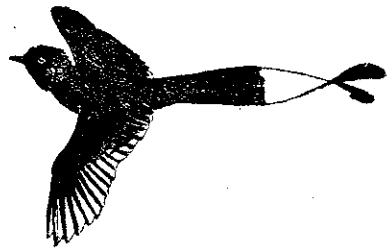

REPORT AND RECOMMENDATIONS OF THE INDO-US BINATIONAL WORKSHOP ON CONSERVATION AND MANAGEMENT OF BIOLOGICAL DIVERSITY, BANGALORE, MARCH 2-11, 1982.

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I

CONCLUSIONS

AND

RECOMMENDATIONS

1. IMPORTANCE OF CONSERVINGBIOLOGICAL DIVERSITY

It is increasingly recognised throughout the world that the preservation of biological diversity is among the most important, and at the same time, least appreciated challenges of the present and immediate future. For extinction is for ever, and the irreversible reduction of the biological wealth of the planet is the crime for which future generations are likely to blame us most more than wars, pollution, social disruption or any other reversible change. Once a large fraction of the earth's biological species is extinct, it may take millions of years for nature to evolve to replace whatever functions and uses the extinct species had, and in a man dominated world.

Preserving biological diversity is important for atleast five major reasons:

- Maintaining ecosystem functions
- Direct economic applications of species and genetic material
- Beauty, pleasure and quality of life
- Moral and religious values
- Dependence of culture on nature

In regard to ecosystem function, systems which lose too many of their component species may become less efficient in maintaining natural cycles, be they of water, soil enrichment, or involve local and global climatic regulation. The breakdown of mutualistic networks may produce ripple effects in which the extinction of one species may lead to the extinction of others (including commercially valuable species), cause pest outbreak, or lead to irreversible system fulfil innumerable roles, even in man-dominated ecosystems. Such species may provide food, fodder, wind break, nitrogen fixing, green manure, erosion control, indirect pest reduction, and so on.

Rich natural ecosystems also serve as ecological baselines for detecting long term change, as system function models for managed lands, and of course, species capable of repairing degraded ecosystems.

As a reservoir of present and future renewable natural resource options, existing species and gene pools are irreplaceable. All our existing tree and field crops have been drawn from this reservoir, which continues to provide genetic variability important to the improvement of such cultures. Some products of natural ecosystem may be used directly, as in selection forestry, collection of forest produce such as honey, grazing, and so on. It is well known that most of our medical drugs and many industrial lubricants, tars and plastic precursors such as aromatics, hydrocarbons etc. originate from various chemical by products of species from very diverse taxonomic groups, some of which are still obtained directly from the wild. The potential for future discovery of useful chemicals is immense, because only a tiny fraction of plants and animals have been tested for useful products.

Future applications in integrated pest control are particularly important since this can simultaneously increase productivity, reduce costs, and cut pollution. Moreover, the potential for the quick utilization of an exploding array of genetic variants has suddenly increased dramatically with the fast developing techniques of 'gene cloning'. It may soon be possible to exploit genetic characteristic without bringing species into cultivation or domestication. Nitrogen fixing genes from legume genera, pest resistance acquired from species as far apart as phyla, and 'bacterial factories' for the production of nearly any useful organic chemical may be about to become a reality.

Thus it is more crucial that we retain a larger genetic resource base than at any time in the past; ironically this being appreciated just as we are beginning to rapidly destroy our genetic heritage.

All human beings enjoy a healthy, stable beautiful and diverse environment; everyone finds pleasure in discovery and observation of the infrequent and unusual so that their lives are enhanced by the richness of biological diversity. No one wants to live in the middle of a giant crop monoculture since it is deadly monotonous to do so. On the other hand, such pastimes as bird watching, botanizing, gardening and horticulture are every where on the increase and all depend entirely on the richness of natural vegetations.

Many people find a rich spiritual meaning in nature and nearly all the world's religions have a naturalistic origin. Reverence for life is often equated with civilization and a large number of civilized people feel that they have no right to so consume the earth as to destroy other species. Not everyone may feel these moral obligations, but so many do that it appears that the feeling must be related to deep well-springs of human nature.

Last among these arguments for preserving biological diversity is that human cultures are inter-connected with the natural environments, its general character and its many components. India has one of the longest continuously evolving and richest cultures in the world but such culture cannot persist in the absence of its natural causes and symbols. Two thousand year old dances are cherished and performed in India and it is surely intended that this choreography will persist two thousand more. If the rich natural heritage of the India subcontinent is defaced and destroyed, its culture will surely collapse with it, and who could find the spirit to carry it on?

So we can see that from every human perspective, preserving natural biological diversity is crucial. India has been fortunate in having about the richest and most diverse natural heritage in the world, yet this heritage is now being rapidly eroded. If twentieth century Indians can rise to the challenge to reverse this process and preserve the spectacular array of native plants and animals, they will be blessed by future generations through all the ages.

2. SETTING UP A NATIONAL PROGRAMME

2a. An integrated national programme to conserve and manage biological diversity

The need to conserve natural biological diversity in India is urgent. Accordingly an integrated national programme for the conservation and management of this diversity should begin immediately. Successful and efficient conservation of the fullest possible array of biological and gene pool resources will mainly have to be accomplished in situ since there is a tremendous diversity of such entities and these individually depend for their existence on complex multilistic relationships which could not be duplicated outside of natural ecosystems. Therefore what is needed is a systematically selected network of large Biosphere Reserves and smaller nature reserves throughout the country. A system for collecting and organizing biological diversity information must be developed, as well as a process for identifying, selecting, designing, evaluating and establishing Biospheres and other reserves. Existing proposals for reserves should be evaluated and reserves established as soon as possible. Ultimately, administration and management of these reserves should be carried out in a consistent and coordinated fashion.

Among the practical benefits of nature reserves is the retention of potentially useful genetic variation for medicine, agriculture and industry. Volumes have been written on the incalculable economic worth of natural products such as new drugs and materials that are discovered in wild species.

For agriculture, the significance of primitive land races and the wild relatives of cultivated crop species cannot be overstressed. It is well documented that modern agriculture, is highly dependent on 'resistance' genes from such sources. Without them, productivity would continually decline and mankind would suffer famine with increasing frequency. Other critical functions are performed by natural ecosystems. Among these are the protection of watersheds, the control of erosion, the maintenance of humidity and other aspects of local weather.

2b. Role of Biosphere Reserves

The Biosphere Reserve program, which emphasises research oriented to rational management of natural reserves, is well suited to India. It is designed to conserve representative natural ecosystems, addressing the problems of land use in a particular region. However the program's global scope is a unique characteristic which enables nationals to share experience and expertise to solve problems of common concern.

The mission of the international network of biosphere reserves is to address global problems of natural resource degradation and loss of biological diversity. This can only be achieved through the collective activities of individual biosphere reserves, which have the following roles:

1) Conservation of representative natural ecosystems and biological diversity in particular biogeographical regions and their economic, cultural, spiritual and other benefits to human beings in such manner that the natural resources and biological diversity can be sustained.

2) To carry out long term ecological research and environmental monitoring both of natural processes, and human impacts and interactions so that the first role can be achieved.

3) To carry out educational training and demonstration activities, especially for the local population most directly involved in the program, to help achieve the first role and to

develop models of land use for the biogeographic region. The reserve should be a focus to attract the best available expertise to help achieve this aim.

An effective scheme of land use zonation is required if a Biosphere Reserve is to fulfil its roles. The following zones are usually identified and managed according to each zone's individual role.

a) Core Zone(s) : One or more core zones will contain the least disturbed natural areas and usually a significant diversity of species with special emphasis on the wild relatives of economically important crops and other culturally significant plant and animal species. These zones receive the strictest protection with limited human interference. They serve as sites for research and monitoring of natural processes and as baseline areas for comparison with areas receiving various uses.

b) Buffer zone(s): Adjacent to or surrounding core zone(s) help to protect the core areas. Certain uses of this zone are allowed, such as fuel wood gathering, and many traditional uses by indigenous populations, but the uses are managed in such a way as to maintain the integrity and biological diversity of the total reserve.

c) Manipulation or experimental zone(s): These are areas representative of the natural habitats contained in the Biosphere Reserve which can be manipulated, experimented with, or stressed in various ways to determine how the system behaves.

d) Restoration zone(s): In areas that have become badly denuded, eroded or damaged in some way, efforts would be directed to restoration of these areas and would include studies and demonstration projects providing improved restoration methods which can be used elsewhere in the region.

Biosphere Reserves should provide focal points in the nation for the active collaboration of governmental agencies, institutions, and voluntary organizations, as well as international cooperation, to carry out projects which improve the

well-being of local people and, through extended application, the economic productivity and biological diversity of the nation. Cultural diversity and biological diversity are often intimately related and Biosphere Reserve Projects may also provide a means for society to learn from local cultures and traditional land use practices better ways to manage the nation's natural resources.

2c. Information systems on biological diversity

In order to effictively and efficiently conserve and manage natural biological diversity in India, large amounts of information will have to be gathered and organized. Fortunately, a great deal of information has been and is already being collected by a wide variety of surveys, agencies, universities and institutes. However, as in rearly all other countries, this information is still widely scattered, incompatible in terminology and format, and less than comprehensive.

To overcome these difficulties, standardized methods should be developed so that information from various sources can be synthesized. With such a synthesis, information gaps can be identified and the data applied effectively in providing the basis for selection and design of Biosphere and other reserves; in environmental impact assessment; in guiding research in ecology and so on.

Such standard methods can only be developed and applied under the leadership of an integrated permanent 'technical methods task force'. Such a task force must be composed of individuals from a variety of disciplines, including taxonomy, ecology and the information sciences. Obviously, this task force should work directly for whichever agency is responsible for the Biosphere Reserve and biological diversity programme.

The actual development of biogeographic province data based on biological diversity should not be carried out directly by the technical methods task force, however, Instead, the data bases should be developed locally by some suitable organization or institution which is methodologically supported

by the task force through training, standard operating procedures manuals, data services, and direct assistance.

An overall integrated information system of this sort could perhaps best be developed with a pilot experiment carried out for a single biogeographic province in order to develop preliminary procedures and demonstrate the efficacy of this approach. Because of the work already accomplished towards these ends in the Western Ghats, and because of the capabilities of the scientists and institutions involved, we recommend that such a pilot project be undertaken in this biogeographic province.

2d. Need for National Legislation

The existence of legislation for conservation of biological diversity and integrated development is essential for administering effective programmes. Legislative proposals are already being formulated in India to provide for the establishment of a network of biosphere reserves.

Recommendation

We support efforts to develop legislation to provide the framework for establishment and maintenance of biosphere reserves. In developing the legislation, consideration might be given to including

- a statement of policy, underscoring the commitment to sustainable development of natural resources and encouraging Government Ministries to promote this policy to the greatest extent possible in carrying out their functions.

- Provision for strong central administrative role in the planning and implementation of the programme for conserving biological diversity, including the functions of policy setting, information management, funding of protection activities; and legislating establishment of a National Board for Biosphere Reserves to set policies and programme goals for the network. The

legislation should ensure that the management of each reserve is based on a management plan which should set forth a coordinated strategy for protection, management, and use of the reserve to encourage sustainable rural development (see Sections 4b and 4d)

'Clarification of the respective roles of the Central and State Governments in the administration of the Biosphere Reserve sites.

(Note: Several administrative alternatives were discussed. It was generally agreed that the concept of Biosphere Reserves would best be met through administration of entire Biosphere Reserves by the Department of Environment, with active involvement of the Ministry of Agriculture and various other Central and state Government agencies and other entities stipulated in the management plan. However, it was recognised that a number of alternatives for administration of Biosphere Reserves exist (e.g. state administration of entire reserve or buffer zone only). The adoption of any system should give priority consideration to its effectiveness in (1) facilitating cooperation between state Governments and among Central Ministries (2) using existing scientific and managerial capabilities (3) providing a basis for ecodevelopment in the region and (4) involving local populations in the work of the reserves.)

The workshop participants noted that the international Biosphere Reserve programme, under the general guidance of UNESCO, has made significant progress. As of January 1982, 220 reserves in 50 countries have been established under pre-existing legislation. Establishment of specific legislation for Biosphere Reserves in India would make it the first nation to recognise legislatively the unique potential of Biosphere Reserves in supporting the development of better land management techniques. It would thus establish a valuable precedent and model for sustainable development in other nations.

2e. Immediate protection for proposed biosphere reserves

A total of 12 sites and site complexes have been identified by the MAB Committee as proposed Biosphere Reserves, and additional sites may be considered in the future. Portions of the proposed areas are being adversely affected by human disturbances, such as land clearing, overgrazing, industrial development, river valley development projects. Protection is urgently needed to limit inadequately controlled human activities until the Biosphere Reserves can be legally established and a management plan for their use and development is approved.

Recommendation

Sites determined to be qualified as Biosphere Reserves should be set aside as National Parks under the wildlife (Protection) Act of 1972 until Biosphere Reserve legislation is enacted. Existing proposals for development or expansion of existing projects should be postponed pending enactment of legislation and should be considered in the preparation of the Biosphere Reserve Management Plan.

3. SELECTION OF BIOSPHERE AND OTHER RESERVES

3a. General Basis for Selection

Biosphere and other reserves should be selected on a strictly scientific and interdisciplinary basis. Selection of reserves should be carried out with a biogeographic province focus. For this, the country must be divided or classified into such biogeographic provinces. A preliminary scheme for doing this has already been developed and the whole subject of classification is treated in section 3c.

Two types of reserves are needed which differ in size, complexity and management zonation. The larger type is the Biosphere Reserve. The smaller might be referred to as the 'Natural Biological Heritage Reserve' or by some other suitable designations.

Biosphere Reserves should be large reserves capable of sustaining integrated examples of the major ecosystems characteristic of a given biogeographic province. The

smaller 'Heritage Reserves' should be established to conserve those biological associations, special species habitats, genepool resources, special breeding or feeding areas, and other elements of diversity which are not adequately represented in the large Biosphere Reserves.

3b. Size, shape and Composition

In the selection of potential sites for Biosphere Reserves and other nature reserves, it is necessary to consider certain physical dimensions and relationships. Among these are size, shape and the linkages between isolated components.

Size: There is a substantial literature on the optimum size of nature reserves. This topic has been approached from several perspectives, including the following: a) minimum size criteria for particular species (on both genetic and demographic bases), b) topographic considerations, (c) security and protection considerations, d) the role of disease, e) the role of succession and patch dymamics, f) political considerations, g) biogeographic considerations, h) research opportunities, and i) recreational impacts.

A consensus has emerged from the integration of these various points of view. Simply stated, it is that such nature reserves should be as large as possible. For example, using genetic criteria, it is apparent that few individual reserves are large enough, by themselves, to maintain viable populations of large carnivores. In addition, it is the consensus of conservation biologists that extinction rates are inversely proportional to reserve size. Thus, management costs per unit are probably incease with decreasing area.

Each potential reserve must, of course, be judged independently taking into account the factors mentioned above. Experts in each of the above subject areas should be consulted.

Shape: Shape should be considered as an important element in the design of nature reserves. The shape of any reserve should accommodate natural topographic factors such as watersheds,

mountain ranges and rivers. Another criterian usually considered is the ratio of circumference to area. Reserves with a high ratio are generally more difficult to patrol and manage.

Composition: In some cases, the most desirable reserve design might be an archipelago, composed of one or more major core areas, linked administratively and managerially with one or more satellite reserves. Such a system may, in some cases, be a viable reserve, whereas any element, by itself, might not.

The issue of composition is especially relevant when the establishment of a Biosphere Reserve is being considered. Biosphere Reserves may include partially degraded or developed areas. Because of the core zone(s) and these surrounding 'buffer'zones should be managed as a unit, the existence of more than a single core area is fully compatible with the Biosphere Reserve concept.

The use of corridors between isolated components of a reserve is a controversial subject. Some of the factors to consider are:

1. Whether hunting and poaching in the corridor will endanger the ecological structure of the entire reserve.
2. whether corridors could be conduits for epidemics between reserve components, or expose the reserve to contagion from domestic species,
3. whether alternatives to corridors are available, including artificial transfers, in order to maintain viable populations.

Recommendations

1. Reserves should be as large as possible to minimize the rates of extinction and loss of genetic variation
2. Long, narrow reserves are less desirable than more compact shapes.
3. It is desirable to include several patches of undisturbed habitat in a single Biosphere Reserve.

3c. Classification systems

The network of Biosphere and other nature reserves has to be so selected as to provide as complete a representation as possibleof all the biological community types of the country. Such a classification of the biological communities is therefore needed as a basis for the selection of the reserves. We recommend as a working tool the use of the following classification system based on a synthesis of the various classifications proposed earlier:

I - Wet evergreen forests of West Coast - Western Ghats

1. Cullenis - Mesua - Palaquium
2. Dipterocarpus - Mesua - Palaquium
3. Persea - Holigarna - Diospyros
4. Montane (shola) forest
5. Memecylon - Syzygium - Actinodaphane
6. Bridelia - Syzygium - Terminalia - Ficus

II - Wet evergreen forests - Teak zone ecotone

1. Moist deciduous Teak (Tectona-Lagerstroemia lanceolata-Dillenia-Terminalia paniculata)
2. Slightly moist Tectona-Terminalia-Adina-Anogeissus

III - Teak zone

1) Anogeissus-Terminalia-Tectona
2) Tectona-Terminalia

IV - Miscellaneous forests zone forming transition between teak zone and sal zone

1) Terminalia tomentosa-Angeissus latifolia
2) Terminalia-Anggeissus-Cleistanthus

V - Sal zone

1) Shorea-Buchanania-Cleistanthus
2) Shorea-Cleistanthus-Croton
3) Shorea-Buchania-Terminalia
4) Shorea-Terminalia-Adina
5) Shorea-Dillenia-Pterospermum
6) Shorea-Syzygium operculatum-Toona
7) Toona-Garuga

VI - Hardwickia zone

1) Hardwickia binata

VII- Albizia amara zone of Coromandel-Circar

1) Albizia amara-Acacia

2) Anogeissus latifolia-Chloroxylon-Albizia amara

3) Manikara-Chloroxylon

VIII-Anogeissus pendula semi-arid zone of Eastern Rajasthan

1) Acacia senegal-Anogeissus pendual

2) Acacia catechu-Znogeissus pendula

3) Anogeissus pendula-Anogeissus latifolia

IX - Thorn forests of semi-arid Deccan

1) Acacia-Anogeissus latifolia

X - Semi-arid Deccan-Indian Desert

1) Acacia-Capparis

XI - Indian Desert

1) Prosopis-Capparis-Ziziphus-Salvadora-Calligonum

XII- North West Himalaya

1) Subtropical evergreen sclerophyllous forest

2) Alphine steppe

XIII-Himalayas

1) Subtropical Pinus roxburghii forest

2) Temperate mixed oak and coniferous forest

3) Temperate coniferous forest

4) Subalpine forest

5) Alpine scrub

XIV- Eastern Himalaya- -E- India

1) Tropical wet evergreen forest of N.E. India

2) Tropical moist deciduous forest of N.E. India

3) Subtropical broadleaved hill forest of E. Himalaya

4) Montane wet temperate forest of E. Himalaya

XV - Andaman-Nicobar Islands

1) Tropical wet evergreen forest

XVI - Coastal estuarine regions

1) Mangrove forests

3d. Selection criteria for biosphere reserves

According to the UNESCO (1974), the following general criteria should be considered when selecting Biosphere Reserves:

a) Representativeness- the core components should contain the major terrestrial and aquatic ecosystems of the province;
b) Naturalness- the core areas should have suffered the minimal level of human disturbance
c) Diversity - habitat, taxonomic and genetic diversity should be maximal
d) Viability - the reserve as a whole and the core zone(s) especially should be as manageable, defensible and self-regulating as possible.

The other criteria or conditions worthy of consideration are:

a) unique populations, habitats or ecosystems,
b) the presence of degraded ecosystems capable of recofery to a more natural condition
c) comprehensiveness of previous scientific studies and suitability for future research.

Biosphere Reserves may include large areas that have been modified and disturbed by human activities. In addition, the reserve may coincide with, include, or be part of an existing or proposed protected area.

Among the legal and institutional conditions that should eventually exist are provisions and facilities for ecological research, education and training of staff, education and ecodevelopment of the affected populace. In addition there should be provision for long- term legal protection.

3e. Selection process for Biosphere Reserves

The Workshop participants agreed on the importance of a systematic objective approach for selection of Biosphere Reserve with the process being consistently applied through the country.

Recommendation: It is recommended that a scientific committee for selection of biosphere reserves be constituted by the National Board for Biosphere Reserves for each of the sixteen biogeographic zones (see Section 4d for a complete description of this Board). Each Committee should include expertise in the fields of social science, geology, agriculture, forestry, human welfare, archaeology, anthropology, and most importantly, ecology and the environmental sciences.

It is suggested that the experts be located in relative proximity to the site for obvious reasons of familiarity and to facilitate the sometimes long process of selection. The Committee should use a systematic procedure for the description of sites to enable comparison and evaluation using UNESCO selection criteria. Any conditions that may have to be met before, the selection of a site is finalised, should be identified. Sites that are recommended to the National Board for Biosphere Reserves would then be reviewed by the Board and recommendations sent to the concerned Government agency for initiating action. (A description of the composition and responsibilities of the Board is provided in Section 4c).

4. ADMINISTRATION AND MANAGEMENT OF BIOSPHERE RESERVES

4a. Importance of the management plans

The development of a comprehensive management plan is essential to ensure proper management of a Biosphere Reserve. It is required by UNESCO guidelines for selection and management of Biosphere Reserves.

Recommendations:

It is recommended that each Biosphere Reserve statutorily be administered in accordance with a management plan. The plan should govern administration, management, operations, land use and human activities. The responsibility for its preparation should be with the Field Director, assisted by his staff. Scientific and technical assistance should also be available from the regional Technical Committee.

The plan should contain but not be limited to the following subject areas:

- conservation of biological diversity
- ecodevelopment, including tribal development
- environmental education
- scientific research
- environmental monitoring
- establishment of management zones
- resource management
- protection
- public involvement
- training
- tourism
- multiyear budget
- staffing
- facilities and equipment
- institutional considerations

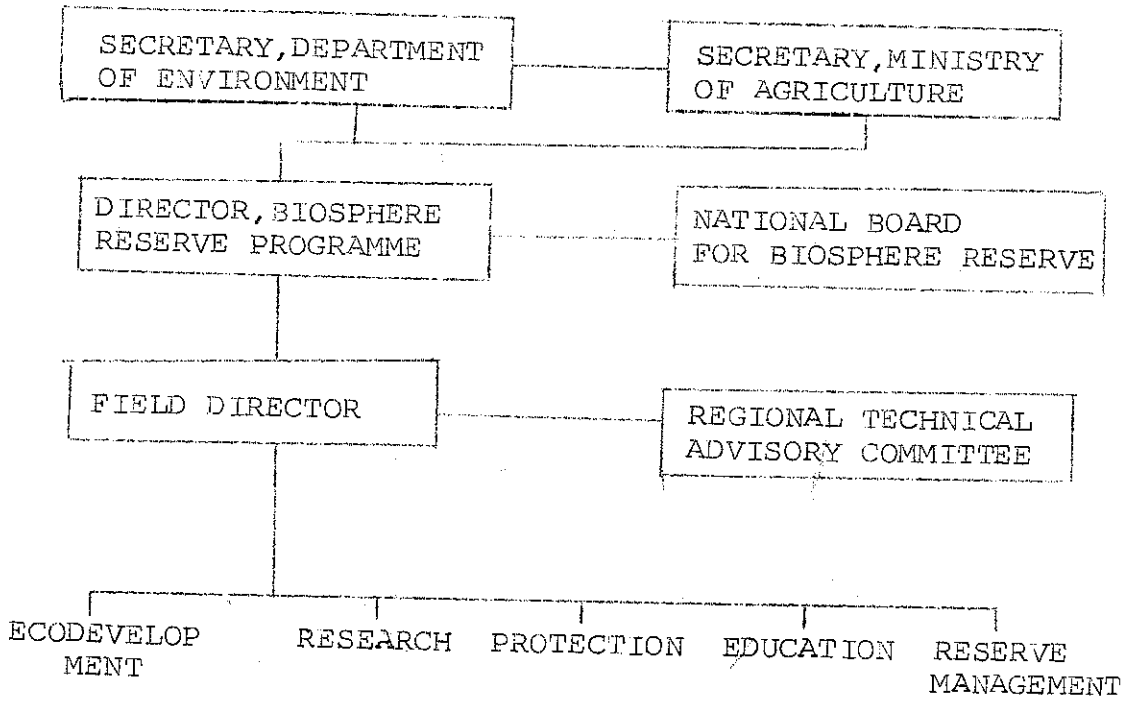
It is important that active involvement programmes, particularly for the local people, be incorporated into the management plan of each reserve as an educational as well as a management practice. Plans should be reviewed by the Regional Technical Advisory Committee prior to submission by the National Board for Biosphere Reserves.

PROPOSED

ORGANIZATION CHART

FOR

BIOSPHERE RESERVE PROGRAMME



4b. Director of the Biosphere Reserve Programme

The Biosphere Reserve Programme needs overall direction from the Central Government to assure consistency of management and evaluation.

Recommendation: It is recommended that a Director of the Biosphere Reserve Programme be established within the Department of Environment or with the Ministry of Agriculture of the Central Government. This individual would provide consistant direction of, support for, as well as evaluate implementation of, programmes in all Biosphere Reserves.

The responsibilities of the Director would include but not be limited to:

1. Approval of major policy decisions
2. Finalisation of budget for Biosphere Reserve programme
3. Approval of international collaboration on recommendation of the National Board for Biosphere Reserve (NBBR)
4. Making appointments of individual members to the NBBR (i.e., appointments not reserved by legislation)
5. Serving as Member Secretary to the NBBR
6. Providing direct line authority over the Field Directors
7. Selection and periodic evaluation of performance of field directors

4c. National Board for Biosphere Reserves

Smooth functioning of the Biosphere Reserves programme required the network to be established and managed in accordance with uniform policies, regulations, standards and guidelines. These will help ensure that personnel involved in the administration and management of Biosphere Reserves are aware of their responsibilities and accountable for carrying them out. By providing a consistent framework for developing each reserve's management plans, it should be possible to

minimize conflicts arising from differences between the agencies and institutions participating in each reserve's programmes. In the area of scientific studies, uniform standards should promote consistency in data collection and analysis, and the greatest possible comparability of information from the various Biosphere Reserves. This will provide the best possible perspective on problems of concern to a particular region or the nation as a whole. Additionally, consistent policies are required to ensure that land uses and human activities are regulated in a manner which sustains and, where necessary, restores the productivity and biological diversity of the reserve.

Recommendations:

A single entity within the Central Government should be responsible for initiating any approvind policies, regulations, standards, and guidelines for Biosphere Reserves. The legislative establishment of a National Board for Biosphere Reserves is recommended. The Board should have the legal authority to develop policies for carrying out the programme and would meet on a regular basis. A secretary of the Department of Environment, or Ministry of Agriculture would serve as Chairman, and the Director of the Biosphere Reserve Programme as a Member Secretary.

Membership of the Board should consist of the following:

1. Representatives of the Botanical and Zoological Surveys
2. Representatives of concerned Central Ministries
3. Representatives of National Planning Commission
4. Eminent scientists
5. Representatives of conservation organizations and voluntary rural development organizations

The duties of the Board should include but not be limited to, the following:

1. Submit Biosphere Reserve nominations
2. Establish Biosphere Reserve Selection Committees
3. Appoint Regional Technical Advisory Committee
4. Approve Biosphere Reserve Management Plans
5. Approve and coordinate inter-reserve research
6. Evaluate the National Biosphere Research Programms
7. Appoint non-ex-office members to the Board
8. Approve interagency coordination at the national level
9. Establish policy standards
10. Develop regulations
11. Recommend international coordination

4d. Administration of Biosphere Reserve sites

Fulfilment of the multiple purposes of Biosphere Reserves as securely protected natural areas for baseline and experimental research, demonstration and training will require high standards of professionalism in management. Field units should be adequately staffed to provide protection, maintenance, educational programmes and of particular importance-coordination of reserve activities with tribal and village populations residing within the reserve and its immediate vicinity. They should also be provided with adequate scientific and technical assistance on a continuing basis to support affective management. Each Biosphere Reserve should have a Field Director responsible for administration and coordination of management, research and public involvement activities. In the ideal situation the Field Director would be responsible for administering all of the lands within the reserve. However, it is recognised that such total administrative control may not be practicable and that coordination of the activities of various land administrators in the Reserve in accordance with the Management Plan for the Reserve may be an important responsibility. Regardless of the extent of the Field Director's jurisdiction, this official should be able to obtain technical, scientific and management assistance from an interdisciplinary

Regional Technical Advisory Committee, established for each biogeographic region, to advise the Field Director(s) on matters of concern and provide a forum for review of reserve activities. Regional Technical Committees would meet on a regular basis in the Reserve or its vicinity.

Recommendations:

Following designation of a Biosphere Reserve, a Regional Technical Advisory Committee should be established to provide assistance on matters pertaining to administration of Biosphere Reserves in a particular biogeographic region.

A representative of the National Board should serve as Chairman of the Regional Technical Advisory Committee. The Member-Secretary should be a Field Director of a Biosphere Reserve in the biogeographic region.

The membership should be as follows:

1. Representatives of the Regional Scientific and Technical Institutions
2. Officials of concerned State Departments
3. Eminent scientists
4. Local citizen representatives

Duties of the Advisory Committee should include but not limited to the following:

1. Review and recommend management plans to the NBBR
2. Review and recommend site research and funding
3. Provide interagency coordination at the State and local level
4. Provide programme evaluation for individual Biosphere Reserves
5. Provide public involvement coordination(other than routine)
6. Promote equitable management and use of the Biosphere Reserve in consideration of the well being of local populations.

Recommendations:

Each Biosphere Reserve should be under the immediate supervision of a Field Director who should be trained in

resource management, a strong supporter of research and having proven ability to communicate effectively with local populations.

The duties of the Field Director should include but not be limited to:

1. Managing and directing all field activities
2. Making day to day management decisions necessary to maintain an efficient and effective organisation
3. Expending funds for effective accomplishment of the management plan
4. Preparing necessary budget requests, annual reports, annual plans of operations, staffing proposals and evaluations of subordinate staff

The Field Director should be supported by adequate clerical staff as well as staff for eco development, protection and scientific research. The size of the staff will depend upon the size and individual needs of each Biosphere Reserve.

The Field Director will be responsible directly to the Director of the Biosphere Reserve Programme.

5. SCIENTIFIC ACTIVITIES IN THE BIOSPHERE RESERVES

One of the original objectives of the Biosphere Reserve programme is to provide areas for baseline research and monitoring. These inventory, research and monitoring activities will both benefit the society at large, and be of great utility in the management of the Biosphere Reserves themselves.

Four major areas of scientific activity may be recognized: (i) inventory and monitoring of the elements of biological diversity, (ii) ecology and resource utilisation by the human populations; (iii) ecosystem monitoring and research and (iv) population monitoring and research.

5a. Inventory and survey

A basic requirement for Biosphere Reserves is an ongoing inventory and survey programme for assessing the status of elements of biological diversity. This involves data collection, data management and mapping of both the elements, and the environmental factors affecting them (e.g.soil, drainage, climate, exotic species and human land use).

The Survey of India has prepared maps showing the major geographical features and forest boundaries at 1:250,000 and 1:50,000 scale for the entire country. Specific forest areas have also been mapped at 1:15,000 scale. The National Remote Sensing Agency (NRSA), is processing satellite imagery from LANDSAT (both black and white and colour infrared). They also have capabilities for aerial photography. Studies carried out by the NRSA include different themes like drainage, ground water, vegetation, land use patterns, etc. The Botanical Survey of India and Zoological Survey of India are responsible for carrying out floristic and faunal surveys in the country.

Other agencies which have capabilities in providing base line information also include the Geological Survey of India, and the Indian Meteorological Department with its network of observatories and stations.

Mapping

Preparation of maps of the Biosphere Reserve is of fundamental importance. The entire Biosphere Reserve should be mapped at 1:10,000(or 1:15,000) scale in addition to the existing 1:50,000 maps. Maps of 1:10,000 scale are needed for certain key aspects such as topography, vegetation types, drainage, land use pattern.

Maps of a smaller scale (say 1:50,000) may be sufficient to illustrate soil types, geology, faunal distribution and climate. Basic topographic sheets will have to be provided by the Survey of India and subsequent mapping of the different themes can be done in coordination with the concerned agencies.

Remote Sensing

Advanced technology in the form of remote sensing should be used in conjunction with conventional mapping techniques. This would include using LANDSAT imagery enlarged to 1:250,000 scale to map gross features. These and aerial photographs at a large scale taken by NRSA should be used and Survey of India should be enlisted to map the finer details of land use patterns, vegetation, drainage etc. Landsat imagery and aerial photographs already available must be released for inventorying and monitoring in Biosphere Reserves. For those areas of the Biosphere Reserve where such imagery is lacking, work should be taken up by the NRSA and the Survey of India.

Computer systems for storage, analysis and efficient retrieval of data obtained from remote sensing should be developed.

Flora

Preparation of a flora for a Biosphere Reserve is the most basic requirement for the inventory of available plant resources. For the Nilgiri Biosphere Reserve, this requires updating of existing information, which includes Tyson's flora of the Nilgiris, Gamble's flora of Madras and numerous papers on specific areas. Information gathered on each

species for the preparation of the flora should be standardized for computer storage. This would facilitate correction, undating and retrieval of information.

For key species as well as endemic, rare and threatened species status and distribution maps will have to be prepared. Gaps exist in inventory of lower plant groups such as micro-organisms, algae, fungi, lichens and bryophytes and special attention will have to be paid to these groups. A herbarium of the flora should be established for the Nilgiri Biosphere Reserve, as part of the existing field station. The herbarium would be an invaluable reference for studies undertaken in the Biosphere Reserve. The preparation of the flora, vegetation mapping and establishment of the herbarium should be the responsibility of the Botanical Survey of India with help from Universities and colleges and the French Institute.

Fauna

Preparation of Fauna for the Biosphere Reserve should be undertaken by the Zoological Survey of India in collaboration with the Universities and colleges. Apart from an inventory of the vertebrate groups (mammals, birds, reptiles, amphibia and fishes), special attention must be paid to the invertebrate groups since they have been generally ignored. Distribution maps with information on detailed localities of such elements should be prepared to determine the relationships of animals to the various vegetation types. Fauna of streams, land locked lakes, lagoons and coral reefs should receive special emphasis. Faunal collections will have to be suitably classified and stored, supplemented by computerized date storage.

Inventory of Cultivars and Domestic Animals

To preserve the genetic diversity of agricultural and other culturally significant plants, an inventory must be made of all taxa cultivated within and around the Biosphere Reserve. Wild relatives of crop plants and species of ethnobotanical significance occurring in the reserve must also be added to this inventory. The Agricultural Universities can undertake this investigation.

Strains of domesticated animals traditionally kept by the people will have to be similarly investigated by the Veterinary Science Department of Agricultural colleges.

Climate

Long term climatic data should be collected for the Biosphere Reserves. In the case the Meteorological Department already has numerous stations as in the Nilgiri region, information available from these stations pertaining to previous years will have to be consolidated. Key stations should be identified for maintaining accurate climate records in the future and new facilities will have to be established where necessary.

Establishment of a Research Station

Every Biosphere Reserve should have its own field station, preferably located within the reserve. The size and facilities at the field station would depend on requirements of the particular reserve. Thus, in the Nilgiri biosphere reserve it should be possible to establish a large field station with computer and library facilities, laboratories, and housing. Other field stations or camps can be set up using existing buildings wherever possible. The field stations would provide a suitable base for scientific personnel engaged in long term monitoring and research and also for short term workers in specific projects.

5b. Ecology and Resource use by Resident Human Populations:

In the proposed Nilgiri Biosphere Reserve area, there are many traditional ethnic groups such asCholanaikas, Todas, Badagas, Irulas, Kanies, Kurubas, Pannias, Chetties and Soligas. In addition there is a large population of Sri Lanka repatriates and people of different castes from various parts of the states of Tamil Nadu, Kerala and Karnataka. Most of the tribal ethnic groups are spatially and culturally isolated. Their distribution and major occupations are as follows:

CHOLANAIKAS are the only genuine hunter gatherers of the Indian peninsula. They were discovered in Nilambur forests in the south western parts of the Reserve only a few years ago.

TODAS are buffalo keepers of the Upper Nilgiri Plateau.
BADAGAS are an advanced farming community and they cultivate the fertile slopes around Ooty.
IRULAS are originally hunter gatherer of the drier tracts and are today mostly gatherers of minor forest produce.
KURUBAS and SOLIGAS are found in Mudumalai and Bandipur Sanctuaries and are gatherers of minor forest produce.

CHETTIES own land in the Wynad area and are agriculturists by occupation and
PANNIAS are landless labourers and work mostly in the lands of Chetties.

Many tribals such as Irulas, Kanies, Kurubas, Chetties and Soligas now do odds jobs such as building roads, maintaining elephants and as fire watchers for the forest department.

The impact of these tribals on the natural resources of the area was probably not damaging until large tracts of dry deciduous and moist deciduous forests were cleared for planting teak, eucalyptus, coffee, tea and wattle. The destruction of natural vegetation has grown worse in unprotected areas with the arrival of thousands of Sri Lanka repatriates, who needed more land for tea plantations as well as wood for building houses and for cooking. As vast tracts of natural vegetation w re thoughtlessly cleared to develop plantations, and as afforestation was not carried out anticipating fuel wood shortage, the need for fire wood by the locals people has grown acute and has led to clandestine exploitation of the wood available in sanctuaries. For the population around Ooty the scarcity of fire wood is severe, as wood obtained from the monoculture plantations is taken off to far away rayon factories and paper mills.

The clearance of natural vegetation for cultivation of monocultures and the building of houses have led to soil erosion, and have completely disturbed the movements and dispersion of many animal species such as the Nilgiri langur, tiger and elephant. Landslides are frequent, causing considerable damage to property and human life.

It is not clearly known how much ecological deterioration has affected the lives of the tribals of the area. It is possible that poaching and destruction of habitats in the Nilambur Valley may be affecting the hunting success of Cholanaikas. Landslides and reduced rainfall may be causing considerable loss to predominantly farming Badagas. When farm lands are developed along the migratory route of elephants the fields are likely to be raided by elephants and one could surmise that the Chetties may now find agriculture near sanctuaries unproductive. As these and other problems have to be carefully studied on a long term basis, while efforts are taken to ameliorate the conditions of the tribals, we submit the following recommendations:

Recommendations:

The present situation suggests only two possible outcomes relating to the role of Tribals in the proposed Nilgiri Biosphere Reserve. Either they will continually be forced into land use practices inimical to the fundamental objective of the Biosphere Reserve Programme, or their needs will be integrated within the framework of the programme in a manner consistent with the overall Biosphere Reserve objectives. Failure to accomplish the latter would not only threaten the Programme, but reduce the likelihood of conserving the diversity of cultural traditions of the tribals. In this regard the following recommendations are made:

1. Demographic studies should be undertaken to assess the current size and distribution of tribals and to project future trends.

2. Detailed studies of land and resource-use, (e.g. agriculture, animal husbandry and gathering- particularly of fuelwood) and the impact of biological diversity should be undertaken.

3. Demonstration projects should be established as a means of adjusting land and resource use practices determined to be inconsistent with objectives of the Biosphere Reserve Programme.

4. Detailed ethnological studies should be carried out for the purpose of documenting the irreplaceable cultural heritage of the tribals. Ethnobotanical studies are particularly desirable. These studies would also aid efforts to implement adjustments in land and resource use.

5c. Ecosystem Monitoring and Research

Research Needs

Biosphere Reserves are internationally qualified sites for long term ecological research. Both basic and applied questions in ecosystem research can be addressed in such a way as to contribute to scientific advancement in ecology and to development of practical natural resource management techniques. The following general research goals should form the framework for a long term research programme.

a) to analyse principal structural characteristics and functional properties of the major ecosystem types of the Biosphere Reserves.

b) to evaluate the regulatory role of factors limiting plant and animal population growth and size.

c) to determine the impacts of anthropogenic and natural perturbations upon ecosystem functions and productivity and to determine responses and recovery potential of major ecosystems in relation to these perturbations.

d) to develop management strategies to promote conservation of biotic diversity and optimization of natural resource productivity on a long term sustainable basis.

Existing Capabilities

The International Biological Programme(IBP) initiated in 1967, provided an opportunity for studies in India, on productivity and nutrient cycling of grazing lands and forest ecosystems. These studies have continued under the Man and Biosphere Programme mainly in the States of Uttar Pradesh, Madhya Pradesh, Orissa and Gujarat. Banaras Hindu University, Rajkot University, Kumaon University and Vikram University are amongst the institutions engaged in this research. The French Institute(Pondicherry) has carried out studies in physiography and spatial distribution and mapping of different vegetation types throughout Peninsular India. The Bombay Natural History Society has ongoing ecological research programmes at the Bharatpur Bird Sanctuary and Point Calimere Sanctuary. The Indian Institute of Science has carried out ecological studies on the Bandipur National Park.

Recommendations:

A core programme of long term ecological research in the Biosphere Reserve should develop along the general guidelines presented by Armentano in the Indo-US Workshop on conservation of Biotic Diversity. Main research topics include:

a) Productivity of major ecosystem types including natural and man altered systems.

b) Cycling of major nutrients (N,P,K) and micro-nutrients known or suspected to limit productivity or reproduction of important plants or animals.

c) Human interactions with major ecosystem types including effects of clearing of forests, partial forest cutting, shifting cultivation, fire, cattle grazing, upon productivity, soil organic matter and nutrient content, plant and animal community composition, diversity and population dynamics.

A series of proposals may be required to cover each of these topics thoroughly. But an initial project covering a sub set of these topics would initiate a long term collection of data valuable in planning another research and periodic sampling of permanent plots. Baseline data collection should begin as soon as possible.

5d. Population Research and Monitoring

A key concern in the Biosphere Reserve Programme is research and monitoring of selected plant and animal species. Such studies are necessary to provide a scientific basis for (i) the management of threatened and endangered species and (ii) developing reserve selection and management guidelines. In general, a better understanding of the population processes that underly the production, maintenance and loss of biological diversity, is required.

Of all natural areas in India the maximum number of population studies have been carried out in the proposed Nilgiri Biosphere area. Included are studies on dholes, leopard and tiger (Johnsingh, 1980) spotted deer (Sharatchandra and Gadgil, 1976, 1981), elephant (Nair and Gadgil, 1980; Nair et al. 1980), Nilgiri tahr (Davidar, 1978) Nilgiri langur (Pasier, 1968, 1969, 1970), lion tailed macaque (Johnson, 1980) and bonnet macaque (Simons, 1965). Bird studies include those on the blue and orange flycatcher (Rezakhan, 1977) Blue Chat (Reza Khan, 1980) and sunbirds flower-peckers (Priya Davidar, 1979).

Other population studies include analysis of mammal distribution patterns (Prasad et al. 1980) and Loranthus infestations (Priya Davidar, 1980) and the effects of monoculture plantations on bird populations (Reza Khan, 1980).

Recommendations:

In order to fulfil the objectives for research and monitoring in Nilgiri Biosphere Reserve and other reserves, four types of projects are needed at the level of selected species and their populations:

(i) Basic research to determine the environmental controls of biological diversity, the geographic distribution of biological diversity, and the concordance in diversity among different groups of taxa.

(ii) basic research to determine the population biology of extinctions and loss of genetic diversity.

(iii) Research and monitoring of plant and animal populations.
(iv) Baseline monitoring of selected populations as indicators of ecosystem health.

Justification and details of these four types of projects are elaborated below:

i) Nature of biological diversity

The over riding objective of the world network of Biosphere Reserve is to conserve as much of the earth's biological diversity as possible. Since very limited areas and resource are available for establishment and management of reserves, we must select areas which capture maximum diversity and manage them in such a way as to maintain this diversity. Present scientific understanding of biological diversity for the Nilgiri Biosphere Reserve or for any other reserve in the world is inadequate to allow us to meet these requirements.

To remedy this weakness, we recommend that comprehensive surveys of species diversity of selected taxa be carried out to determine the influence of natural and man induced environmental control on diversity. Control factors of particular concern are the fragmentation and isolation of habitat; abiotic factors (e.g. climate, soils, elevation), biotic factors (E.G. influence of plant diversity on animal diversity) and various types of man-induced disturbance and land-use.

There is no scientific evidence that the taxa typically used as indicators of biological diversity are adequate indicators of overall taxonomic diversity. We recommend

that species diversity be surveyed not only for mammals, birds, reptiles, amphibians and insects, but also for other taxa (usually ignored) that are ecologically important or numerically abundant (including such taxonomic groups as gastropods, soil micro organisms and 'lower' plants).

ii) Biology of extinction:

Studies based on the theory of island biogeography suggest that most Biosphere Reserves may not be large enough to contain sufficiently large animal and plant populations to ensure their long-term survival. Plant and animal species are typically comprised of many local demographic units- subject to extinction, immigration, dynamic fluctuations in size, and to variations in genetic composition in time and space. The long term demographic, genetic and evolutionary health of a species depends on the integrity of this dynamic system.

As a consequence of the above considerations, the following questions must be addressed in order to ensure adequate protection of species and their genetic diversity.

1. What is the minimum area required for long term survival of a species?
2. What characteristics predispose some species to endangement while others flourish?
3. What is the relationship between characteristics of species and the genetic diversity it contains?
4) What is the relationship between genetic diversity and susceptibility to extinction?

To answer these questions the following approaches are suggested:

1) Fragments of wet evergreen forest should be conserved for selected taxa to determine especially the effects of habitat fragmentation and isolation of different species. Collection and analysis of data should follow standard procedures that are set forth by similar previous studies.

Studies of selected taxa representing different life history strategies, dispersal capabilities, home range requirements, population diversity and dispersion patterns should be initiated. The results of such studies will provide basic information on the value of such characteristics in predicting minimum area requirements and susceptibility to extinction.

2) Long term population monitoring and research programme should be instituted involving species selected on the basis of their suitability as models from which general inferences could be drawn. The studies should focus on the fundamental aspects of population biology, which are generally lacking, only a handful of such studies have even been carried out. Emphasis should be on population dynamics; population regulation, population genetics and the relationships of each to the extinction process and minimum population size requirements.

iii) Research and Monitoring of Selected Populations

For the successful management of the animals of any Biosphere Reserve, research and monitoring using standard population monitoring techniques are necessary. Research on the following key animal groups in different habitats with varying human interference is recommended:

1) Insectivorous birds;
2) Frugivorous birds with special reference to Hornbills;
3) Small carnivores and their prey;
4) Large mammalian predators and their prey;
5) Elephant population dynamics, movement patterns, and impact on habitat.

It is also recommended that a study be initiated to investigate the reciprocal impacts of human wild life interactions. The following lines of research shall be undertaken:

1) impact of elephant, while pig, rodent, monkey, parakeet and other animal depredations on agricultural crops;

2) the effects of hunting, habitat modifications, and trapping on endemic and endangered species.

It is envisaged that these lines of research will result in appropriate measures being implemented to mitigate the deleterious effects of human wild life conflict.

iv) Baseline Monitoring of Indicator Elements

Occurrence or absence of certain plant and animal groups can be correlated with habitat quality. Hence research and monitoring are also required on the following likely sensitive indicator species such as :

Butterflies:	as indicators of habitat diversity
Crocodiles :	as indicators of the health of the river ecosystem
Kingfishers:	as indicators of the health of the aquatic ecosystems
Woodpeckers:	as species dependent on tree holes
Eagles :	as species dependent on the availability and abundance of reptilian, avian and small mammalian prey
Langurs and other primates:	as indicators of habitat diversity and quality
Sloth bear :	as indicators of health forest ecosystem

6. EDUCATION AND TRAINING

Concerted actions at local, regional, national and international levels will be required to halt the destruction of the earth's natural systems, and this will only be achieved through unprecedented public support. This understanding will have to be generated through public education and understanding, not only of the problems, but of the means to solve them. The Biosphere Reserve programme, of conservation, research and rational management of natural resources offers one means to help solve, the problem, but to suceed it too will need a strong component of education and training, for the public at various levels and for those persons who are involved in the management and operation of Biosphere Reserves.

The development of education and training activities associated with Biosphere Reserves is discussed here under the following headings:

a) Dissemination of information
b) Development of educational programmes
c) Training of professional and management personnel
d) Demonstration projects

6a. Dissemination of Information

National and State agencies which have responsibilities in the Biosphere Reserve programme should develop and disseminate information which explains the programme; its objectives, and their responsibilities for carrying out the programme. Information could be disseminated in various ways such as newspaper articles, bulletins, radio programmes etc. The MAB office in UNESCO(Paris) can provide regular information on the status of the international programme and Biosphere Reserves in other parts of the world, if this information is desired. Exhibits on the MAB programme are also available to countries that request them.

An example of a radio programme which might serve as a useful model for the Biosphere Reserve programme is the so-called 'Environment school' broadcast on AIR, Bangalore.

Each individual Biosphere Reserve should also provide informational material describing its programme and activities, as well as material on the history, culture, and natural features of the area. The development of this material should always take into consideration the cultural and religious traditions, needs and welfare of local residents, and how Biosphere Reserve activities affect them.

At each level of information dissemination, the materials should be developed in the local language of the people.

6b. Development of Education Programmes

While educational activities should be developed at the various levels mentioned above, the programme at the reserve level is probably the most important. Here, it should be developed primarily for local residents, but also for visitors to the Biosphere Reserve. Ideally education centres should be developed where information such as that produced by research in the reserve, can be interpreted and made useful to local teachers, officials and residents. Wherever possible, educational centres should present educational materials and programmes relevant to the resource problem, with special emphasis on problems associated with resource use practices, in particular habitats.

Activities to be carried out by these education centers include:

1. Documentation and interpretation of scientific information;
2. Printing and distribution of educational material related to the Biosphere Reserve and its programmes;
3. Development of exhibits, audio-visual programme etc.

4. Programme for local schools and work with teachers in actual projects in the reserve.

It is expected that each Biosphere Reserve would develop a plan for its educational activities which would outline the requirements for staff, facilities and equipment as well as develop the theme of the programme and methodology for carrying it out.

6c. Training of Professional and Management Personnel

Training of both professionals and managers will be extremely important in the management of India's Biosphere Reserves. Some of the training can best be undertaken in the individual reserves while other training may be handled in specialized training centers. Under the South Asian Co-operative Environmental Programme (SACEP) India has already been given the nodal responsibility for environmental education. Other proposed means of handling this would be creation of a training institute modelled after the College of African Wildlife, which is devoted to the development of inter disciplinary skills in such diverse subjects as wildlife management, vehicle maintenance, administration, law enforcement, public relations and education, all taught with a special emphasis on field training.

The type of institutional arrangement for training will depend on the people being trained and the type of training they will receive. For scientists, managers, administrators and special need groups, the center concept probably will work best. At the Reserve level, the important training should be carried on in the workshop format. These types of programmes should be primarily inter disciplinary, skill oriented and field conducted wherever possible. A wide range of programmes will be conducted in this way. It will be important to stress the need for all employees to understand the various functions of the reserve and to be trained in both education and communications so that they can spread the conservation message to the people they interact with.

It should be stressed that special training must be given to local people so that they can qualify for jobs on the Reserve. Refresher programmes will also be necessary.

6d. Demonstration Projects

Once the Biosphere Reserve has been established or even before if possible projects should be developed to demonstrate the application of information resulting from existing scientific knowledge about a particular problem or from the research activities in the reserve.

Consideration should also be given to organizing eco development camps involving local residents, as has already been done in several areas in India. The Dasholi Gram Swarajya Mandal, which pioneered the famous Chipko movement has organised community forestry programmes since 1976; their ecodevelopment camps provide a good example of the type of programme which could be tried in Biosphere Reserves. Scientists, environmentalists, local government officials, state foresters, college students and community leaders have participated in the programmes of Dasholi Gram Swarajya Mandal and should do so in the BiosphereReserve Programme. The help and existence of volunteer organizations should also be utilized wherever possible. These volunteer groups might be encouraged to organize these community forestry or eco-development camps, which would be funded by appropriate agencies of government.

II

PROPOSAL FOR

INDO--US COLLABORATION

1. DEVELOPMENT AND REFINEMENT OF BIOLOGICAL DIVERSITY INFORMATION SYSTEM

Synoptic description: Certain institutions and scientists in India and the U.S. would cooperate in the development of systematic standardised procedures for the collection, compilation, organization, analysis, and application of information on the elements of natural biological diversity in India. This program would begin with a pilot project on the biological diversity of the Western Ghats biogeographic province. If successful, efforts would then be made to institutionalize the system on a national basis and to initiate similar efforts in other biogeographic provinces.

Benefits of Indo-U.S. Collaboration: On the Indian side, scientists could benefit from more than eight years experience in the development, application, and refinement of such systems in the U.S., presently being carried out through 28" State Natural Heritage Programmes" and other related efforts. This experience could prove helpful in avoiding the sorts of mistakes which hindered the U.S. programmes in the early stages of their development. On the U.S. side, certain aspects of such an Indian information system, especially in regard to its potentially unprecedented integration into the national process, for selection and design of Biosphere and other reserves and the direct inclusion of information from the reserve site inventors and research could also prove instructive in the refinement of similar systems with the U.S.

Collaboration institutions:

India : Department of the Environment, Indian Institute of Science, others as necessary

U.S. : National Park Service, The Nature Conservancy, others as necessary

Principal Investigators:

India : Dr. Madhav Gadgil, Professor, Centre for Theoretical Studies, Indian Institute of Science

U.S. Dr. Robert E. Jenkins, Jr., Vice President, Director of Science Programs, The Nature Conservancy, 1800 North Kent Street Arlington, Virginia 22209

Proposed initiation date and duration:

September 1982, to be continued for 3 years.

Budget (by year);

DEVELOPMENT OF BIOLOGICAL DIVERSITY INFORMATION SYSTEMS

3 year Budget

	Year 1	Year 2	Year 3	Total 3 years
U.S.SIDE				
- P.I.+12 staff-10th time				
- 1 round trip, 2 weeks, 6 months into program	Contributed	Contributed	Contributed	Contributed
airfare-Dullen-Delhi-Bangalore and return	Rs.27,000			
per diem $85x14	10,710			
	37,710			
-1 round trip-add 10 percent inflation		Rs. 41,481		
-1 round trip-6 months before end-add 10 percent			Rs.45,629	Rs.124,820
INDIAN SIDE				
P.I.-1/3 time Subramanian-1/4 time Joshi -1/2 time Prasad-1/3 time Father Saldanna -1/3 time	Contributed	Contributed	Contributed	Contributed
3 Student research assistants				
Salaries:Rs. 10,000X3	Rs. 30,000			
+10 percent		Rs.33,000		
+10 percent			Rs.36,000	

FIELD COSTS P.I. Prasad, Sultanha - 4 mo/yrx3 =12
3 Research Assistants - 6 mo/yrx3 =18
Joshi, Subramanian - 1 mo/yrx2 =02

Field time/yr in months 32

From prepage

Field Transportation costs	Year 1 Rs.	Year 2 Rs.	Year 3 Rs.	Total 3 years Rs.
32 man months x Rs.2000/mo	64,000			
+10 percent		70,400		
+10 percent			77,440	
Field per diem				
32 man months x Rs. 1000/mo	32,000			
+10 percent		35,200		
+10 percent			38,720	
Equipment:1--4 wheel jeep	100,000			
Furniture,filing cabinets,maps, film, cameras, miscellaneous	100,000			
Space:1000 ft addition to Center for Theoretical Studies x Rs.100 ft^2	100,000			
Foreign Travel: 2 trips of 3 months to work in State Heritage program				
2 round trips	54,000			
Per diem $60/dayx180 days	97,200			
	577,200	138,600	148,460	864,260

GRAND TOTAL : 3 years -- Rs. 1,089,080 ($ 121,009)

2. INDO-US WORKSHOP ON SUSTAINABLE DEVELOPMENT OF THE COASTAL ZONE

Description:

India's extensive coastline provides terrestrial, nearshore and deepwater habitats which support a rich diversity of plants and animals. The coastal zone provides commercial and subsistence fishing and shell fishing important to the nation's economy. Human settlement of the shoreline had resulted in widespread disturbance of the land surface. In many cases near complete destruction of natural ecological conditions has occured as well as locally severe contamination of near shore waters from sewage, domestic wastewater, industrial development, and accelerated runoff from inappropriate land management practices. At the present time, India has not developed institutions, law and regulations to provide the framework for conservation and sustainable development of the coastal zone.

In order to enable effective conservation and the greatest possible sustainable benefits to the well being of people, the Indo-US Workshop on Conservation and Management of Biological Diversity recommends that the responsibility for coastal zone management policy with Indian Government be clearly established and that development of a coordinated coastal zone management programme be considered.

As an initial undertaking, an Indo-US workshop is proposed to provide for exchange of information useful in program development.

BENEFITS OF INDO-US COLLABORATION

The proposed Workshop would enable the Government of India to utilise the extensive experience of the United States in classification, natural resource inventory, ecological research, and management of the coastal zone in developing a programme for planned development. It would create

awareness of the unique problems of the coastal zone, and provide a framework for evaluating and addressing these problems. Additionally, it would enable the development of policies and institutions needed to maintain the productivity of coastal resources in the face of the growing demands of human populations for exploitation, particularly of shoreline and nearshore marine environments.

PRINCIPAL INVESTIGATORS

Not yet determined

MISCELLANEOUS

None

3 INTEGRATION OF REMOTE SENSING AND DIGITAL CARTOGRAPHY IN DEVELOPING A MANAGEMENT INFORMATION SYSTEM FOR BIOSPHERE RESERVES

Description:

Remote sensing technologies using airborne and satellite multispectral scanners provide opportunities for obtaining large amounts of information on the physical, biological and cultural features of the landscape rapidly, inexpensively, and with a high degree of accuracy. The advent of modern digital image processing techniques has revolutionized our capability to analyse and integrate geographically referenced information on surface features and phenomena. Repetitive surveys using these techniques provide the basis for monitoring changes in these features and phenomena, as well as prediction of future conditions. Nevertheless, the full benefits of these techniques in providing an improved basis on land management can be realised only through integration of information derived from remote sensing and information from other sources.

Digital cartography involves the conversion of mapped information into digital form for entry into a computer. The technology provides virtually unlimited opportunities for data analysis and integration. As progressively more types of mapped information are added to the digital data base, its value in supporting planning and decision-making increases.

The union of remote sensing and digital cartography, now undergoing experimental development in the United States, will enable the rapid generation and display of information in forms most suited to the needs of the scientist, land managers, planner, and decision-maker.

This proposal envisions the development of an integrated cartographic information system as a demonstration project in the proposed Nilgiri Biosphere Reserve. This will be the first effort in India to combine the benefits of remote sensing and digital cartographic technology in the planning and management of a protected conservation area, and will provide a prototype for application elsewhere. The project will include high resolution vegetation and land use mapping using airborne multispectral data collection in the Nilgiri Biosphere Reserve. This work will enable evaluation of the utility of this technology in classifying and mapping the tropical forest vegetation of southern Peninsular India.

Benefits of Indo-US Collaboration

For India, the project enables development and testing of new technologies to improve the amount and availability of scientific, geographical, and socioeconomic information relevant to the management of Biosphere Reserves and other protected areas. For the United States, the work permits the testing of new technologies in regions possessing different characteristics of vegetation, land use, and human impacts. It will also enable standardization of methodology and provide a framework for innovative application of the technologies and management both domestically and internationally.

As effective land management in the years ahead will depend on the timely availability of accurate and up to date information, including comparative data from multiple sites, the development of an integrated management information system on a multinational scale will be of increasing value to both countries in developing perspectives on problems of common interest.

COLLABORATING INSTITUTIONS

INDIA: National Remote Sensing Agency, Hyderabad; Botanical Survey of India; French Institute of Pondicherry, Indian Institute of Science, Bangalore

U.S. : National Park Service
Other natural resources agencies as required.

Proposed Initiation Date and Duration:

The project is proposed for initiation in January 1983 and will require approximately two years for completion.

BUDGET

(Two year budget, details to be provided by the National Remote Sensing Agency)

Budget Item	Cost. Rs.
Remote Sensing Project	
Visit of 2-3 U.S. experts to National Remote Sensing Agency and field site (Jan. 1983)	1,50,000
Aerial photography(color and I.R.) of approx. 1000 Km^2 and 11-channel multispectral scanning of field site (Jan. 1983)(NRSA)	4,00,000
Procurement of equipment in India (NRSA, IISc?)	?
Software procurement and development in India (NRSA)	?

Budget Item	Cost (Rs.)
Training of Indian colleagues and onsite coordination approx. 2 visits of 2-3 U.S. experts during project, for 2 weeks (U.S. and NRSA, IISC, BSI, FI)	250,000
Image classification and analysis of digital imagery (NRSA, BSI, IISC, FI)	?
Ground truthing for image classification (NRSA, BSI, IISC, FI)	?
Map preparation (NRSA and IISc)	?
Accuracy assessment (IISC, BSI, FI)	?
Map revisions (NRSA and IISC)	?
Supplies and materials	10,000
Digital Cartography	
Visit of 2-3 U.S. experts in digital cartography, at 2 weeks (Jan. 1983)	150,000
Procurement of equipment in India, such as automated digitizer (NRSA)	?
Procurement and development of software in India (especially re. integration of digital cartography and remote sensing capabilities (NRSA)	50,000
Training of India colleagues and on site project collaboration, approx 2 visits of 2-3 U.S. experts during project, at 1 week	150,000
Preparation and publication of handbook on components and use of cartographic information system (NRSA, IISc)	50,000
Supplies and materials (NRSA, IISc)	10,000

One visit of principal Indian collaborators from NRSA, IISc, BSI and FI to visit U.S. agencies/and Biosphere Reserves installations where the relevant technologies are being developed and applied may be desirable.

Source of funds

P.L. 480 funding support of the National Remote Sensing Agency and other agencies and for travel/subsistence of U.S. collaborators will be required.

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Miscellaneous

None

4. SIGNIFICANCE OF LONG-TERM CHANGE IN COMMUNITY AND NUTRIENT COMPOSITION OF FOREST TYPES IN THE NILGIRI BIOSPHERE RESERVE FOR NATURAL RESOURCE VALUES

Objective 1:

In any natural ecosystem changes in plant community and ecosystem properties may occur over periods of several decades in response to natural and anthropogenic disturbances. Shifts in community composition and diversity, productivity rates, organic matter and nutrient accumulation and mineralization rates, etc., can occur slowly, at rates below detection in one or a few years. Over periods lasting one or two decades

or more, however, directional changes could accumulate to significant levels affecting the capacity of the Biosphere Reserve to conserve diversity and natural resource value.

The most immediate source of ecological change with Nilgiri Biosphere Reserve is likely to be induced by increased human utilization for grazing, fibre, and fuel products, and associated disturbances such as fires. This situation can be viewed as an opportunity to analyse the relative sensitivity of various vegetation types to resource utilization and disturbance. This analysis can form the basis for managing human use at levels which preserve the long term integrity of each habitat. Similarly it will help to detect a gradual loss of site productive capacity at an early enough stage to allow management or control strategies to minimize impacts.

Objective 2:

In the same sense, controlled manipulation studies can be carried out in selected forest stands in which future disturbance is anticipated in order to evaluate probable effects of utilization of forests. Selective tree removal, ground layer vegetation and litter harvest, or regulated grazing can be evaluated as to effect on the same parameters measured in control stands (described below). Forest types subject to loss of organic matter or those exhibiting poor or undesirable recovery of remaining vegetation or critical species can be excluded from utilization intensities about tested levels-other forests having greater recovery potential can be managed for sustained yields of forest products at prescribed utilization levels.

Objective 3:

Take together the set of measurements described below will contribute to understanding of long term behaviour of ecosystem dynamics both on response to natural landscape processes like succession or stand aging, and to human interaction.

The data would also form the basis for management strategies aimed at conserving the integrity and biotic diversity of the Nilgiri Biosphere Reserve ecosystems.

The foregoing discussion has introduced the practical basis for posing hypotheses concerning the nature of change in community and ecosystem projects of the Nilgiri Biosphere Reserve which may occur over the next one to three decades. The following hypotheses (phrased as questions) lead to researchable topics which may influence the role of the Biosphere Reserve as focus for preserving biotic diversity and for wise management of regional natural resources:

1. Will shift in the areal extent of one or more of the major ecosystem types of the locality occur over the next several decades in response to climatic change or human use impacts? will changes (if they occur) affect the capacity of the sites to maintain existing biotic diversity and natural resource values?

2. Will the postulated change affect forest growth rates, forest successions patterns, soil and humus layer, and standing crops of nutrients and organic matter?

3. Will current levels of firewood collection, timber removal, litter and ground layer removal and grazing reduce long term resource value of the major forest types? what levels of utilization can each forest type tolerate on a sustained yield basis without loss of ecological integrity and biotic diversity?

RESEARCH APPROACH

Changes in response patterns of forests and other parennial systems frequently take several years or more to become detectable, particularly if casual mechanisms shift gradually. Their research must be conducted for time periods long enough to detect effects that may not be observed in analyses lasting only one to several years. This calls for

long term research for special requirements with respect to sampling methods and data handling. Periodic resampling of the some research sites is a principal method for obseuring deviations in community and ecosystem properties. This approach requires either fixed sampling points (E.g. permanent plots or monitoring stations) or permanently marked sites which can be accurately relocated. The following parameters expressed on an area basis should be measured at permanent sampling stations (suggested periodicity of measurement follows):

1. Germination and establishment of major or representative tree, shrub and herb species (semi-annual or coincident with critical wet and dry season).
2. Survival from year to year of sapling, pole timber and sub canopy, canopy and emergent trees (annual).
3. Growth rates of major tree species determined by diameter increment such as elongation of twigs or litterfall (annual).
4. Accumulation of and major nutrient (NPK) content+ soil and litter organic matter (annual).
5. Litter decomposition rates (variable, depending on decay rates of subject material).
6. Stream water organic matter and mineral content at weir or other permanent stream sampling station (weekly or as fre uently as possible, in rainy season).
7. Microclimate measurements-litter layer, soil moisture, rooting zone moisture, and temperature (weekly in rainy season; monthly otherwise)
8. Detailed descriptions of disturbance (fire, grazing, wood harvest, animal damage or outbreaks). (According to occurrence).

Initial work could proceed by addressing a sub-set of the above parameters (e.g. 1-4 plus litter accumulation), leaving other parameters for a later time.

During the duration of the research, information on climatic trends and land use changes would be needed. Therefore it is assumed that a weather station would be operating somewhere in the Nilgiri Biosphere Reserve. Changes in the intensity of human utilization of experimental stands should be monitored, or where controlled harvest experiments are conducted, documentation of the manipulations provided.

The previously described methods should be applied to the control and experimental forest areas. The two areas should be chosen to match as closely as possible in forest composition, relative location, site quality, topography, position, etc. Control sites can be located in core stands. Experimental stands could be located in buffer zones where human utilization thatis already underway can be monitored, or in other buffer stands where controlled manipulation can be conducted to simulate human utilization at one or more intensity levels. Permanent plots should be established in the major forest types. Exact number of plots and sizes cannot be specified now but approximately ten 100 m^2 plots per forest stand, with nested 6.25 m^2 plots for litter and ground layer studies may be suitable. Plots should be located randomly, or along transects. Initial reconnaissance of stands to be studied should be made by transects in order to evaluate the variability of properties that will be measured. This information will aid in determining the number and location of plots and site-specific conditions that may affect stand response.

Initial work of the project (stand selection, plot establishment and initial data collection) would be carried out by the Principal Investigators. However, subsequent sample collection could be continued by graduate students or technicians. Species identification and mineral analysis

would require specially trained personnel. American co-operators would make site visits and participate in data collection at least annually. Coordination of the project with one or more U.S. Biosphere Reserves would be undertaken to provide for standardization of methodologies where appropriate. Data collection should be extended for as many years as possible since the value of the data sets will increase with duration. Thus, sampling for at least one decade and peferably longer, is needed. But valuable data would become available immediately, providing information on the current base-line ecological properties of the test sites, and year to year variations in these properties.

Benefits to India:

Improved understanding of the resource management needs of the major forest types of the Nilgiri Biosphere Reserve in relation to increasing human use. Also to develop a data-base which allows projection of the effects of different levels of grazing, logging, fuel wood removal, fire and other disturbances upon the growth and productive capacity of the major forest types. The research will also lead to better understanding of the relationship between long term change in the forest ecosystems caused by natural causes and by man.

Benefits to U.S.:

Expand the limited understanding that currently exists regarding tropical ecosystem both to advance the basic science of ecology and to improve resource management capabilities.

	BUDGET A. (for a reduced programme addressing parameters 1-4 only)	BUDGET B. (for a full programme addressing parameters 1-8
Salaries - Indian Participants		
	Rs.	Rs.
Co-Investigator	45,000.00	75,000.00
Technician	20,000.00(1)	45,000.00(2)
Field Hands	10,000.00	20,000.00
Secretarial	10,000.00	20,000.00
Travel - International U.S. side	25,000 (1 person trip)	Rs. 50,000 (2 persons trip)
Local - US side	400	1,000
Indian side	3,000	5,000
Equipment/supplies		
Field instruments	3,000.00	6,000.00
Laboratory instruments	1,000.00	12,000.00+
Miscellaneous supplies	1,000.00	3,000.00
Overhead (20 percent of above total)	11,340.00	23,700.00
TOTAL	1,24,740.00	2,60,700.00

+ A one time cost for an atomic absorption Spectrophotometer at Rs. 10,000.00 is included

Collaborating Institutions:

U.S. The Institute of Ecology
4600 Sunset Ave.

and U.S. Agencies (to be determined)

Principal Investigator : Dr. T.V. Armentano
The Institute of Ecology
Indianapolis
Indiana

INDIA : Not determined
Principal Investigator: Not yet determined

5) TRAINING PROGRAMME FOR NATURAL RESOURCE MANAGEMENT PERSONNEL

Nature reserve personnel require both scientific and human relations skills, and should be trained to discharge their duties in a professional manner. Due to the increasing complexity and sensitivity of their jobs, such training should include a period ofstudy in a facility devoted to this particular role. Therefore, the workshop concludes that there should be a programme developed in Indian to train persons involved in the administration, management and protection of Biosphere Reserves.

The training at the College of African Wildlife Management, Mweka, Tanzania could serve as a model. This college serves persons from several countries who have been assigned to national parks and reserves. Students are given one or two years of specialized but interdisciplinary training in subjects ranging from wildlife management to vehicle mechanisms, administration and law enforcement, and public relation and education. A great deal of time is spent in the field working on the kinds of problems they will face in managing a reserve.

Such a center for specialized training could be established in India in association with an existing institution, and possibly in cooperation with other nations in Southeast Asia. It should also be able to draw upon the resources of several ministeries, organizations, as well as international sources of training experience. The center might also develop training materials based upon particular problems in individual reserves to improve the effectiveness of working with local people and carrying out the various duties.

The U.S. has developed considerable expertise in such training in recent years, especially in Africa, Latin, America and in its own territory. India, therefore could derive considerable benefit from this experience, particularly as it pertains to the core areas. The U.S. on the other

hand, has had relatively little experience in the management of thickly settled buffer areas, such as are envisaged for Biosphere Reserves in India and elsewhere in the tropics. The U.S., therefore, could derive considerable benefit from exposure to the challenges inherent in buffer area management and administration.

As a first step, it is proposed that there be an Indo-US Workshop to develop a plan for an appropriate training facility. Such a plan would include descriptions of the courses(curricula) and programmes, example syllabuses, as well as suggestions useful materials, field training procedures, staffing and related topics.

Principal Investigator : Not yet determined
Miscellaneous : none

6) INDO-US DIRECTORY OF SCIENTISTS, INSTITUTIONS AND ORGANIZATIONS CONCERNED WITH CONSERVATION OF BIOLOGICAL DIVERSITY

Discussion: The proposed project involves preparation of a directory of Principal Scientists, Institutions, and Organizations concerned with the study, conservation and intelligent use of ecosystem, with particular emphasis on tropical regions. The directory will serve as a basic reference on sources of information, technical assistance, and expertise in India and the U.S. on a broad range of topics covering such fields such as floristic and faunal surveys, population studies, conservation biology, ecosystem modelling, community and systems ecology, genetics, ethnobotany, social forestry, and ecodevelopment,environmental education, management training, environmental monitoring, remote sensing and digital cartography, natural areas protection programme, biosphere reserve etc.

Benefits of Indo-US Collaboration

The directory would facilitate bilateral collaboration in all fields relevant to the conservation and management of biological diversity by providing a well indexed and cross-referenced selective listing of authoritative sources with required capabilities in the subject areas.

Collaborative Institutions:

India	:	Department of Environment, Ministry of Agriculture, and other agencies and organisations as appropriate
US	:	The Institute of Ecology, Smithsonian Institution, National Park Service, other agencies and organizations as required

Proposed initiation date and duration

July 1982

Duration about 6 months

BUDGET

India : Project Coordinator	?
6 nos. at Rs. 3,000	Rs. 18,000.00
Typing	
1 no. Rs. 800	Rs. 800.00

U.S. sources funding to be determined

Principal Investigators : to be determined

APPENDIX A

List of participants

Indo-US Binational Workshop on Conservation and Management of Biological Diversity

2-11 March, 1982

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APPENDIX B

P R O G R A M M E

Tuesday, 2nd March 1982

Session I

Chairman - Madhav Gadgil

Zafar Futehally
A National Overview of problems and opportunities for nature conservation in India

Michael Soule

A global perspective on conservation of biological diversity

R. Rudran

U.S. Institutional capabilities and accomplishments in tropical ecosystem inventory and research

COFFEE BREAK

Session - II

Chairman- William P. Gregg

N.C.Nair

The Indian capabilities in botanical survey

K.C.Jayaram

The Indiancapabilities in Zoological surveys

L.R.A. Narayanan

Indian capabilities in remote sensing

LUNCH BREAK

Session - III

Chairman - C. Karunakaran

N.V.Madhavan Unni

Role of remote sensing in survey of vegetation types and planning conservation and management

N.Menon

Indian capabilities in cartography

S.K. Saxena

Management of Natural Resources of Indian deserts

P.N. Vishwanathan

Indian capabilities in monitoring air pollution

M. Mariappan

Indian capabilities in monitoring of water pollution

COFFEE BREAK

Session - IV

Chairman - Robert Jenkins

V.C.Gilbert

Development of the MAB programme in India

Wednesday, 3rd March 1982

Session - V

Chairman - N.C.Nair

Robert Jenkins

Planning and development of the natural heritage programme

Madhav Gadgil

Identification, evaluation and selection of biosphere reserves in India

The U.S.experience in selection of biosphere reserves

B.A. Wilcox

The Role of research in population biology in the selection and management of biosphere reserves

COFFEE BREAK

Session - IV

Chairman - V.C. Gilbert

K.C. Malhotra

The social context of conservation

Paul Nowak

Environmental education and
public communication in biosphere reserves

L.S. Prahlad Rao

Environmental education in India
communication in biosphere reserves

T.V.Armentano

The role of long term ecological research in addressing regional and global environmental problems

LUNCH BREAK

Session - VII

Chairman - K.C.Malhotra

R.C.Haradan

Practical considerations in management
of biosphere reserves - Manager's perspective

D.K. Deshmukh

Natural area protection and management

R.E.Good

The New Jersey Pinelands

L.A.Loope

The role of science in the management of three U.S. tropical ecosystem biosphere reserves

COFFEE BREAK

Session - VIII

Chairman - M. Soule

S.S.C.Nair

Namdapha biosphere reserve - a case study
Bhag Singh
The tura Citrus Gene Sanctuary
Thursday, 4th March 1982

Session - IX

Robert Jenkins

Ecosystem restoration

M. Gadgil

Nilgiri Biosphere Reserve - a case study

N.D. Jayal

Legislative and administrative framework for biosphere reserves in India

March 4 and 5, 1982

WORKING GROUP MEETINGS

1. Selection of a network of nature reserves

2. Biosphere reserve criteria/administration

3. Motivation of public

4. Inventory, monitoring and ecological research

March 6, 1982

Presentation of working group reports by Group Chairman

FINALIZATION OF RECOMMENDATIONS

March 7-11

Field Trip to Nilgiri biosphere reserve