientific Affairs, Council on Environmental Quality.

Chapter A: Introduction

1. *Background*

Historically, mankind has been dependent upon and inextricably linked to the environment. As man impinges upon the environment, this relationship becomes increasingly tenuous. Thus, it is essential to understand and predict how the environment responds to man's activities.

Ecology is the study of the relationship of living organisms—plants and animals—to each other and to their environment. The levels of biological organization which ecology deals with are characterized by increasing complexity and inclusiveness: the individual, the population (individuals of the same species), the community (a collection of various species), the ecosystem (a geographically distinct assemblage of interacting communities), and the biosphere (all organisms and their habitats).

Scientists recognize ecosystems as the smallest integral unit of nature, and therefore as the logical unit for study of perturbations within and between ecological systems. Thus, ecosystems represent a level of organization as significant for study as the cell or organ in the biological sciences and the neighborhood or institution in the social sciences.

Experimental ecological research is aimed at understanding the structure and function of the ecosystem as a whole. It involves both nonmanipulative research activities such as monitoring, and manipulative activities such as removal of a species.

Understanding the function of an ecosystem will depend upon having access to a wide variety of ecosystems, each with unique characteristics which determine their response to stresses. There is much to be learned before scientists' predictive capabilities will be adequate to assess the impact of perturbations on different ecosystems. Long range experiments must be designed and monitored carefully to give us the baseline data necessary in determining the ecological effects of man's activities on the many biologically different ecosystems found within the United States.

2. *Purpose of the hearings*

The Subcommittee on the Environment and the Atmosphere held hearings which were designed to explore existing and proposed networks of environmental research reserves. "Environmental research reserves" is a term used in this report to describe generally the concept of geographically and ecologically varied areas which either have been, or potentially could be, set aside for long-term research and/or experimentation in a broad range of disciplines. These research reserves ideally consist of two complementary and ecologically similar sites—one which is subjected to deliberate alterations and disturbances, and one to serve as a control or reference area. These sites might both be located in the same area (nested), be coterminous, or be entirely separate. This dual setup offers a unique resource for

understanding man's impact on a given ecosystem, and for planning and controling future utilization of varied environments in keeping with national social, economic, and environmental goals.

The four major specific examples of the environmental research reserve concept which either have been established or are proposed are the: National Environmental Research Parks (NERP's); Research Natural Areas (RNA's); Biosphere Reserves of the Man and the Biosphere (MAB) program; and Experimental Ecological Reserves (EER's).

The purpose of the hearing was to obtain information on existing and proposed environmental research reserves, and on the feasibility of integrating them in a coordinated national network that would represent all major and/or unique ecosystems in the United States. Information was sought on the advantages and drawbacks of such national system, on the steps required in establishing it, research activities likely to be carried out within it, and legislative action that may be needed to achieve, protect, and support the system to permit its programs to carried out in a systematic, productive and continuous fashion.

3. Organization of the report

This chapter (A) provides an introduction to the subject of environmental research reserves and the scope of the hearings. The remaining chapters are organized according to the various issues which the witnesses were invited to address, as follows:

Chapter B. Description of research areas and networks

The purposes for which they have been established; their status in terms of long-range management, support, protection, and comprehensive utilization; and, if applicable, their position within a coordinated research framework.

Chapter C. Policy considerations

Advantages and drawbacks of existing networks of research sites; proposals for broad, coordinated research reserve networks; opportunities for establishing a complete nationwide system; and obstacles which may prevent the creation, maintenance or effective utilization of such a system.

Chapter D. Similar activities

Initiatives or programs whose goals are compatible to inclusion of research reserves.

Chapter E. Program gaps

Ecosystems currently not represented or available for research but needed to complement long-term investigations; information exchange systems; and coordinated, mutually comparable monitoring and data collection systems.

Chapter F. Legislative needs

Integration of existing research sites into a comprehensive national system; and the selection, establishment, long-term protection, support, and utilization of appropriate sites, both existing and new, that will complete the chain.

Chapter G. Witness recommendations

A summary of the witnesses' major recommendations.

Chapter B: Description of Research Areas and Networks

The witnesses discussed four examples of environmental research reserves, touching upon their status at present in terms of existing research, ownership, and long-term protection, as well as on the potential of and need for incorporating such reserves into a nationwide network. The four systems are described in the following order: (1) Research Natural Areas, (2) Experimental Ecological Reserves, (3) National Environmental Research Parks, and (4) Biosphere Reserves.

All four reserve systems appeared to be similar in their intent, namely, to preserve areas representing a broad spectrum of U.S. ecosystems. Each of these sites are expected to provide areas in which research and experiments can be conducted to assess the impact and consequences of manmade disturbances, and/or control areas which are preserved in their natural condition and against which findings from the impacted areas can be measured, monitored and analyzed.

Various uncoordinated efforts were made in the past to create ecological reserves, including the designation of Research Natural Areas on Federal land controlled by various agencies, experimental forests and ranges by the U.S. Department of Agriculture, and biome research sites in the International Biological Program. In 1974, a report by an interagency committee on ecological research entitled "The Role Of Ecology in the Federal Government" specifically recommended completion of the national systems of natural and experimental areas. In order to carry out both of these recommendations, the Federal Committee on Ecological Reserves (FCER) was established jointly by the Council on Environmental Quality (CEQ) and the National Science Foundation (NSF) as a successor to the Federal Committee on Research Natural Areas. The committee has 21 members representing interested public and private institutions. One of the committee's main objectives is to establish and maintain a national system of sites reserved primarily or exclusively for research and education on ecological and environmental problems. This system includes undisturbed Research Natural Areas (RNA's) which are established to preserve a certain ecosystem or environmental feature and to serve as controls; and experimental ecological areas which are used for experiments or manipulative management practices. The Experimental Ecological Reserves (EER's) are subsets of these areas, and complement the RNA's.

1. Research Natural Areas (RNA's)

The Federal Committee on Ecological Reserves defines RNA's as "conservation reserves to protect unique and natural ecological features for scientific *reference*" to distinguish them from NERP's and EER's, on which experiments are actually conducted.

The main objectives of establishing a comprehensive RNA network are to preserve areas representative of significant natural ecosystems as baseline or reference areas, and to obtain, mainly through observational, nondestructive research, information about these systems. Both

objectives serve ultimately to provide the basis for comparison between undisturbed areas and areas manipulated by either scientists or mankind.

The RNA system has been under development by the Federal land management agencies since 1927 and consists, to date, of 389 areas covering 4.4 million acres in 46 States and 1 territory. Each of these areas is managed by one of eight cooperating agencies, including the Bureau of Land Management (BLM), the Fish and Wildlife Service (FWS), and the National Park Service (NPS) of the Department of Interior. Consequently, representatives of these three agencies testified with regard to Research Natural Areas.

FWS: 181 RNA's are located within the National Wildlife Refuge System administered by the U.S. Fish and Wildlife Service. An RNA selected by the FWS, Mr. Nelson stated, would be a site where natural processes are allowed to predominate, and where only nondestructive research would be allowed. It might include typical or unusual flora, fauna, and terrestrial and aquatic features and processes. The size of the area is determined by the ecosystem it represents.

NPS: The National Park Service, according to Mr. Sudia, considers that its entire system of parks, monuments and recreation areas "serves as a network of research reserves which are protected in perpetuity . . ." The system is used by Service as well as non-service investigators for research aimed at resource preservation and management, such as ecology, geology, vegetation, and various other topics. The Organic Act of August 25, 1916 establishing the National Park Service, is interpreted by the Service to mean preservation of the parks in their natural condition, and maintenance of the natural ecosystem processes. A large number of research projects in the parks are supported by outside funds.

BLM: The Bureau of Land Management has designated 19 Research Natural Areas in order to preserve areas worthy of scientific research within the 470 million acres of public lands it manages. On other lands, BLM has set up environmental research reserves, closed to intrusion by livestock, to provide baseline monitoring and permit comparisons with areas in which varied types of cattle raising are practiced.

RNA's are not designed to serve the mission objectives of only one agency; therefore, they are usable for collaborative projects involving several Government agencies, universities and other public and private institutions.

As present, each agency follows its own procedures for the selection, classification, use, administration and management of the RNA's it controls. However, in an attempt to provide uniformity to these procedures, the FCER is encouraging the agencies to adopt the standards and policy guidelines developed for RNA's which are attached to its publication entitled "A Directory of Research Natural Areas on Federal Lands of the United States of America."

2. Experimental ecological reserves (EER's)

An EER is defined as a field site which represents a natural ecosystem and which is committed to long-term, manipulative research. EER's are intended to complement Research Natural Areas in the research reserve system by providing continuous detailed information

on the responses of ecosystems to various perturbations and management strategies. As Dr. Risser pointed out, this information, when compared to the information collected at the control sites, is expected to lead to the detection of subtle changes in natural systems before the overt and often irreversible changes occur.

Dr. Talbot revealed that the concept of a cooperative national network of ecological reserves, largely intended to protect representative portions of the Nation's ecosystems, was discussed as early as the 1950's. Another aspect of a cooperative network which has been a subject of much concern in the past is that it would provide a mechanism to coordinate management of the sites as well as of the research planned at them. However, no such network has yet been established.

Most recently, the National Science Foundation sponsored an intensive study by The Institute of Ecology (TIE) entitled "Experimental Ecological Reserves—A Proposed National Network". The report identifies an initial EER network of 71 sites at 67 locations, representing one-half of the ecosystems in the United States. These sites were selected from an inventory of existing sites based upon various criteria discussed below, including size, representativeness, extent and quality of the research history, and proximity of a control area (such as an RNA). (In fact, some EER's are "self-contained" ecosystem reserves, since they contain natural, control areas.)

The sites ultimately selected for EER's were representative of the major U.S. ecosystems, and in most cases possessed a significant amount of biological diversity. Selection of representative ecosystems was made on the basis of a natural vegetation classification system published in 1964 by A. W. Kuchler, and additional criteria were developed for inland waters, the Great Lakes, marine, and coastal systems.

The process of establishing and administering the EER's is being carried out under the aegis of the Federal Committee on Ecological Reserves (FCER). The only financial support available at present to candidate EER's is in the form of small grants through the National Science Foundation. Beyond this, no other major action to establish the proposed EER's has been taken.

3. National Environmental Research Parks (NERP's)

NERP's are outdoor environmental laboratories sponsored by and located at sites owned by the Energy Research and Development Administration (ERDA) which were inherited from the Atomic Energy Commission (AEC). Since the sites were acquired in the 1940's and 1950's for nuclear research laboratories and production plants, large buffer zones surrounding these facilities were required for safety and security purposes.

Large portions of these nuclear energy sites, protected from public intrusion, were left in their natural state (or allowed to revert back to it) for up to 30 years. During that time, environmental research and monitoring programs conducted in tandem with the nuclear research resulted in a substantial amount of information.

In the late 1960's, AEC scientists suggested setting aside portions of these sites as reference ecological areas and as protected outdoor laboratories on which long-term experiments could be carried out.

99–754—78——3

In fact, on the Hanford Reservation in Washington, the Arid Lands Ecology reserve became a prototype by being set aside for ecological research in 1967, and by later being designated as a Research Natural Area. Thus, Dr. Liverman explained, since 1972, 4 NERP's totaling 1 million acres have been established by administrative decisions to carry out the following general objectives:

(1) To develop methods to continuously monitor and assess the environmental impact of man's activities; (2) to develop methods to estimate and predict the environmental response to proposed and ongoing activities to minimize adverse impacts; and (3) to serve as demonstration areas to fully inform the public of the various environmental and land use options open to them.

While NERP's could essentially be considered synonymous with EER's in terms of serving as experimental, manipulated sites, they sometimes also include natural areas set aside for purely observational research (such as the Arid Lands Ecology reserve on the Hanford NERP).

4. Biosphere Reserves (Man and the Biosphere (MAB) program)

MAB is a UNESCO program of environmental research and education designed to provide solutions to manmade environmental impacts on the biosphere to decisionmakers and resource managers. With the participation of 82 countries, 14 specific tasks or project areas have been selected. In particular, MAB's Project 8, which is an effort to establish a global network of Biosphere Reserves, was described as particularly pertinent to the purpose of the hearings.

The three broad objectives for establishing Biosphere Reserves are: Conservation and protection of the diversity and integrity of the natural flora and fauna; provision of managed and experimental segments within and near the reserves to be used for research—insofar as is consistent with the first objective; and provision of facilities for education and training. Specific objectives include the maintenance of long-term records of change and the provision of baseline information related to the structure and function of ecosystems.

One criterion for selecting Biosphere Reserves is that both natural and experimental areas of the same ecosystem type must be represented. This choice of complementary areas in close proximity is called "pairing" or "clustering". An example of this is the pairing of the Coweeta Experimental Forest with the nearby Great Smoky Mountain National Park (both have been selected as Biosphere Reserves).

When an area has been selected for designation as a Biosphere Reserve by a country, a recommendation to this effect must first be submitted to the MAB National Secretariat, and, if approved, forwarded to the UNESCO headquarters in Paris, France. Thus far, UNESCO officially recognizes a total of 118 Biosphere Reserves throughout the world, 28 of which are located in the United States.

Chapter C. Policy Considerations

When discussing the feasibility, desirability and utility of a national network of ecological research sites, witnesses focused on three major elements that they considered particularly important in assessing the performance and adequacy of existing sites, and in determining whether and where additional sites should be established. These elements were:

1. The process of designating sites—criteria for their selection, internal policies of the establishing agencies, comprehensiveness of present and future programs to be carried out on a given site;
2. Utilization of the land—the uses to which pristine and manipulated areas are being put, and whether the research potential of each site is being fully utilized;
3. Management of the reserves—administrative authority, protection and maintenance of the sites, budgets, interagency coordination, and policies governing the selection of individual research and educational projects.

1. Designation

The process of selecting and designating appropriate ecological research sites appears to depend, in large measure, on the general mandated goals of an agency when a single Federal institution is the sponsor of the site, or, whenever several institutions select and administer a research site together, on objectives they have agreed on jointly.

Dr. Brisbin commented that a NERP research site need not be an undisturbed natural beauty spot, but rather represent a classic example of a disturbance and its environmental impact. For example, the Savannah River Plant near Aiken, S.C. (the first NERP designated) includes several nuclear production facilities and radioactive waste storage areas. For more than two decades, these reactor facilities have released heat and occasionally radioactive materials into the water courses that drain through a swamp into the Savannah River. Studies performed at this site have explored the mechanism whereby the 30 square mile band of cypress swamp apparently acts as a heat exchanger and radionuclide filter which cleans and cools the nuclear effluents before they drain into the Savannah River. The studies have demonstrated that a natural system of adequate size can cleanse and cool nuclear effluent using only sunlight energy (but not without significant changes to the natural system).

In a similar vein, Dr. Liverman emphasized that establishment of new environmental research parks should be closely tied to major anticipated manmade environmental disturbances. For example, in order to insure that the impact of large-scale surface mining is assessed, a new research park should be established in the area when the mine is first opened and should include disrupted as well as undisturbed areas.

Dr Liverman described an ideal NERP site as one that is likely to be exposed to only the most essential disturbances over the long term, and even such disturbances would be controllable. At the same time, uncontrolled disturbances would be monitored to determine their impact so that decisions on prevention of future degradation could be made. To accomplish these purposes, he continued, a research area must be large enough to have controlled natural, undisturbed sites protected from any external impact. In addition, several identical sites in the same general area, which are subjected to various kinds of stresses resulting from man's activities, are needed for comparison purposes.

Dr. Reichle recommended adoption of the criteria for site selection used recently by task forces of The Institute of Ecology (TIE). According to TIE's document "Experimental Ecological Reserves", in which this procedure was discussed, selection of sites for an initial national EER network started with an inventory of existing Federal, State, university, and private sites "which now encourage or have potential for long-term experimental ecological research." Descriptions were obtained of the sites' environment and natural resources, the type and quality of research projects carried out, and available physical facillties and technical support. Next, these sites were evaluated according the following criteria: Site quality—including how well a site represents a major ecosystem type, size, and presence of control areas; research history—the quality and quantity of the available data base and of the current research activities; logistics and support; and other benefits such as training programs. Site quality was given the greatest weighting (50 percent).

2. Utilization

All witnesses generally agreed that a network of ecological research sites would be less than useful unless each site's research potential is fully developed. Although the type of research project must necessarily vary with the characteristics of a given area and with the goals of the institution administering it, witnesses said that sites selected to remain undisturbed (RNA's) should be used chiefly for observation and for baseline monitoring.

On the other hand, experimental and already disturbed sites (such as NERP's) should be made available for manipulations and perturbations to the degree that the characteristics of the areas allow, in order to determine the mechanisms of an ecosystem's response to manmade stresses. Data derived from both types of sites should then be usable to predict changes arising from certain types of activities, and recommend early preventive measures.

The witnesses emphasized that careful land use p'anning for both types of site is essential to insure the success of a comprehensive, long-range program. Projects must be coordinated carefully to insure inclusion of all important elements. The investigation of drastic changes anticipated to arise from major disturbances and requiring adjustments by humans should become an integral part of all projects performed on the experimental sites.

Comprehensiveness of research, according to Dr. Reichle, also means inclusion of studies which track a system's response to chronic, low-level pollution or other anthropogenic stresses; provide information on potential environmental problems; and evaluate the present

nationwide status of the health of the various ecological systems so that projections of future trends may be based on an understanding of past changes in the biotic environment.

A different aspect of site utilization was discussed by Dr. Whitson. He felt that no amount of research activities performed on a site would be adequate unless a detailed, comprehensive and up-to-date data bank containing information on these projects is made available for use by all interested Government agencies and by the private sector as well. This arrangement would ensure that the results of the research are incorporated in the decisionmaking process of these institutions.

The benefits of a precisely calibrated site were pointed out by Dr. Reichle. For example, utilization of the Oak Ridge Walker Branch watershed located within the TVA system is so carefully planned at all times that it serves, in Dr. Reichle's view, "as one of the most detailed environmental reference systems (ever devised) for the transport and fate of pollutants generated by fossil fuels and resulting acid precipitation." It has generated cooperative programs in a number of agencies interested in the various elements of this problem.

Lest utilization of an experimental site become too strongly identified with conservation, Dr. Brooks underscored the importance of experimental manipulation of the land to establish "a scientific basis for decisions on conservation and preservation activities and practices." He cited the biome projects of the International Biological Program, which are designed to accomplish this purpose, as useful examples.

Scientists' attitudes sometimes prevent the full utilization of a site, according to Dr. Franklin. He pointed out that scientists tend to object to using existing sites, and instead try to set up entirely new systems whenever their research objectives change even though the new projects can frequently be carried out within the systems that are already available. However, Dr. Franklin also said that allowances must be made for the fact that interests and objectives governing the use of dual-site (manipulated and nonmanipulated sites) systems are not equivalent even though they are very closely related. Hence, projects on each site represent individual and distinctive components.

Finally, Dr. Talbot emphasized the importance of using environmental research sites to identify and understand human needs arising from anticipated manmade disturbances. For example, genetic data required to help humans adapt to sometimes radical, environmental changes should be gathered and incorporated into the research program.

3. Management

Many witnesses agreed that a comprehensive national network of ecological research areas would represent the most efficient administrative mechanism to ensure systematic site acquisition, protection and utilization of representatives of the major U.S. ecosystems.

In this context, most of the testimony addressed the following administrative elements: acquisition of suitable sites; their protection and maintenance; funding; and interagency and interinstitutional coordination and cooperation.

(a) Acquisition and administration

Dr. Reichle underscored the urgency in securing suitable research sites that represent important ecological systems, since these are

rapidly disappearing. A national network would permit effective coordination of efforts to accomplish this purpose, insuring that the main goals for which the sites are being established and maintained are achieved; namely, early identification of critical environmental issues, and an equally early initiation of investigations.

Acquisition of land for research reserves is dependent to a large degree on the status of the ownership of the land. For example, the initial EER network which was ultimately proposed includes sites located in 28 States, Puerto Rico, and the Virgin Islands. Approximately 90 percent of the areas are owned and operated by Federal agencies, of which 65 percent are owned by ERDA and 14 percent by the U.S. Forest Service. Of the remaining areas, 7.4 percent are university owned and 2.5 percent are in private hands. While these privately owned sites are limited in size, they are considered disproportionately important because of their location and the ecosystems they represent.

Dr. Vaughan advocated ownership and management of each site in a network by a single agency to minimize interference by institutions pursuing conflicting goals. He described the problem of encroachment by other governmental agencies on the Hanford Reserve, one of the four existing NERP's: Bonneville Power Administration requested the transfer of a strip of land for power lines to its jurisdiction, which meant cutting through the only bitter sage brush stand within the Hanford reserve. Opposition to this request on grounds of the need to preserve a unique ecological feature was difficult since "a cost/benefit argument for detouring a powerline reckoned against 100 out of 77,000 acres in our 15-year research cost just does not hold water . . .". ERDA was also prevailed upon by GSA to relinquish control over land on the Hanford NERP that had hitherto been used as a buffer zone. This area was subsequently turned over to State and local agencies for recreational use, and motorized vehicles were permitted on it. This change in usage threatened the natural characteristics of the rest of the reserve until permission to use the land for recreational vehicles was finally withdrawn.

Other ownership problems of this nature which remain unsolved involve unused easements and mineral rights on the land despite the fact that ERDA, a single Federal agency, owns the site. Dr. Vaughan called attention to this "nibbling away" process which must and can be solved, in his view, by a uniform national strategy for the administration and preservation of ecological sites.

In contrast, Dr. Franklin urged that sites in a nationally managed network be selected in neutral locations as often as possible, and not be controlled and managed by single agencies. He said that programs at the State level particularly bog down because of interference by special interests.

Asked about differences in land management that might exist between ERDA-administered and National Park Service administered areas, Dr. Sudia said they they were largely qualitative: since the missions of the two agencies differ, management of their respective sites differs. In ERDA's case, the management of the NERP's reflects its preoccupation with specific research on nuclear technology, while assessments of the consequences on the environment of using such technology are of secondary concern. The basic mission of the Park Service, on the other hand, is to preserve large areas for recreation,

and prevent degradation of natural areas. As a result, the Park Service views itself mainly as a land manager, permitting the general public to use the lands for whatever projects it wishes, provided they are consistent with the purpose for which an area is being maintained and protected.

Dr. Talbot of CEQ summarized the discussion by underscoring CEQ's and the President's interest in a comprehensive effort to safeguard ecologically important sites and make them available for research. He felt that sufficient single research programs were available to make a comprehensive network possible if they were all incorporated in it, and that the managers of the individual agencies which operate existing sites are beginning to favor a national network of ecological sites.

(*b*) *Protection*

The witnesses agreed that the research systems, including control areas, must be protected against encroachment and interference for many years, if not in perpetuity, so that long-term experiments may be conducted undisturbed, and so that representative ecosystems are preserved. Long-term protection of these sites was considered one of the most important, if not the most important, aspects of ecological site management by all witnesses. One reason given was that keeping a site intact both in size and in quality for indefinite periods of time was essential if ongoing and future research is to yield useful results which can be applied to national policy formulation. Sites in the system must also remain available for reexamination, if this is warranted at a future date.

Dr. Brisbin proposed that a mechanism be devised to restore lands previously appropriated by other agencies to sites which are at least partly protected under regulations established by the controlling agency. In addition, protection of manipulated areas should include the purposeful integration of new developments or other changes into the overall research and monitoring plan for that area.

From an administrative standpoint, in Dr. Liverman's view, environmental research site protection should include governmental regulations that would prevent an agency administrator or secretary from discontinuing a research site because of a change in agency policy. Similarly, regulations should be established to permit surplus Government-owned land to first be considered for use as a potential research site before GSA is permitted to dispose of it.

Short-term protection of the sites, an integral part of an overall planning program, should include, according to Dr. Vaughan, surveillance programs—preferably aerial surveillance, buffer zones, and appropriate fire control, since techniques used in firefighting seldom are compatible with ecological considerations. In addition, he proposed that use of a site be controlled and access permitted only for "bona fide scientific purposes."

On the other hand, Mr. Nelson's view was that governmental designation of a wilderness area constitutes adequate protection because of the "normally . . . unobstrusive character or isolated location of . . . research natural areas," but that "research on these areas must be nondestructive and reasonably consistent with the purpose and character of the surrounding land." Federal requirements for the protection of sites were also endorsed by Dr. Sudia, who thought

that the safeguards afforded the national parks by the Organic Act of 1916, which requires that parks remain "unimpaired for future generations", were adequate. Since only a very small percentage of the total area of a park is used by the public, he pointed out that it is possible to conduct comprehensive ecological studies on large untouched tracts of land while keeping the park open to visitors as well.

(*c*) *Funding*

There seemed to be general agreement that many of the agencies and institutions administering ecological research sites experienced problems related to dependable, long-term funding. The witnesses said that a continuous source of funds is needed for the acquisition of new sites, for operation and maintenance, and for the conduct, coordination, and monitoring of long-term research projects. A guaranteed realistic budget over a prolonged period of time was also viewed as an effective deterrent to attempts at expropriation or sale of segments of established sites, or to efforts to change the character and utilization of a research site. While the entire operational budget need not come from the Federal Government, witnesses felt that, since funds from private institutions or State and local governments could not be relied upon to be available regularly, a continuous, adequate Federal commitment is essential if a viable national network of sites is to be established, administered, preserved and monitored, and options for future land acquisitions are to be retained.

Dr. Reichle said that numerous agencies and organizations had difficulties in justifying a firm line item in their budgets for funds to support ecological sites. This may be, as Dr. Vaughan pointed out, because some activities associated with certain projects may appear "very frivolous . . . to the uninformed taxpayer, the biomedical scientist or to the engineer concerned with technology," although they do produce the data needed to judge long-term ecological impact. As a result, Dr. Vaughan doubted that some of the programs with which he has been associated in the Pacific Northwest Laboratory at Hanford will be completed.

On the other hand, the National Park system, Dr. Sudia reported, claims that many active research programs in "some 80 or 90 parks" are supported almost entirely by outside funding because of the assurance, provided in the system's enabling legislation, that the research sites would always be available for continued monitoring. Another way to share expenses was described by Mr. Olson as applicable to the MAB program. For management purposes, the State Department provides basic administrative support, but other agencies interested in the program contribute by detailing professional program coordinators to the committee. The research budget of the MAB program, however, still appeared to be in the discussion stage, especially within the Department of the Interior, which is under consideration as the lead agency.

(*d*) *Interagency coordination*

The witnesses generally agreed that a comprehensive network of national ecological sites could be established and operated efficiently only if there was systematic, long-term coordination and cooperation among the participating agencies and organizations, be they governmental or private. They also agreed that it was important to establish

a definite system for research projects and for the management of each site that not only would be coordinated with the network as a whole, but would pool information on lands reserved for a specific use, thus preventing duplication of effort as well as encroachment by other agencies.

The testimony indicated that, by and large, voluntary cooperation among institutions was good. Individual agencies appeared to have few problems in ensuring that visiting scientists also respected the intended use to which land on a specific site was to be put. Periodic pressures were exerted by State and local jurisdictions to use reserved lands for other purposes, but had only on occasion resulted in expropriation of boundary areas. However, several witnesses felt that the limits of voluntary cooperation and coordination among the various institutions and agencies involved had been reached, and that a more formal framework governing the establishment and use of a national network was now in order. According to Dr. Reichle, cooperation may be complicated

> . . . by the very dispersion of environmental interests and responsibilities across a number of agencies. Sometimes the seeming unwillingness to cooperate is more a problem of identifying who really has the responsibilities.

Dr. Sudia pointed out that the present inadequate pooling of information among agencies may be due to the differences in their basic missions. Research in the national parks may emphasize an understanding of basic existing ecosystem processes while wildlife management is concerned with wildlife enhancement research. Nevertheless, the actual activities are "quite similar and quite compatible."

MAB fosters linkages between "diverse groups working in some common format," according to Dr. Krugman. The program is not limited by congressional or executive constraints, as mission-oriented agencies seem to be when sharing their resources and information, but can freely bring together agency and nonagency personnel, the academic community, the States and the private sector. MAB uses regional workshops to formulate research priorities and goals for each region of the country. This medium lends itself to the coordination of the diverse interests of each cooperating institution for all types of projects, for it addresses the different philosophies, policies and legal aspects of each participant when attempting to work out a method for the pursuit of a given project with which all institutions involved can agree.

Dr. Brooks solicited greater State participation and explained that the Federal Committee on Ecological Reserves (FCER) was keeping State and local governments informed of its activities. Dr. Whitson added that the committee was assuming leadership—

> . . . in developing the structures for coordinating Federal activities with those of States and local governments, academic groups and private organizations concerned with scientific reserves and experimental areas.

He acknowledged that time consumed in obtaining approval for a project from some 20 agencies presented a problem, but that the process could also be interpreted as "a more conservative approach to a very positive end." Overall, as Dr. Risser summarized it, the FCER is providing liaison for a "voluntary effort among agencies to define what, in fact, constitutes a Research Natural Area."

Chapter D. Similar Activities

At the time of the hearings, some initiatives had been proposed whose goals were potentially compatible with those of an environmental research reserve network.

One recent proposal mentioned several times during the hearings was the National Heritage Trust Program. This proposal, included in President Carter's environmental message of May 23, 1977, directs the Secretary of the Interior to develop a National Heritage Trust Program to "protect our natural and cultural heritage." The program is to include "measures to identify, acquire and protect these resources; to provide for rapid acquisition of the most significant and endangered areas and examples of natural ecosystems; to protect areas already within Federal jurisdictions; and to coordinate Federal programs with States and private citizens more effectively." Dr. Talbot of CEQ said he understood that the program would include a Research Natural Area system or a broader ecological research system.

The Secretary of the Interior assembled a task force in response to the President's request. The task force was to develop a proposal for a National Heritage Trust by September 20, 1977, which would assure the protection of places with special natural, historical, cultural, and scientific value. At the time of the hearings, the four teams—natural resources, cultural resources, information systems, protective methods—had prepared an initial classification of natural and cultural resources, identified the appropriate alternative types of information systems, and identified the categories of protective tools that would be required in a National Heritage Trust proposal. In January, 1978, the Heritage Conservation and Recreation Service was created in the Department of Interior by merging most of the functions of the former DOI Bureau of Outdoor Recreation and the Historic Preservation and Natural Landmark programs of the National Park Service. In addition, the goals of the Natural Heritage Trust were incorporated into this new Service under the Natural Heritage Preservation program.

The need for action was recognized by others in the legislative branch. A bill for the protection of natural diversity, H.R. 6286, was introduced by Mr. Sebelius and Mr. Burton and referred to the Interior and Insular Affairs Committee. On August 2, 1977, the Subcommittee on Parks held a hearing on this bill. The thrust of the bill is to preserve unique habitats, representative ecosystems and geologic land forms, and the flora and fauna which is supported in these natural areas. The bill also establishes an Office of Nationwide Ecological Reserves in the Department of the Interior, the functions of which would include the following: (1) the development and administration of a comprehensive data inventory, storage and retrieval system; (2) the development and administration of a nationwide registry of ecological reserves; (3) the administration of a funding program; and (4) the coordination with related interests at the international level to advance the preservation of natural diversity on a global scale.

Chapter E. Program Gaps

The most frequently mentioned gaps in existing programs were: an insufficient number of sites—resulting in an inadequate coverage of representative ecosystems, missed opportunities for new land acquisitions which would permit the timely establishment of a comprehensive national system, and a lack of authority to completely protect existing reserves in order to safeguard their characteristics and full utilizations. Gaps in reliable funding, and the absence of national regulations which prevent the effective execution of a comprehensive research program, were also cited frequently.

Dr. Reichle summed up a number of inadequacies by saying that

> . . . the ecological sciences do not presently have calibrated environmental laboratories equivalent to those of the physical and atmospheric sciences.

He said that NERP'S, for example, could be viewed at present only as the beginning of a comprehensive system, the forerunner of a national EER network as envisioned by the Federal Committee on Ecological Reserves. For example, the Appalachian coal fields are near NERP sites, but are inaccessible for long-term research or for experimental projects which attempt to restore strip-mined lands because ERDA lacks the authority to examine activities carried out in the private sector.

Apparently, according to Dr. Liverman, there also is no mechanism at present in ERDA's administrative procedures that would require excess or surplus lands under the agency's control to be first reviewed for potential use as NERP sites before they are released for sale.

Dr. Lauff stated that there is no comprehensive classification of ecosystems in the United States ". . . that enables classification, aggregation, and analysis of data into larger and larger natural units." As a result, he claimed that roughly 25 percent of the country's ecosystems are not effectively covered, resulting in a conspicuous lack of EER's in the north central and south central regions of the U.S. In addition, there is little information on and coverage of aquatic ecosystems, including the Great Lakes, major river systems, ano the coastal marine environments. Areas modified as a result of man's activities, although they are becoming increasingly important, also are inadequately researched, Dr. Lauff said. Dr. Franklin added that, when identifying gaps in the coverage of the natural systems, non-Federal lands in particular merit consideration, because these lands are neither adequately supported nor properly monitored.

Dr. Risser said that gaps also exist in effective support of research reserves, especially if they are to function as a network. While the sites are individually funded to some degree, their support is directed at different goals and missions. Overall support is needed to develop long-term data bases, which are difficult to justify in an annual budget request. Obtaining such support is aggravated by the communications gap: not enough information is being provided to the general public on the value of the programs conducted on the research sites and their use in planning, with the result that public support for the sites and the research conducted on them is poor.

Chapter F. Legislative Needs

Testimony dealing with the legislative aspects of proposals to create a coordinated network of research sites addressed three major legislative objectives: protection, support, and enhancement of the sites. Thus, the witnesses focused not only on the need for additional authority and support to preserve and protect existing selected ecosystems, but also on the need for a mandate to establish and maintain a comprehensive network of areas that would permit preservation of natural ecosystems as well as deliberatc, experimental manipulation of given sites. In elaborating on these objectives, the majority of the witnesses favored specific legislation concentrated on the following elements: prevention of encroachment on selected land areas; earmarking of sites for scientific research; augmentation of the number of sites to form a comprehensive and coordinated network; free access to sites and resources for all user groups; a formal mechanism for the establishment, protection and monitoring of EER's (that is, standard policy guidelines); an identified funding base; and a mechanism for cooperation among participating agencies and organizations.

Dr. Liverman said that since large federally owned areas are always subject to encroachment by other agencies and private interests, it would be simpler if a formal mechanism existed to prevent such attempts. Such legislation could be patterned after ERDA's NERP system to insure a capability for gathering of data which are essential for predicting and evaluating environmental changes.

In addition to specific funding and measures to assure continuation of EER's once they have been designated, Dr. Reichle proposed reconsideration of establishing nonprofit laboratories for environmental research, to be developed in conjunction with EER's, as conceptualized in H.R. 35 (94th Congress) and H.R. 6379 (95th Congress).

Dr. Lauff urged that mandatory requirements to augment, support and protect EER's be established as soon as possible while additional lands are still available, so that options for their future use need not be curtailed. Provisions for long-term protection also are needed since many existing sites with highly developed research facilities lack long-term commitments for continued Federal ownership.

On the other hand, Mr. Nelson felt that the U.S. Fish and Wildlife Service possessed adequate authority to preserve as natural areas the lands and waters under its jurisdiction and make them available for "useful and desirable research." Mr. Monroe added that provisions in the Federal Land Policy and Management Act included the mechanism and the management tools to administer public lands properly, obviating the need for additional authority. He also thought that adequate regulatory authority applicable to the Outer Continental Shelf (OCS) where BLM has environmental R. & D. responsibilities, already exists under the present OCS law, and that this mandate is likely to be further defined in the pending legislation which seeks to amend that act.

Chapter G. Witness Recommendations

The hearing debate yielded general agreement on the part of the witnesses that a comprehensive national system of environmental research areas is desirable to achieve reliable, systematic, continuous and long-term data gathering and analysis in all major U.S. ecosystems. Such a program would permit future planning and utilization of the country's natural resources characterized by minimal disruption and opportunities for preservation and renewal, rather than by exploitation without rehabilitation. Recommendations on establishing such a system by formulating national enabling legislation included the following:

1. Funding and authority to acquire additional sites are urgently needed. Existing environmental research reserves can be incorporated into a national network, but major gaps in coverage of ecosystems exist if a complete, comprehensive system is the goal.

Agencies and other institutions frequently appear to have been unable to acquire additional land because of jurisdictional and mission-dictated conflicts. Yet, unless the sites needed to complete a comprehensive ecological system are acquired soon, the land will have been preempted for other uses and will no longer be available for the monitoring and research envisioned by environmental research reserves. For example, disturbances on sites to be earmarked for programmed manipulation will have begun without the benefit of simultaneous data collection and analysis, and the pristine areas will have been degraded to a level which will render them useless as experimental controls. Coverage of aquatic environments seems particularly poor at present, despite the acknowledged fact that they form an integral and essential part of U.S. ecosystems. Priority may have to be accorded to funding rapid acquisition of aquatic areas of all descriptions.

2. Additional specific authority is required to protect lands designated as EER's for long-term use.

Some agencies apparently to not possess adequate authority to safeguard existing sites under their jurisdiction from encroachment by other Federal, State, and local institutions or private interests which pressure the agency and GSA to dispose of research reserves for other uses. Appropriations to retain natural, "control" sites are particularly difficult to justify when the overall budget for an agency comes under review.

3. Dependable, continuous support for the protection, operation and maintenance of environmental research reserves is essential for effective programming, monitoring, and analysis of research efforts and their results.

The management and utilization of these reserves should not be subjected to the vagaries of short-term changes in national, social and economic programs. Consensus on this issue revealed that research projects which are executed within the framework of a national envi-

ronmental research reserve network can yield useful results only if their continuation over the long-term is guaranteed by legislative mandate.

4. Guaranteed access to reserves for all *bona fide* user groups should be mandated, although a specific definition of such groups may be needed to prevent misuse of the sites.

At present, administering institutions make their own individual selection of the groups desiring to conduct research projects on a given site. The decision arrived at sometimes seems predicated as much on the project's contribution to the agency's mission as on the anticipated effects on the existing ecosystem. While it is natural that an agency should hold its mission paramount, greater flexibility in project planning and greater awareness of national targets are needed if a national environmental research reserve network is to produce results that are applicable to more than one area.

5. Systematic, continuous monitoring of all natural and manipulated sites should be required and incorporated into a nationwide recording system. A mechanism for oversight and provisions for ready access to the measuring and monitoring data by all participating institutions should be included in any legislative proposal.

Adequate, continuous monitoring and a comprehensive nationwide data collection network that is readily accessible to all participating agencies and groups was high on the list of priorities of most witnesses. Ongoing monitoring and data gathering projects on individual sites might accurately chart changes occurring in one ecosystem, but might not sufficiently record the effects on that system of activities elsewhere. Therefore, a nationwide data collection and evaluation system was deemed a crucial element of any legislative proposal.

O