BIOLOGICAL DIVERSITY IN THE ASIA REGION

ISSUES AND OPTIONS FOR ACTION

Volumes I and II

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BIOLOGICAL DIVERSITY IN THE ASIA REGION:

ISSUES AND OPTIONS FOR ACTION

VOLUME I

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ANE/ASIA TR/EFE

August 28, 1985

This paper is dedicated to my son Kenneth Viktor Golubic-Campbell (born April 5, 1985), with the hope that he, and his children, and his children's children will have the same chance as I to delight in this wonderful world of living creatures and enjoy the benefits of their existence.

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INTRODUCTION

Conservation of biological diversity is a relatively new aspect of development activities at the U.S. Agency for International Development. Our involvement began in 1983 when Congress amended Section 119 of the Foreign Assistance Act to reflect concern for the impact of development assistance on biological diversity worldwide, although environmental protection has been an important aspect of AID activities for a number of years. Charged with responsibility to take the lead in developing an approach, a task force was formed and led by AID. Together with input from a number of other government agencies and interested groups, a U.S. Stategy to Conserve Biological Diversity was published and presented to Congress in February, 1985. Implementation of this strategy must now be accomplished, and will require the concerted effort of all branches of the agency. This paper was written to summarize some of the major issues relating to conservation of biological diversity in the Asia region, analyse what they imply for development assistance, and to present options for action that the Bureau for Asia and the Near East (ANE Bureau) could undertake.

The crucial difference between problems of biological diversity and problems of environment per se, is that conservation of biological diversity emphasizes the inherent value of variety among life forms both for basic ecosystem functioning and as a basis for the differences among ecosystems, as well as the need to use species and ecosystems in a judicious fashion to support human needs. Environmental protection, on the other hand, emphasizes the interrelatedness of organisms and their surroundings, and the need to respect and preserve the integrity of ecosystems from impacts of human activity to ensure their continuity. These concepts are interrelated, however, as environmental protection serves to preserve diversity, and diversity is known to contribute to ecosystem stability.

The accelerated exponential growth of human populations that occurred during the latter part of this century, combined with efforts to increase living standards, led to exponential use of natural resources for economic growth worldwide. Hunting for pleasure, sport and trophies (tourism), collection and hunting for food and for trade are known to be the most direct causes of species extinction. It is now recognized that extinction of species also occurs through destruction of their habitats, through deforestation, conversion to agricultural lands and monospecific forest plantations, and as a result of mining and construction activities. Other important impacts on species and their habitats derive from pollutants, e.g. toxic wastes, municipal and industrial effluents introduced into water and air, and fertilizer and pesticide laden run-off from agricultural land.

During the period from 1960 to 1980, an estimated 20,000 species of plants and more than 1,000 vertebrate animal species of Asia were threatened with extinction. The current number of species in the Asia region is estimated to be between 300,000 and one million. The number of species which are likely to become extinct in Asia during 1980-2000 may lie between 33,000 and 110,000[1]. (These estimates probably do not take microbial species into account.) The largest number of extinctions are expected in the insect order, the next largest in the plant order and in the third place comes the extinction of mammals, birds, and reptiles. The importance of the increasing frequency of extinctions can only be indirectly inferred through study of similar catastrophes contained within the fossil record. What we cannot do is predict the exact consequences of these extinctions for human and other forms of life, although the outcome as ascertained by ecological study of discrete areas is not promising. However, as we come to understand more about the relationship between diversity and ecosystem function, and sustainable harvesting of the resources required for human existence, we will be less and less erroneous in our decisions about what may be crucial and what may not be, if, indeed sacrifices of other life forms are truely inevitable for the survival and comfort of our own species.

The U.S. Agency for International Development is primarily concerned with devising and providing means to less developed countries (LDCs) for their own economic growth, in support of human survival and improved quality of life. There has been a shift in philosophy away from supporting development projects having a single objective to a more integrated approach, that includes appropriate concern for the consequences of planned projects on the environment, cultural context, and other development sectors, in addition to efforts to achieve the primary objective. The cost/benefit ratio of single objective projects has increasingly been called into question, as evidence of unforeseen undesirable short and long term side-effects started to accumulate. Now that environmental concerns have become an integral part of agency policy it is appropriate that ways be found to reduce to the smallest possible level any untoward effects of development activities which could conceivably undermine the future stability of any nation's natural resource base or curtail their maximum potential benefit from it. In this context, it must be borne in mind that of the multiplicity of applications which have been found for the known species we use to our benefit, only a fraction of their economic potential, and that of others as yet unknown to science, has been tapped.

BIOLOGICAL DIVERSITY IN THE ASIA REGION: ISSUES AND OPTIONS FOR ACTION

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August, 1985

EXECUTIVE SUMMARY

GENERAL ISSUES

Perhaps the most important thing to keep in mind when discussing the seemingly esoteric subject of biological diversity is that we are talking about the heritage of all mankind: the collection of unique lifeforms which have evolved on a unique planet in our solar system. The second point is that everything is interrelated with everything else, and it was the increasingly complex web of their interaction over eons of time which created the very conditions that eventually were suitable for the emergence and success of *Homo sapiens*. We are completely dependent upon the continued functioning and outputs of that system for our own existence. Evolution will continue, regardless of the severity of our impact, but if we pursue the present path, the prospect is for less rather than more beneficial conditions for our support.

Our species has embarked on an indeliberate mission of reducing the complexity of this living planet. This complexity is reduced through the extinction of species, which occurs by overexploitation and habitat destruction. We are currently witnessing the largest extinction event that has occurred on the Earth since the end of the Cretaceous period 70 million years ago when the dinosaurs became extinct, and we are causing this one. Each lifeform which becomes extinct is gone forever. No amount of human innovation can conceivably replace what has taken nearly four billion years, most (99.9%) of that time in our absence, to accomplish.

We Americans have been, and still are the prime beneficiaries of the unique fruits of this diversity. We have, in pursuit of our economic strength and our material demands, quite literally created many of the pressures that now threaten the survival of a myriad of species all over the world. We have set the pace and the example for the rest of the world. Considering the gulf between our economic strength and that of our third world cousins, it is quite clear that we are obligated not only to preach our newfound wisdom to the rest, but also to be the leader in designing and applying the necessary remedies. It is, in that sense, almost ironic that the Agency for International Development, which is primarily an economic development agency, should be charged by Congress with the leadership in devising and carrying out a strategy to conserve biological diversity. Yet, preservation of diversity and continued gains in economic strength and quality of human life are, theoretically, not incompatible. They must not be if the concept of "sustained development" is to be more than a slogan. As with a disease, the cure is most affordable and least painful when applied at the outset or as a prophylaxis. It is imperative that we engage in serious work and devote sufficient professional and financial resources to the effort to achieve a few truely significant results, setting the patterns and the standards for the rest. Everyone else has a better excuse not to.

SPECIFIC PROBLEMS IN ASIA

The level of species diversity in the tropical forests of Asia is probably the second highest in the world[1], both in terms of sheer numbers of species and concentrations of endemic ones (those that evolved there and livve nowhere else), following that of the Andean and Amazonian forests of South America. Deforestation of tropical (particularly lowland) forests has been clearly defined as the most eminent problem for biological diversity in the Asia region[1]. Although there are a large number of protected forested areas, lowland forests are underrepresented in the protected area system[2] (relative to their importance for biological diversity), because they can usually be converted to profitable agricultural land. Whereas quite a bit is known about the vertebrate animal species of the region, there is an appalling lack of data on microbial, plant, insect, and other invertebrate animal species in forests and other types of ecosystems of Asia[1]. Even less is known about the ecology of these species and the successional stages of the forests, or how they respond to selective harvesting[3]. Therefore, basic research in systematics and ecology is essential if we are to acquire a sufficient base of knowledge to make reliable predictions of minimum critical ecosystem size, carrying capacity of natural forests, and for successful "minimum management-maximum yield" mixed plantation forestry[3].

The alarming degradation of freshwater resources has been identified as one of the most important constraints to improvement of human health in Asia[1]. Unpolluted water is required to support the great diversity of freshwater species which have evolved in Asian rivers, lakes, and wetlands. The quantity and quality of freshwater ecosystems and the multiplicity of species which inhabit them are directly related to the areal coverage of intact, natural forests in watersheds. Therefore, large tracts of forests (perhaps as much as 20% of a country's forested area, particularly in the higher reaches of mountainous areas, should be managed as conservation units for their contribution to the biological diversity of both terrestrial and aquatic ecosytems. Low input fertilization (i.e. use of compost or dung rather than chemicals), integrated pest management (rather than heavy use of pesticides), no- or low-till farming methods, and pollution control (especially in industrial and urban areas) are the most significant contributors to freshwater quality and attendant biological diversity in downstream areas, including the marine coastal zone. It cannot be overemphasized that it is in oligotrophic (nutrient poor) freshwater and seawater in which the highest aquatic species diversity occurs, in every climatic region of the world.

RECOMMENDATIONS

My recommendations for a meaningful program for conservation of biological diversity in Asia are summarized below. They represent the results of my yearlong study of this issue as a AAAS Science, Engineering, and Diplomacy Fellow in the ANE/ASIA TR/EFE office. An expanded description of each activity mentioned in this summary, together with options for its implementation and probable cost, is found in Part III, Chapter 2 of this document.

1. We need to know where the most unique species and ecosystems occur, what is their current preservation/conservation status, and the degree to which they are threatened. In the face of limited resources, they must be prioritized for action. The existing information base (see Part I, Chapter 2 of this document) could be substantially improved by a dedicated consultancy of 6-7 months, and be quite comprehensive, with respect to existing information, with a year long effort. The least information on important terrestrial ecosystems is available for Oceania and Pakistan. Less progress has been made in the identification of the most valuable freshwater ecosystems than of terrestrial and marine ones. Documentation of threatened species of animals is more complete than it is for threatened plants, insects, and microorgansisms (in that order), although it is thought that greater numbers of insects and plants than animals are becoming extinct (there being essentially no information about extinction rates of microorganisms).

2. Basic scientific data specific to these unique organisms and ecosystems, and the principles derived from their evaluation must be obtained, validated through rigorous peer review, and then applied to devise management practices appropriate to sustain them. Multi-disciplinary ecological research involving both intact and experimentally modified ecosystems is required. The time frame of such research efforts must mirror the time frame of the species and the ecosystem regenerative capacity (in general this is greater for forest- than for aquatic systems). Identification and quantitative assessment of species composition (inventorying), and basic systematic research to describe those new to science, constitute essential components of this work. Screening them for economic value and suitability for domestication is the next step. Establishment of an exemplary field research facility for the Asia region is suggested. It should be located in a South East Asian Dipterocarp forest which has lakes, ponds, and streams representative of typical aquatic environments. It could constitute a discrete program of an Asian university or a private foundation, but should involve extensive

collaboration with the U.S. scientific community in its design, management, and program of research. At least ten years of support should be guaranteed to ensure success.

3. A program of technical assistance including provision of computer equipment is needed to establish one or more databases for Asia either (1) as one central service facility in an Asian country (preferably at the same location as the major research effort) or in Washington, or (2) several small country-level database facilities with a networking capability. A large initial investment into equipment, with 3-5 years of follow-on support for development and maintenance would be advisable.

4. In situ preservation of genetic diversity in National Parks, Wildlife, and Biosphere Reserves has been recognized as the preferred long-term solution because it is in most cases the cheapest, most effective way of dealing with the plethora of species, and because it simultaneously serves other beneficial functions (e.g. recharging of aquifers, stabilization of rain patterns, production of oxygen) that are essential for human survival and quality of life, as well as providing basic elements of support for the material-based economic system upon which modern civilization depends. In situ preservation and conservation activities must be given priority for support because they represent the only practical and affordable way to accomplish the goal. In any given watershed (from the mountain to the sea), the upstream ecosystems must be in balance or have a reasonable prospect of becoming so, or there is no point in working to protect those located downstream. A few highly visible projects for conservation of lowland tropical forests, solicited from the U.S. and Asian P.V.O. community should be the first projects of this type to be funded. The criteria for selection of each project should include: (1) representativeness of the site for subregions of Asia (2) the site should be relatively undamaged and big enough to support the endemic large carnivores (3) it should have a relatively low human population in the immediate surrounding area (4) it should include a plan to involve these people in the management of the site and enlist their active support of it (5) it should provide the means for adequate subsistence to alleviate the need to poach. Such projects should become a standard component of the yearly portfolio in ANE/ASIA.

5. It is important that there be recognized leaders in systematics and ecology in the academic institutions of Asia, if Asian countries and scientists are to take on the major responsibility for data collection, its interpretation, and translation to effective management schemes. Flexible, innovative thinking is required. The American system of education is noted for its ability to draw out and develop this quality, whereas traditional educational approaches in Asia are not. Therefore, some young people need to be educated in the principles of ecology and systematics and learn about research design from the finest U.S. specialists, conducting their doctoral field research in the Asian context, perhaps in the very research station described above. Some areas of research are hardly represented at all in Asia (e.g. microbial ecology), and they should be addressed first. A fellowship program for at least 100 Asian students to study in the U.S. during the next five to ten years is needed.

6. A program of technical assistance in mitigation of water pollution, particularly for freshwater resources, is greatly needed. It should provide U.S. expertise in water quality analysis, resource planning and management, regulatory design and enforcement, and industrial and urban pollution control equipment. Those nations which are approaching middle income status and/or are well advanced in the transition from an agrarian to an industrial economy should receive attention first.

7. The genetic diversity of important indigenous Asian crops must be researched and collected, and adequate plans and incentives for the *in situ* maintenance of traditional cultivars, and facilities for the *ex situ* preservation (in germplasm banks) of wild and cultivated stocks, established or expanded. This will become increasingly important as new higher yielding hybrid crop varieties are developed by conventional and genetic engineering techniques, creating market pressures that demand their even more widespread use. (The development of such hybrids is itself dependent on the diversity of naturally evolved genes and the desired characteristics they code for.) This effort will require both competitive research and designated institution building activities. It should be an ongoing part of ANE agriculture work.

8. Effective policy dialog is dependent on effective arguments. Both hard data and illustrative anecdotal examples are needed to convince government and business leaders that it is in their interest to make the right choices for conservation of natural resources to ensure a renewable basis for current and future economic development. A study of the consequences of continued overexploitation of species and habitat destruction for Asian economies is needed. It could probably be completed in one or two years.

9. Every country profiling (CP) effort should include an assessment of biological diversity, its current status and trends. The quality of such an effort would depend substantially upon the status of basic research in the country. If insufficient local expertise is available, technical assistance by U.S. researchers should be incorporated into the project. In and of itself, a biological diversity profile would probably not be very expensive, adding no more than 20 to 30% onto the cost of most CPs.

10. A half-day seminar on "Biological Diversity and Development Assistance" should be presented at one of the upcoming mission directors' conferences. The personal involvement of mission directors in policy dialog with LDC goverments on the issue may be one of the most important avenues to success. Providing them with the rationale and data, and an opportunity to ask questions and discuss the issue in such a forum would provide a mechanism to engender committment.

11. In the absence of an additional congressional appropriation for a biological diversity program in AID, an equitable means of supporting

activities of the types listed above must be found. A requirement for "environmental mitigation" should be a compulsory part of all development projects which have demonstrable environmental impact (as determined by results of the Environmental Impact Statement). In most cases the effort should be directed to restoration of environmental damage involving biological diversity in the vicinity of the project. In other cases, it may be a better choice to assess a fee that would be used in support of a biological diversity project at some other location. A study in one or two countries, to be conducted by a natural resource economist should collect the data, develop criteria for determination of the types of mitigation efforts that should accompany certain types of projects, determine some method of calculating the appropriate level of an alternative fee, discuss implications (including constraints to and incentives for LDC acceptance), and make proposals for implementation. Such a study may take one to two years to complete, and could be done in partnership with the World Bank which is considering a similar proposal.

12. The ANE Bureau should make every effort to increase its complement of technical expertise in the natural resources area, so that the financial resources allocated for work in biological diversity can be put to the best possible use. During the interim period of personnel reductions in direct-hire staff, other mechanisms such as Personal Services Contracts, PASA and RSSA arrangements, or AAAS Fellowships should be used.

THE LEVEL OF FUNDING RECOMMENDED

The level of funding which should be designated for discrete projects, primarily concerned with conservation of biological diversity in the Asia region, should lie between \$2.0 and 2.5 million per year. Allocation of less than \$500,000/year by the ANE Bureau might be interpreted as underestimating the importance of the issue and/or failure to comply with the congressional mandate. Initially, the Bureau may need to share a greater percentage of the funding burden, until more concern for biological diversity is reflected in mission initiated and funded projects. A bill is presently before Congress, which calls for a line item in the AID budget for biological diversity and a yearly spending level of \$10 million agency wide.

GENERAL GUIDANCE TO MISSIONS

Missions should be encouraged to include consideration of biological diversity in their CDSS documents to provide orientation for project planning, determination of funding levels, and as a way of coordinating the efforts of other types of indirectly related projects so as to achieve an integrated effort from a variety of sectoral activities. In addition to the discrete project activities in biological diversity suggested in this document, by influencing the intent and selecting appropriate siting of other types of economic development projects, particuarly in the agriculture, forestry, and rural development sectors, missions can achieve a far greater, and more lasting impact than by exclusive use of such special focus projects alone. However, supportive activities should not be pursued in lieu of special projects in biological diversity, but should constitute an effective, low cost, addition to them.

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PART I. CONSERVATION OF BIOLOGICAL DIVERSITY: THE BASIS FOR CONCERN

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PART I. CONSERVATION OF BIOLOGICAL DIVERSITY: THE BASIS FOR CONCERN

CHAPTER 1. DEFINITION OF BIOLOGICAL DIVERSITY

Biological diversity is a concept which encompasses species diversity (the numbers and kinds), the genetic diversity within individual species, and the diverse functions of the species as they interact with one another and with non-living matter in the environments of their occurrence.

Species Diversity

There are many different ways of assessing species diversity. We can conduct an inventory in an environment, listing the species found there and noting which taxonomic categories are represented (genera, families, orders, etc.), and which of the trophic levels (positions in the food chain) they occupy. These are qualitative determinations of species diversity. We can count the species on the list to determine "species richness". Then we may measure the abundance of each, and map the pattern of its distribution to calculate "species equitability". These are quantitative determinations which, when conducted periodically, allow us to determine temporal patterns of dominance and succession within the ecosystem under study.

The qualitative determinants of species diversity involve not only which species are present, but also include their genetic make-up (called the genotype), and the width of the morphological (structural) and physiological (functional) traits which are expressed (that together constitute the phenotype) within the environment of occurrence.

Some species have evolved to have a low specificity for their environmental requirements and/or to have a wide tolerance for environmental change. They can be called "generalists". Others have a high specificity for their environmental requirements and/or a low tolerance for environmental change. Such species can be termed "specialists". Both generalists and specialists are represented in every environment. The specialists, however, seem to be much more susceptible to forces of extinction, and they tend to become rarer in their distribution as their natural habitats are increasingly impacted by man. The loss of one such species from its refuge may be of much greater consequence than the loss of several generalists from that same habitat which are more likely to be abundant in many other places. This is particularly true in the case of the top predators which hold positions high on the food chain, and whose presence or absence may have the farthest reaching impacts on the community structure of the remaining taxa. Furthermore, the adaptive strategy of a great many plant specialists resulted in the evolution of specialized chemical compounds which have already been a lucrative source of new medicinals and industrial chemicals. For example, a curative drug for leukemia, vincristine, was derived from a flower which grows only in the forest of Madagasgar. Thus, biological diversity is as much or more a qualitative concept as it is a quantitative one.

Genetic Diversity

Genetic diversity is another qualitative aspect of biological diversity which refers to the variety of genes present within a species (or often, as a more practical matter, within a population of a species). The genetic material which codes for all of the properties that can potentially be expressed in the species is called the germplasm. The most important components of germplasm are the genes, segments of DNA which, in plant and animal cells, reside mainly in the nucleus on small bodies called chromosomes.

The total amount of genetic information within a group of interbreeding organisms constitutes the gene pool. Wild gene pools are generally more diverse than domesticated gene pools. This is because breeders selectively propagate only those organisms which exhibit the desired characteristics. When this happens over many generations, some genetic material is lost because the individuals which carried it were not allowed to reproduce. Because the gene which codes for one "undesirable" trait is always linked to at least one other gene which could very well be coding for a different, and more desirable characteristic, "good" genes are inevitably lost along with the "bad". Moreover, something which constitutes a desirable characteristic in one ecological situation (e.g. ability to withstand waterlogging) may be considered undesirable in another (e.g. in a semi-arid region). It is for these reasons that wild, weedy relatives and indigenous cultivars are considered to be valuable repositories of germplasm.

Application of poisons to control plant and animal pests is also a form of selection. Those individuals which have a higher tolerance for it or can metabolize it into a harmless compound are selected for. They will come to dominate the population if the chemical persists or is reapplied frequently. Soon, the pest species has acquired "resistence" to the pesticide. There is never any way of predicting which pest will develop resistence to which control agent. So the breeder cannot decide in advance to try to retain or breed in inherited resistence to that particular pest. Lacking the "pre-adaptive" protection to pestilence which often resides within a plant or animal species having a highly diverse gene pool, our modern crop and livestock varieties succumb more easily to newly evolved varieties of pests.

It is now generally accepted that modern crop varieties could not endure such stresses without a constant influx of disease resistence genes specifically bred into them. This is becoming increasingly true for livestock as well. Thus, modern technological advances, including those achieved through genetic engineering, are and will remain quite dependent on a continuing source of genetic resources from different parts of the world. Because the wild relatives and ancestral cultivars are usually found in the less developed countries, the security and future of agriculture in the developed countries as well as in the LDCs themselves, rests in the assurance that genetic diversity there will not die out! For these reasons it is imperative that developed and developing countries join together to invest in the preservation of genetic diversity wherever it resides. Our mutual survival and quality of life depends on it.

CHAPTER 2. THE ANALYTICAL FRAMEWORK

Development Goals

The preservation of biological diversity within a development context means that program and project planning and implementation must involve consideration for the effects that they will have on the supporting biosphere. All of our development projects must involve an assessment of short and long-term negative consequences upon other species (plant, animal, and microbial), and provide for implementation of palliative measures should any species or ecosystem in an impacted area belong to an endangered group, or should project activities contribute to habitat destruction. In recognition that sustained economic development will not be possible if the environment or the species that comprise it are destroyed, our goal is to provide tools for recipient countries to improve their standards of living in a way that is compatible with conservation of their natural history heritage.

Principal Considerations

Control of Population Growth

In an era of run-away human population growth, combined with our understandable anthropocentric orientation, it is felt by many that the best moral and political decisions are those that provide in the first place for human needs, through relieving of suffering, and promoting better standards of living. However, the awareness that our planet with its finite resources cannot support either infinite numbers of people or development which expends or destroys those resources is growing. It is clear that the Earth cannot support a monoculture of Homo sapiens (mankind). Thus, bringing world population growth to the replacement rate is the first and most effective way of helping to attain preservation of biological diversity. The fewer people there are to make demands upon the world ecosystems, the lesser is their competition with other forms of life, and the greater is their potential for healthful and fulfilled lives in balance with nature.

The Role of Biological Diversity and Its Response to Stress

It is important to recognize the interrelatedness of biological species and processes. The only complete ecosystem known to man is global in size. It is called the ecosphere. Even that one is not a closed system, but a thin skin of life (biosphere) on the surface of the planet requiring energy from the sun, and the chemical building blocks of life (elements) from the surface crust to synthesize the organic matter that comprises living things. The molten center of the Earth recycles that crust, adding new elements through volcanic and tectonic activity and withdrawing others by crust subduction and melting. Every ecosystem has sources of energy and materials, and sinks for the waste products of their activity. The waste products of one ecosystem serve as the starting materials for another. Thus, all ecosystems are related in some way.

The simplest example of this interrelatedness of ecosystems is seen by examining the chemical inputs and outputs of plant vs. animal life. Plants use the sun's energy (the only real "free-lunch"), water (H_2O), and carbon dioxide (CO_2) from the atmosphere together with compounds and minerals containing some other essential elements (e.g. nitrogen and phosphorus) to produce organic matter and oxygen (O_2) which is released to the atmosphere. The organic matter is eaten by animals and the oxygen breathed by them to provide energy and the elements needed to run their metabolic processes. The products of this metabolism (called respiration) are heat, water, and the gas CO_2, which is released to the atmosphere. Thus, a cycle has been established in which a waste product of plants, O_2, is an essential starting compound for animal life, and a waste product of animal life, CO_2, is an essential starting compound for plant life. Maintenance of a precise balance between such processes would be critical for continuation of both forms of life were it were not for the presence of buffers. In this case, the buffer, or reserve of these gasses, is the atmosphere which contains a far greater volume of both CO_2 and O_2 than is needed at any given instant in time to support the needs of all of the plant, animal, and microbial life on the Earth. This interrelationship between the biosphere (the living species) and the atmosphere which involves the exchange of gasses between them, provides another model which we can use to think about the way life operates within the environment.

All forms of life maintain themselves by cycling materials, both simple and complex, among themselves and between themselves and the inorganic Earth which is comprised of the atmosphere, hydrosphere (water), and lithosphere (rock). (Soil is a mixture of rock particles, dead organic matter, and live microorganisms and is a place where many cyclic processes occur.) The three inorganic compartments provide buffers for the materials (and sometimes energy) needed in biological cycling processes. All chemical elements required for life are cycled. If we remove too much of one thing from any given cycle too quickly, the cycle will scavenge the needed material from the buffer until it is depleted. Then the cycle will collapse. When a crucial cycle collapses, the entire ecosystem dependent upon it will collapse because wastes will build up to toxic levels, and/or'limiting' nutrients will have been expended. The extent to which cycles of materials that maintain the balance of life are interrelated is not fully known. Nor is the capacity of the buffer systems to replenish what we take for our own needs or detoxify our wastes fully known. Therefore, it is imperative that we proceed very carefully in our exploitation of the living and inorganic resources we need or impact in the pursuit of our own survival and comfort.

We can cause the demise of a species or an ecosystem in three ways: 1. by killing it (intentionally or unintentionally by applying toxic chemicals to it), 2. by interrupting a cycle essential for its survival (usually unintentionally), or 3. by depleting the buffer system for support of cycles, or by overburdening it with competing or excessive chemical reactions (e.g. through acidification, increase in the biological oxygen demand through eutrophication).

Earlier, the statement was made that the only complete ecosystem is the global one. Yet, we can compartmentalize the world and speak of smaller ecosystems which are relatively self contained (e.g. the world ocean, or a freshwater pond). So the word "ecosystem" can be applied to many associations of living things on many size scales. Also it is important to realize that ecosystems may be changed and yet, still function, and that naturally occurring events (such as climatic change) are capable of introducing impacts as great and as damaging as those applied by modern man. The biosphere as a whole, made up of interrelated ecosystems can absorb huge shocks and still regenerate itself given enough time. But individual smaller ecosystems may not. Whether or not an ecosystem will survive a damaging event is often a question of scale: the size of the ecosystem vs. the magnitude of the shock applied vs. the time available before irrevocable ecosystem demise. The same applies for an individual species. Often the most important question we will have to answer is not whether to apply a certain shock. Rather, will the values we gain from its application be of sufficient importance to accept the consequences we expect as well as those we do not expect? Furthermore, we must realize that we do not know enough (and may never know enough) to predict with certainty which human generated impacts are acceptable in type and dimension and which may exhaust a buffer capacity. Thus, we must try to identify indicators to assist in our decision making.

Why and How Species Diversity Should Be Conserved

Ecosystem Stability and Diversity

The identification of indicators which provide a reasonable basis for decision making is a scientific problem. In the course of studying the impact of human activity on supporting ecosystems, it has been determined that species diversity is often one of the most obvious (i.e. noticable) and sensitive indicators (signals) of the relative health of an ecosystem. In comparison with pristine (unpolluted) ecosystems, those which are degraded or heavily polluted invariably support only few species capable of tolerating the prevailing conditions. Thus, we can generalize that "the higher the diversity of plant, animal, and microbial life supported by a given ecosystem. the greater is its health." (Here we must keep in mind that diversity is naturally higher in some biotopes than in others even under pristine conditions, e.g. tropical biotopes are known to have a far greater number of species than do desert biotopes.) Thus, if a human activity can be conducted so that products may be removed from an ecosystem and/or wastes of human activity introduced into that ecosystem without substantially affecting the biological diversity (and here we refer to the representation of species not just the numbers of species) and their relative proportions, then that human activity is probably compatible in type and magnitude with the ability of the ecosystem to buffer it. This activity will most likely be sustainable in the long run. The value of biological diversity as an indicator of ecosystem health is only one of the reasons that it should be maintained. In addition, biological diversity is but one of the many types of indicators that may be used to monitor the health of an ecosystem.

Economic Considerations

Another important reason why biological diversity should be maintained, and development programs must take it into consideration, is an economic one. When a biological resource is overexploited, and it can no longer regenerate itself at a sufficient rate to support an industry this is known as "diminishing returns". Eventually, the industry will collapse. Furthermore, as the population of a species and its function within an ecosystem diminishes, an unknown number of other species will be affected. Often, if one species is eliminated, others which are directly or indirectly dependent on its activities also disappear. This is why it is so important to prevent species from becoming extinct. It has been estimated that 10-30 other species face extinction when one known species is eradicated (a kind of landslide effect). It is also possible that removing one competitor from an ecosystem will enable another to increase in dominance, and often this is the result. However, such "opportunistic" species are rarely of great economic value. Something like this occurs when a desirable fish species (e.g. a carnivore like a tuna) has been overfished. Its removal from a body of water allows expansion of the niches of smaller fishes lower on the food chain (mackerel among them). Unfortunately, the price per pound of mackerel is not as great as that of tuna since the taste and smell, as well as sizes of the filets is less desirable, even though the protein content may be of equivalent nutritional value. Thus, the consumer is deprived of the possibility to have tuna (which lowers his quality of life) and not only is the fishing industry forced to spend money to modify procedures for catching different fish types, but it must also catch more fish to maintain the same income. Since it may take more time and energy to maintain the industry income than previously, the price of mackerel will probably rise, forcing a further reduction in the consumer's quality of life. If mackerel are overfished, industry can again compensate by catching more sardines. But when they disappear through overexploitation, what happens to the industry, the ecosystem, and the consumers then? A situation very similar to this is developing in the Adriatic Sea fisheries in Europe.

If, instead, the fishing industry prudently harvested fish in appropriate ratios at every level of the food chain (thus leaving species diversity, species representation, and the abundance relationships of those species in their original balance) the long-term sustainability of the entire industry and the marine ecosystem itself would be more likely to remain intact and the consumer would be better served in the long run (i.e. poorer people would eat sardines and richer people would have some tuna, but all would have something at a price they could afford, and in addition, they would have a choice).

Future Values or Costs?

A third reason why biological diversity should be maintained is that the economic value of the vast number of species, particularly in the tropical biotopes, has not yet been determined or even recognized. A particular irony lies in the fact that the most inspiring scientific and biotechnological advances have been made using only a very small number of species. This is called the "reductionist" approach, in which a model organism is studied in as great detail as technically possible and the principles derived from its study are used to explain life processes in general. A byproduct of this approach is that many in the scientific community as well as the general public have lost sight of the fact that these organisms are not replacements for those found in nature. Thus, an extraordinary amount of attention has been paid to a few species while others which may be equally or more important are rapidly becoming extinct. Just as our ability to begin to apply the enormous technical advances introduced by the discipline of molecular biology to many more species enters its infancy, and the genetic improvement of economically important species using genes derived from wild relatives (and even unrelated organisms) is becoming a reality, unchecked exploitation and habitat destruction world-wide are rapidly removing the very diverse genetic resources that might allow a genetically manipulated green

revolution to occur at some time in the future. As many have pointed out, the
costs of this loss of genetic diversity may be incalculable. Thus, it is important to establish and implement policies which safeguard all types of biological diversity (plant, animal, and microbial) and regard them as investments for the future which, like an IRA retirement account, cannot be tapped without great penalties before the appropriate time for doing so has arrived. Setting aside a portion of one's liquid assets with a rainy day philosophy is always painful, but it should not be difficult to justify when the consequences of what happens when there are no more reserves and one's ability to deal with everyday survival are curtailed is clearly going to be a far worse option.

Critical Lands and Species in Asia

Bangladesh

Threatened and Endangered Species

1. See: "The mammals of Bangladesh - their status, distribution and habitat", Sarker & Sarker[16].

New Areas: Threatened and in Need of Conservation

1. Sundarbans mangrove forests[11].

New Areas Identified for Inclusion in the Protected Area System

1. St. Martin's island should be established as a marine national park[4].

Ways in Which a Donor Organization Can Help

1. Microbiological Resource Centers (MIRCENS) are important sites, in this country and other LDCs, of important ex situ work on economically valuable microbiota, which are being selected and engineered for use in degrading chemical pollutants, and as biological control agents for pest management[11].

2. Demonstration Protected Areas should be set up in a few protected areas which can already be considered as "biogeographic units". To do this support will be needed for equipment, management, education, and training. The Sundarbans would be suitable for such a project[17].

3. Government agencies should be supported in their efforts to design, promote, and implement a few demonstration projects on making protected areas accessible for local recreation, including such areas as: Bhawal National Park, Himchari National Park Cox's Bazar, and Madhupur National Park[17].

Burma

Threatened and Endangered Species

1. "Species conservation priorities in the tropical forests of Burma", J. Blower[14].

Areas in Need of Improved Management

1. Katthin Wildlife Sanctuary in Burma needs to be up-graded to a Nature Reserve and provided with professional staff[4].

New Areas: Threatened and in Need of Conservation

The Chittagong Hills[11].

Expansion of Existing and Proposed Protected Areas Needed

1. Alaungdaw Kathapa National Park, west of Mandalay, as Burma's first national park, is planned to consist of the existing Patolon and Taungdwin Forest Reserves (both cover the upper catchment basins of the Patolon and Taungdwin chaungs, northward flowing tributaries of the Chindwin River). UNDP/FAO has been asked for further assistance[15].

New Areas Identified for Inclusion in the Protected Area System

1. Thamihla Kyun and South Moscos, and Kadonly Kyun need to be established as marine reserves[4].

2. Lampi Island in the Mergui archipelago, which, with its undisturbed forest, magnificent beaches, and extensive coral formations could become an outstanding marine park[15].

3. Parks or Nature Reserves are proposed for Mount Victoria (Natma Taung) and Kyaukpandaung, two isolated massifs in the southern Chin Hills, and for part of the Pakchan Reserved Forest in Tenasserim, an area of dipterocarp on the mainland opposite Lampi[15].

India

Threatened and Endangered Species

1. The flora of the Andaman and Nicobar Islands are endangered[1].

Seriously Threatened Protected Areas

1. The Gir National Park, Silent Valley National Park and the Manas Tiger Reserve are all on the 1984 list of Seriously Threatened Protected Natural Areas[1]
2. The unique ecosystem of Simlipal Tiger Reserve in Orissa is considered fragile and threatened[4].
3. Indravati National Park, Bastar, Madhya Pradesh is threatened[4].
4. A marine park in the Gulf of Mannar, India is threatened[4].
5. The Mutamawali Wildlife Refuge[11].
6. The Mudumalai Refuge[11].

New Areas: Threatened and in Need of Conservation

1. All mangrove ecosystems are endangered[1].
2. The bamboo forests of Saranda, Bihar are threatened[4].
3. Krusadei and Shingle islands of the Rameshwaram coast[4].
4. Logtak Lake in Manipur is considered fragile and threatened[4].
5. The high altitude montane forest areas in west, central, and eastern Himalayas, including the Inner Seraj Pandra, areas of Outer Seraj and Bushahar, and Bharmour area of Chamba in Himachal Pradesh[4].

6. The cold deserts of Ladakh, Lahul and Spiti in north India are considered fragile and threatened[4].

7. Moist tropical forests of northeast India (Arunachal Pradesh, Assam, Meghalaya) are considered fragile and threatened[4].

8. Semi-arid and temperate grasslands in northwest India are considered fragile and threatened[4].

9. Khadir Island and adjacent areas of the Great Rannof Kutch are considered fragile and threatened[4].

10. The lower-level moist forest of the Western Ghats, India is threatened[4].

11. Tropical wet evergreen and wet deciduous forests of the Western Ghats in Karnataka State (biological diversity is exceptionally high and human population density is lower there than in most of India)[11].

12. Sacred groves scattered throughout the country (often they represent relic stands of original forest)[11].

13. Ladakh/Srinagar/Jammu areas should be separate priority forest conservation areas[11].

14. All forests of the Andamans Islands are in need of conservation[11].

15. Forests of Upper (Eastern) Assam, particularly Digboi, Lakhimpur, and Sibsagar Forest Divisions[11].

16. Wet mixed forests of North Bengal, particularly Kalimpong, Alipore, and Buxa Forest Divisions[11].

17. All tropical freshwater swamp forests[11]

18. Dry forests of the Sialik Hills[11].

19. Montaine, subtropical, and wet temperate forests of the Darjeeling and Kalimpong Forest Divisions, West Bengal; also in Khasi and Jaintia Hills, Megahalaya; Arunachal Pradesh, Nilgiri Hills, Tamil Nadu[11].

New Areas Identified for Inclusion in the Protected Area System

1. Identification and establishment of protected areas is needed in the Western Ghats[1].

2. A sanctuary for the Indian Bustard is needed in Andhra Pradesh[4].

3. Neora Valley of West Bengal should be established as a national park[4].

Ways in Which a Donor Organization Can Help

1. A research program and support is needed for the systematic monitoring of forest plots established before independence (oral communication by R. Primack) would be particularly valuable for obtaining information on rate of growth and success of various species both for conservation and fuelwood-producing plantation forestry[11].

2. Although their rather traditional education is strong in systematics, Indian students need more training in ecological processes. U.S. scientists acknowledged for their expertise in tropical forest ecology should be sent as visiting professors to the forestry institute in Dehra Dun to assist that school develop an educational program in biological diversity[11].

3. The Wildlife Institute of India shows considerable potential for aiding in conservation of biological diversity and is in need of support for programs[11].

4. Demonstration Protected Areas should be set up in a few protected areas which can already be considered as "biogeographic units". To do this, support will be needed for equipment, management, education, and training. The following protected areas would be suitable for such projects: Manas Wildlife Sanctuary, Dudhwa National Park, Gir National Park, Keibul Lamjao National Park, Silent Valley National Park, Desert National Park, and Tirthan Sanctuary in Himachal Pradesh [17].

5. Support applied research into human ecology in areas of importance for conservation, including such areas as: Keibul Lamjao, Abuhujmar, and the Himalayas adjacent to protected areas in Himachal Pradesh and Uttar Pradesh, [17].

6. Support government agencies in their efforts to design, promote, and implement a few demonstration projects n projects on making protected areas accessible for local recreation, including such areas as: Keoladeo Ghana National Park in Bharatpur, Corbett National Park, Kanawar Sanctuary in the Parvati Valley of Himachal Pradesh, and the Periyar, Van Vihar Bhopal, Shivpuri, and Panna national parks [17].

Indonesia

Threatened and Endangered Species

1. "Species conservation priorities in the tropical forests of Indonesia", Mackinnon & Suwelo[12].

2. Rhinoceros, and all its remaining habitat[11].

Seriously Threatened Protected Areas

1. The Kutai National Park (in Kalimantan) is on the 1984 list of Most Threatened Protected Natural Areas. WWF Project 1523 includes a management plan for Kutai. Project 1524 includes one for Tanjung Puting[3].

2. The Kerinci-Seblat National Park on Sumatra needs to be protected from logging, and illegal land clearing and two proposed roads[1].

Areas in Need of Improved Management

1. The Bukit Raya reserve (in Kalimantan) is in need of a management plan, and the WWF plans to address this[3].

2. Boundaries of the Sungai Kayan-Sungai Mentarang Reserve located along the border with Sarawak are in need of revision. This is one of the objectives of the World Wildlife Fund program[3].

3. The Ujung Kulon National Park on Java, which is the sole remaining habitat of the Javan Rhino (Rhinoceros sondaicus) is in need of a vegetation map for proper management. Project 1963 of the WWF/IUCN is dedicated to that purpose, and will also include information on topography and hydrology. Most of the park consists of secondary vegetation, including palm forests and scrub-jungle, and swamps. Primary rainforest is scarce because a tidal wave resulting from the eruption of the Krakatau volcano in 1883 eradicated the forest in all the low lying areas. The vegetation is still building up and, unlike most primary rainforest, is in a process of change[3]. This may make Ujung Kulon a valuable area to establish a monitoring project for ecological change to study the effect of widespread destruction on reestablishment of climax rain forest (most projects which seek to do the same propose removal of only small tracts of primary forest within virgin areas to study recolonization).

New Areas: Threatened and in Need of Conservation

1. In Irian Jaya more than 50% of the area is under proposed concession to timber companies.[3]

2. In Kalimantan (the Indonesian part of the island of Borneo), particularly East Kalimantan, the world's richest Dipterocarp forests (the source of the world's best hardwoods) are threatened by extensive logging, oil and mineral exploitation, and transmigration settlements, in addition to the devastation caused by extensive forest fire. There are few mangrove reserves in Kalimantan and insufficient lowland dipterocarp reserves[3].

3. A summary of Critical lands listed in 1969 by the Directorate of Land Use in Jakarta is appended on a separate page[5].

4. Tropical lowland forests of Kalimantan (including appropriate action on Peraira S. Mahakam, Danau Semagang, Berambai, Kelompok Hutan Kapur, Muara Sebuku, Sungai Kayan-S. Mentarang, Pleihari Martapura, Muara Uya, Hutan Sambas, Gn. Niut/Becapa, and Danau Sentarum)[4].

5. Mangrove forests on Cilacap[11] and Java[4] are considered fragile and threatened.

6. Coastal and marine habitats (and Komodo Island in particular[11]) need conservation attention in Indonesia, following recommendations made in the Master Plan for Coastal and Marine Protected Areas[4].

7. Musi River and Lake Toba in Sumatra[1].

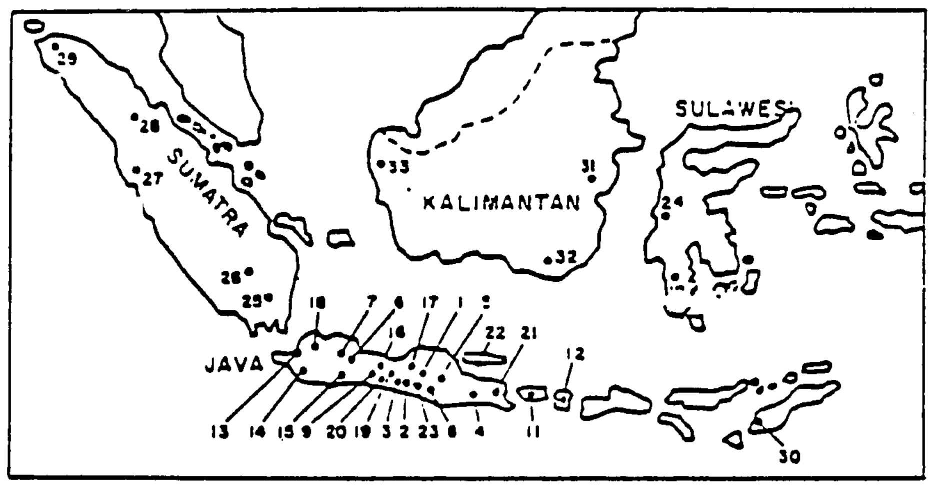
New Areas Identified for Inclusion in the Protected Area System

1. Biosphere reserves have been proposed for Siberut and should be implemented[1].

2. Proposed major reserves on Irian Jaya include: Lorenz, Mamberamo-Foja, Wasur and Tamrau Mountain reserves. (Irian Jaya has been little explored by scientists). The reserve system envisiged by the Government of Indonesia and WWF covers about 7 million hectares of land, including more than 600 km of beaches as well as large areas of coral reefs and sea grass beds[3].

31a

FIGURE 5
MAP OF CRITICAL LAND AREAS
(Directorate of Land Use, Jakarta, 1969.)



CRITICAL LANDS
Key to May of Figure 5

1. Upstream Bengawan Sala
2. Gunung Kidul
3. Bantul
4. Brantas River Basin
5. Madiun River Basin
6. Cimanuk River Basin
7. Citarum River Basin
8. Grindulu River Basin
9. Serayu River Basin
10. Jeneberang - Walanae
11. Gunung Agung
12. West Nusa Tenggara Islands
13. Banten
14. Cimandiri River Basin
15. Citanduy River Basin
16. Central Java
17. Jratun Seluna River Basin
18. West Java
19. Upstream Sempor Dam
20. Luk Ulo River Basin
21. Sempejan River Basin
22. Madura
23. Klaten
24. Palu Valley
25. Lampung
26. South Sumatra
27. West Sumatra
28. North Sumatra
29. Banda Aceh
30. East Nusa Tenggara Islands
31. East Kalimantan
32. South Kalimantan
33. West Kalimantan

(Source: Directorate of Land Use, Jakarta, 1969)

(Note: This is an example only since it differs markedly from the Forestry Service Critical Lands map)

Ways in Which a Donor Organization Can Help

1. Surveys of biological diversity and ecosystem stability are needed for priority areas of Sumatra, including the Tiga Puluh Mts., Kota Panjang, Torgamba, and Bukit Patah[4].

2. The Gunung Leuser National Park in the Bukit Barisan mountain chain of Sumatra is one of the largest rainforest conservation areas in Southeast Asia, and presently one of the the least disturbed. However, it is essentially the last retreat of the Sumatran orang-utan, and serves as a vital refuge for the Sumatran rhino, elephant and tiger and for plants such as rattan and other palms, rafflesia and dipterocarps. An application was made in 1980 for a loan from the World Bank to establish buffer zones, development tourism, and build a regional school[3].

3. The forest institute in Bogor is seriously underequipped, and needs financial assistance and revivification[11].

4. Demonstration Protected Areas should be set up in a few protected areas which can already be considered a "biogeographic unit". To do this support will be needed for equipment, management, education, and training. The following protected areas would be suitable for such projects: Kerinci-Seblat National Park, Ujung Kulon National Park, Komodo National Park, and Dumoga-Bone National Park [17].

5. Support applied research into human ecology in areas of importance for conservation, including such areas as: transmigrant populations adjacent to protected areas[17].

6. Support government agencies in their efforts to design, promote, and implement a few demonstration projects on making protected areas accessible for local recreation, including such areas as: Bali Barat National Park and the Gunung Halimun Nature Reserve[17].

Nepal

Threatened and Endangered Species

1. Evaluation is needed of Koshi Tappu Wildlife Reserve for its appropriateness to conserve wild water buffalo[4].

New Areas Identified for Inclusion in the Protected Area System

1. The Annapurna National Park is being established to protect the habitats of mountain-dwelling animals. The park will provide sanctuary for the snow leopard, musk deer, and blue sheep, and will preserve some of the most beautiful rhododendron forests in the world[8]. The evolutionary origins and diversificaton of rhododendron are thought to have occurred here[9].

Ways in Which a Donor Organization Can Help

1. A new international institution called ICIMOD, concerned with integrated mountain development, is serving as a clearing house for information, and is in need of financial support[11].

Pakistan

Threatened and Endangered Species

1. The Indus River dolphin[11].

New Areas: Threatened and in Need of Conservation

1. Chir pine (*Pinus roxburghi*) ecosystems, such as in the pass to Saidu Sharif, Swat Valley[11].

2. Desert scrub ecosystems west of Peshawar, near Kohat.[11].

3. River Swat and tributaries - an area with endemic fishes[11].

Philippines

Threatened and Endangered Species

1. Improved protection of the tamaraw habitat is needed in Iglit/Baco National Park[4].

2. The Philippine eagle and timaraw buffalo[11].

Seriously Threatened Protected Areas

1. Mt. Apo National Park, which needs protection from illegal logging, colonization, and (government backed) agricultural development is on the 1984 list of the World's Most Threatened Protected Natural Areas[1].

2. The MAB reserve at Puerto Gallera, Mindoro[11].

New Areas: Threatened and in Need of Conservation

1. Conservation of mangroves (especially the mangrove swamps of Pagbilao, Quezon[11]) and coral reef ecosystems is especially needed[1].

2. The coral reefs and seagrass beds of Bolinao and Pangasinan are of special value[11].

3. Tubataha Reef and San Miguel Island, Palawan are considered fragile and threatened [4].

4. Conservation of lowland moist forests on all the larger islands[1].

5. Apo Reef, Mindoro is considered fragile and threatened[4].

4. The mangrove forests on Palawan (which are among the world's best developed, with some trees 150ft tall) and southern Mindanao[11].

5. The virgin lowland and upland forests of Palawan[11].

New Areas Identified for Inclusion in the Protected Area System

1. Mt. Pulong, Luzon should be established as a national park[4].

2. Honda Bay, Palawan should be established as a marine park[4].

Ways in Which a Donor Organization Can Help

1. Demonstration Protected Areas should be set up in a few protected areas which can already be considered a "biogeographic unit". To do this support will be needed for equipment, management, education, and training. The following protected areas would be suitable for such projects: Mt. Apo and Mt. Iglit-Mt. Baco National Park[17].

2. Support applied research into human ecology in areas of importance for conservation, including such areas as: the Mt. Apo region[17].

Sri Lanka

Seriously Threatened Protected Areas

1. The Sinharaja Forest Reserve[11].

New Areas: Threatened and in Need of Conservation

1. The southwest area, where there are important concentrations of endemic species, especially in the rain forests[11].

Ways in Which a Donor Organization Can Help

1. Demonstration Protected Areas should be set up in a few protected areas which can already be considered as "biogeographic units". To do this support will be needed for equipment, management, education, and training. The following protected areas would be suitable for such projects: Mahaweli, and the Sinharaja Forest Reserve [17].

2. Support applied research into human ecology in areas of importance for conservation, including such areas as: areas surrounding the national parks and proposed national parks in the Maduru Oya basin[17].

3. Support government agencies in their efforts to design, promote, and implement a few demonstration projects on making protected areas accessible for local recreation, including such areas as: Yala National Park[17].

Thailand

Threatened and Endangered Species

1. The most threatened primate is the pileated gibbon. Other threatened animal species are tiger, leopard, clouded leopard, small cats, wild dog, elephant, Malayan tapir, Javan and Sumatran rhinos, brow-antlered deer, buffalo, kouprey, giant and white-shouldered ibises, Hume's bar-tailed pheasant, helmeted hornbill, white-eyed river martin, river terrapin, marine turtles, crocodiles and Burmese python[3].

2. There are twelve species of threatened or endangered fishes whose habitat is the Mekong River basin of Thailand. The main threat is overfishing, but agricultural (run-off) and large hydroelectric projects contribute to their demise. Smaller hydroelectric development on tributary rivers combined with stabilization of the mainstream fishery with a research and management program should ameliorate the situation somewhat[7].

3. Seventeen animal species on threatened or endangered species lists occur in the tropical evergreen forest habitat, nine of them exclusively there. More than half of this habitat has been deforested to date[7].

4. Twelve of the species on the threatened or endangered lists range into the dry evergreen forest, and one lives there exclusively. Deforestation is proceeding rapidly[7].

5. Eight of the listed endangered or threatened species occupy the dry Dipterocarp and mixed deciduous-evergreen forest, but none are strictly limited to them. Only a few sizeable tracts remain, mainly in northern and western Thailand[7].

6. Encroachment upon the hill evergreen forest, due to cutting, farming for a short period, and then burning to convert the tracts to grassland, has resulted in habitat destruction for five animal species which depend solely upon this environment, and affects 13 others which also use it[7].

7. Endangered species lists for Thailand are "woefully inadequate" with regard to those affected by nationwide deforestation. Some are not yet known to science, and for most whether they can survive in habitats modified by human activity is unknown[7].

8. With its extensive latitudinal and altitudinal range, Thailand possesses a remarkably diverse and, in many respects, poorly understood flora. Before a definitive statement of the true endangered species of plants can be made, many man-years of effort need to be invested in basic systematic and field studies[7].

9. *Tilapia* species in Dusit Palace are rare, important genetic resources for aquaculture[11].

10. "Species conservation priorities in the tropical forests of Thailand", see Jintanugool et al.[13].

Seriously Threatened Protected Areas

1. The Thung Yai and Huai Kha Khaeng Wildlife Sanctuaries which have been proposed to become biosphere reserves are on the 1984 List of Seriously Threatened Protected Natural Areas, due in part to the proposed Kwai Yai dam and settlement[1]. According to sources at the World Bank (1985), because of tabeling of the dam project on the part of the Thai cabinet (proportedly in response to testimony by the Siam Environmental Club and other NGOs) World Bank activity on the project has now lapsed and it is unlikely to be resusitated. World Wildlife Fund Thailand reports (personal communication, 1985), however, that a funding agreement for dam construction may soon be or may already have been reached between the Thai and Japanese governments despite ongoing opposition by environmental groups.

2. The Khlong Saeng Dam will flood part of Khlong Saeng Wildlife Sanctuary[10].

3. The Khlong Yan Dam will flood part of the Khlong Nakha Wildlife Sanctuary[10].

4. The Pha Chi Dam will flood part of Maenam Pha Chi Wildlife Sanctuary[10].

5. The Khoi Dam will flood part of Maenam Pha Chi Wildlife Sanctuary[10].

Note: World Wildlife Fund Thailand claims that these power sources are not required for development of the country, and that it is mainly the special interest lobbying on the part of the logging industry (which will make the greatest short term gains by clearcutting the areas that would be flooded) that spawned these projects and keeps them alive in the face of strong opposition.

Areas in Need of Improved Management

1. There is a boundary conflict situation in Khao Yai and Huay Kha Khaeng National Parks. Government agencies need support to design, promote, and implement a project to solve these conflicts and provide an exemplary demonstration for other, similar problems elsewhere[4].

2. The Tarutao National Park should be made accessible for local recreation to increase support by local people[4].

3. The trekking program and community development in the Khao Yai region is a case of effective management of a protected area which led to tangible benefits for local people and the nation, and could be used as a model for efforts in other protected areas[4].

4. The area around Thale Noi Non-hunting Area needs to be investigated with respect to the development of irrigation schemes[10].

5. Increased support should be accorded to the Fisheries Department and research programmes on marine productivity in coastal waters including mangroves and mudflats in the provinces of Petchaburi, Songkhla, and Trat[10].

Upgrading of Non-hunting Areas to Wildlife Sanctuary Status

1. The Thale Noi non-hunting area is an important waterfowl area[10].

2. The Bung Boraphet non-hunting area should be declared a wildlife sanctuary in order to protect crocodile, birds and other animals[10].

3. Pa Phru non-hunting area should be surveyed[10].

4. Lawa Cave -Daowadung Cave non-hunting area: the caves are a habitat for a particular species of bat[10].

5. The Thale Sap non-hunting area is an important waterfowl area[10].

New Areas: Threatened and in Need of Conservation

1. Beung Boraphet and Songkhla Lake are considered fragile and threatened habitats[4].

2. Mangrove swamps on the east and west side of south Thailand as well as near Phuket are suffering major encroachment, mainly through oil and chemical effluent pollution (see Dr. Toshio Tsutsumi, Ph.D. from Kyoto now at Kasetsart University)[6].

3. The bamboo ecosystem in Kanchanburi Province, NW of Bangkok on the Burmese border is being threatened by rapid land clearing and harvesting of bamboo by people crossing over into Thailand from Burma (see Jim Redhead, UN FAO consultant based in the U.S.)[6].

4. Areas of swamp forest (including *Mallotus*, *Camnosperma*, *Metroxylon*, *Alstonia*, and *Melaleuca* species) occurring on the floodplains of the Chao Phraya, Mun, Chi, and Mekong rivers and their tributaries, of the smaller rivers of peninuslar Thailand, around Thale Noi, and on the seasonally flooded land around Songkhla Lake "have never been

described carefully, probably because little of the original vegetation has been present during recorded history"[7].

5. A national inventory of potentially remaining wetlands is urgently needed, and existing remnants should be protected as wildlife refuges...for at least sixteen species of listed animals that require freshwater marshes, swamp forests, and associated habitats. Otherwise extinction or extirpation of these species will occur[7].

6. Coral reefs in Ko Tarutao suffer from illegal use of dynamite by fishermen and from siltation arising from mining[10].

7. Mud flats and mangroves which are critical habitats of commercially important species of marine fish and shell fish as well as other species should be identified[10].

8. Sandy beaches which are critical to the survival of marine turtles need to be identified, and conservation measures instated[10].

9. The habitat for the false gavial (Tomistoma schlegelii) at Surat Thani province should be evaluated and considered for protection[10].

10. Rivers which contain Scleropages formoses or Pangasius sanitwongsei should be identified and considered for inclusion in the protected area system[10]

11. The habitat of the limstone rat (Rattus hinpoon) and Neill's rat (Rattus neilli)[10] needs evaluation for possible protection.

12. The habitat of Tylototriton verrucosum, Rana blythi, Platysteron megacephalon, Testudo emys, Batagur baska, and Peolcheiys bibroni should be declared as wildlife sanctuaries[10].

13. The habitat of the giant ibis (Pseudibis gigantea) should be considered for inclusion in the protected areas system[10].

Expansion of Existing and Proposed Protected Areas

1. Protected areas need to be expanded to include lowland moist forests (particularly Dipterocarp forests[6]) and freshwater marshes1.

2. The Loeng Li Wildlife Sanctuary, Lam Nam Pai Wild-life Sanctuary, Phu Luang Wildlife Sanctuary, Khao Soi Dao Wildlife Sanctuary, and Klong Saeng Wildlife Sanctuary all need to be enlarged[10].

3. The Khao Sam Roi Yod National Park should be expanded[10].

4. Nam Nao National Park should be joined with Phu Luang Wildlife Sanctuary[10].

5. Thung Yai, Huai Kha Khaeng, and Salak Phra should be consolidated with Erawan National Park[10].

<u>New Areas Identified for Inclusion in Protected Area System</u>

1. The Bay of Phangnga. This area includes numerous small limestone islands and mangroves and should be declared a marine national park. The area would provide a study area for the Phuket Marine Biological Centre[10].

2. Similan coral islands and reefs. The area could also be designated as a national park[10].

3. Phuket mangrove. This area should be protected as a wildlife sanctuary[10].

4. Ko Kra. This area could be an important turtle island sanctuary[10].

5. Border area west of Kwae Noi River (?)...[10]

6. Yan Hae dam site. May be suitable as a waterfowl sanctuary[10].

7. Mae Ping gorge. It could be included in the proposed Mae-Tuen Wildlife Sanctuary[10].

8. Area between Fang and Chiang Rai[10].

9. Doi Wiang Fa[10].

10. The geyser region southwest of Chiang Dao could be included in the proposed Doi Chiang Dao Wildlife Sanctuary[10].

11. Wat Phai Lom[10].

12. The mangroves in Ranong, Trang, and Satun districts of Peninsular Thailand should be surveyed for selection of sites for protection[10].

<u>Ways in Which a Donor Organization Can Help</u>

The document cited states "assistance of international and/or bilaterally assisted programmes should be sought to accelerate the progress of land classification and allocation within forest reserves and to enable their completion by 1981, so that both settlement and reafforestation of land allocated for these purposes can be organized without delay[10]. According to Dr. Kasem of the Kasetsart University School of Forestry the land classification project for watershed classification has only started (personal communication, 1985) and it is hoped that it may be completed five years from now! Foreign assistance would still be welcome.

2. Establishment of education centers in the following protected areas is in need of funding: Khao Chong, Khao Khieo, Doi Suthep, Khao Tapet, Mong Kratae and Khao Soi Dao. Such a centre should contain a museum, a botanical garden and a system of nature trails. Audio-visual material as well as leaflets, guidebooks, and nature trail guides are needed. Some staff education in effective public relations techniques may be needed[10].

3. Reforestation efforts, encouraged by funding from AID, are being undertaken with exotic pine and Eucalyptus species. Such extensive use of these trees should be stopped as they are known to cause adverse environmental effects at the ecosystem level. Endemic species, planted in mixed species stands should be used instead[11].

4. Rural development schemes should regard agricultural land adjacent to protected areas and forest reserves as priorty targets, to raise local living standards. Establishment of woodlots there to reduce dependence on stolen fuelwood is encouraged. Local people should be involved in the development of the tourist industry, and engaged in management and policing activities. This may require loans and/or adult education. In this regard it is important to note that World Wildlife Fund Thailand (personal communication of Mr. Pisit Na Patalung and Mr. Kurt Rohlings, 1985) has determined that it is loan sharking by local (usually Chinese) businessmen that causes the need for stealing of forest products. They calculate an average 4,000 Bhat shortfall/year/family between needed and earned income. They further report that villiagers are aware that they are undercutting their own future by overexploitation of the forest but are unable to do otherwise economically. WWF is establishing a revolving fund of 600,000 Bhat to provide short term loans to relieve the need for villiagers to poach.

5. Demonstration Protected Areas should be set up in a few protected areas which can already be considered a "biogeographic unit". To do this support will be needed for equipment, management, education, and training. The Huay Kha Khaeng and Thung Yai Wildlife Sanctuary complex would be suitable for such projects[17].

6. Support applied research into human ecology in areas of importance for conservation, including such areas as: the area surrounding Khao Yai National Park[17].

7. Support government agencies in their efforts to design, promote, and implement a few demonstration projects on making protected areas accessible for local recreation, including such areas as: Tarutao National Park[17].

8. Survey of relatively undisturbed wetland areas that still remain should be carried out in order to include them in the protected area system[10].

9. The preparation of a marine conservation strategy would be considered a matter of great urgency[10].

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PART II. REVIEW OF AID PROGRAMS, ACTIVITIES, AND POLICIES

PART II. REVIEW OF AID PROGRAMS, ACTIVITIES, AND POLICIES

CHAPTER 1. AGENCY-WIDE PROGRAMS, ACTIVITIES, AND POLICIES RELATING TO BIOLOGICAL DIVERSITY

AID Task Force Report to Congress: U.S. Strategy on the Conservation of Biological Diversity

When Congress amended Section 119 of the Foreign Assistance Act in 1983 to include conservation of biological diversity as a required component of U.S. foreign aid activities, the U.S. Agency for International Development was charged with the responsibility to develop a strategy for implementation. An interagency task force was formed under the leadership of Dr. John Ericksson, Deputy Assistant Administrator for Research. In conjunction with a representative group of other government agencies, including the Secretary of State, the Secretary of the Interior, and the heads of other government agencies, private voluntary groups, and professional societies, a document was developed, published and presented to Congress in February, 1985: the U.S. Strategy on the Conservation of Biological Diversity.

There are seven major elements comprised of 67 recommendations for action that would enhance the conservation of biological diversity in developing countries. These seven elements, which could also be called "Major Policy Directives" are:

1. Continue an ongoing policy dialogue within federal agencies and with developing countries on biological diversity and help them establish and implement national policies for conserving, managing, and developing genetic resources (7 recommendations).

2. Through education programs in developing countries, increase public awareness of the need to conserve biological diversity (5 recommendations).

3. Strengthen developing-country conservation institutions and increase conservation training (14 recommendations).

4. Support research related to biodiversity conservation and inventories of species and ecosystems (11 recommendations).

5. Promote balanced resource management and the designation and maintenance of protected areas (22 recommendations).

6. Encourage developing countries to recognize the effects of and deal with human population pressures on natural resources (2 recommendations).

7. Increase coordination among development assistance agencies and support nongovernmental conservation organizations (6 recommendations).

Thirty four of the recommendations, spanning all seven areas, identified AID as responsible for their implementation.

An AID Action Plan to Implement the U.S. Strategy: Current Status

The action recommendations involving AID were reviewed and grouped into four major areas which are: 1. policy dialogue, 2. building human and institutional capability, 3. technology and information exchange, and 4. research. An assessment of each recommendation has been made by the task force, which is convened and coordinated by the Biological Diversity Advisor Mark Shaffer. Mr. Shaffer, who recently joined ST/FNR on a joint appointment with the U.S. Fish and Wildlife Service, will be holding a meeting on August 30, 1985 to discuss the current draft of the action plan.

The draft document proposes specific actions to be taken in response to each recommendation, and identifies the AID offices and Bureaus which should carry the main responsibility for each. It lists the kinds of project activities which are likely to jeopardize endangered and threatened species, and enjoins bureaus and missions to explore opportunities to design new projects which make use of and protect biological diversity. It identifies the need to consider a broader use of PL480 funds to generate financial support for such projects. Missions are requested to consult with host countries to advise them of the types of assistance for biological diversity conservation activities which are presently available. AID environmental and education efforts will be reviewed, and opportunities to expand them will be identified. Criteria for awarding support to U.S. and LDC nongovernmental and private voluntary organizations are mentioned. Technology and information exchange together with training are viewed as important means of reducing the data deficit in the LDCs. Accordingly, AID will explore ways of fostering development of Conservation Data Centers in-country, and enhancing use of currently existing data bases for AID and host country projects. A plan for identification of persons experienced in international biological diversity conservation is advanced, and the need is voiced for a review of AID personnel staffing guidelines with an eye to enhancing the Agency technical staff capability. A review of ongoing projects in bureaus and missions will be needed to identify new opportunities for incorporation of biological divesity concerns. Together with selected PVO groups bureaus should provide missions guidance on the status of and/or need for Biosphere Reserves in host countries, and determine which forms of assistance can be offered to host countries in support of protected areas. Options for expanding research support for currently existing and/or newly initiated institutions will be explored. Research on the economic aspects of biological diversity may be supported. Identification of research and monitoring opportunities with a view to enhanced productivity will take place.

CHAPTER 2. BUREAU LEVEL REVIEW OF AID PROGRAMS, ACTIVITIES, AND POLICIES

Asia Regional Strategy: Environmental Components

Asia Regional Strategic Plan, November 10, 1983

The Asia Regional Strategic Plan identifies the first priority of the Energy, Environment, and Natural Resources Division as follows: "to develop sound national policies in the energy, forestry, and environmental sectors that incorporate and address the needs of sustained agricultural and rural development. Technical assistance and training should be provided to analyze needs, uses, resources, and policy options in these interrelated sectors...The implications of current land use trends in rural areas, and the economic costs and benefits of protecting tropical forests" are among the "key policy issues". The need for Sri Lanka to "continue to be a showpiece in our efforts to develop sound environmental policies and programs" is highlighted.

The human and institutional capability to solve natural resource problems should be improved by support of "centers of excellence in training and research at the national and regional levels in close cooperation with other development assistance organizations." One of "the two prime areas of focus will be: (1) bioresources management, including biomass production and conversion and watershed research...A major expected accomplishment will be the establishment, in cooperation with the S&T Bureau, of a forestry research network in Asia."

There is no specific reference to conservation of biological diversity in this document, and this should be addressed in the next revision of the plan.

The Asia Bureau's Management Guide To Its Regional Strategic Plan, November 9, 1983

The Management Guide to the Asia Regional Strategic Plan summarizes the strategic objectives in environment and natural resources for the five year period of 1984-1988 as:

1. private sector investments in resource conservation/management and environmental protection increased;
2. research dealing with land and water resource degradation, sustainable utilization of marginal lands, and maintenance of biological species diversity; and
3. strengthen community level participation in resource management.

The verifiable indicators of these five year objectives are listed as follows:

1. all AID/Asia countries have completed national environmental reports and resource assessments;
2. environmental planning and management objectives explicit in national five-year development plan;
3. private sector investment in industrial pollution control expanded and private sector assistance in environmental research initiated;
4. government expenditures for environmental research and extension increased;
5. increased participation of non-governmental organizations in building public awareness of environmental issues and developing local-level resources to address environmental degradation; and
6. watershed management schemes demonstrated which will protect lands most at risk from over-cropping.

Environmental Staffing: status quo

Bureau Officers

The Bureau for Asia and the Near East enjoys the services of the following direct-hire personnel in the natural resources and environmental areas: Dr. Robert Ichord, Chief of the Energy and Natural Resources Division; Dr. Stephen Lintner, Bureau Environmental Coordinator; Mr. Michael Philley, Natural Resources Advisor. The position of Forestry Advisor is currently vacant. All of these individuals have considerable practical experience and formal training in the technical areas they represent. Approximately 2/3 of my effort during my one year appointment as an American Association for the Advancement of Science (AAAS) Fellow in Science, Engineering, and Diplomacy in the ANE/ASIA TR/EFE office was devoted to the assessment of biological diversity issues and options for the Bureau. A new AAAS Fellow, Dr. Cynthia Mackie, will soon be joining the Bureau for a year to work primarily on the forestry component of ANE programs.

Missions are not as well staffed in the environment and natural resources areas. The Burma, Fiji, India, and Pakistan missions have either no Environmental Officer (EO) position, or it has remained unfilled. In Burma it is unclear who is handeling environmental issues. Richard Nishihara, the Agriculture Officer in Fiji is probably handeling the environment for that mission. Graham Thompson, Head of the Project Development Office in the India mission is said to be the liason for environmental affairs. Although the remaining missions, listed below, all have appointed environmental officers, most have not had extensive training in the area they represent. There are, however, several International Development Interns (IDIs) in the missions who have received formal education in the environmental disciplines. The former Regional Environmental Officer, William Knowland, has been reassigned as Natural Resources Advisor to the Thailand Mission, the position being funded as a Personal Services Contract. The Regional Environmental Officer Position he previously filled has been eliminated.

Bangladesh:	Gene George, EO
Indonesia:	Desmond O'Riordan, EO; Ronald Greenberg, IDI
Nepal:	John Penney, EO; Bert Levinson, IDI
Pakistan;	Kenneth Lue Phang, EO
Philippines:	Richard Stevenson, EO
Sri Lanka:	Eric Loken, EO
Thailand:	John Neave, EO; William Knowland

As should be clear from perusal of the preceding paragraphs, there is an urgent need for the creation of additional positions in Backstop 30 (Natural Resources and Energy Management) and/or Backstop 75 (Science and Technology) in the job classification series so that missions can be properly staffed with Environmental Officers. The lack of positions is also a serious hindrance for the career ladders of those IDIs who will soon need to be placed in direct-hire positions. The IDI program itself, which has been instrumental in bringing additional technical expertise in natural resource management into the agency has been suspended due to the ongoing personnel reductions agency-wide.

CHAPTER 3. MISSION LEVEL PROGRAMS, ACTIVITIES, AND POLICIES

CDSS Strategies: environmental components

Missions are not required to address environmental concerns in their Country Development Strategy Statements (CDSSs). A review of the current CDSS roster to determine the emphasis placed on environmental issues gave the following results: one mission mentioned air quality in conjunction with pollution and acid rain; one mission mentioned water quality and issues involving watershed management, aquifers, pollution, and acid rain; one mission cited the depletion of soil through erosion, soil degradation in terms of loss of inorganic and organic components, and the impact of toxic wastes; two missions mentioned depletion or overexploitation of plant cover, and loss of species through habitat degradation. None of the CDSS strategies mentioned animal wildlife.

Programs with biological diversity components: an assessment

There are only two projects in the Asia region which could be considered directly supportive of biological diversity. They are (1) the Mahaweli Environmental Protection Project 383-0055 in Sri Lanka, whose funding period was 1982-84 at an AID contribution level of $5 million, with a total of $7 million (including the GSL contribution) relating to biological diversity, according to the mission, and (2) the Resource Conservation and Utilization Project 367-0132 in Nepal, whose funding period was 1980-85 at an AID contribution level of $27.5 million, with $24 million relating to biological diversity, according to the mission. Both of these projects have been recognized by the U.S. conservation community as being important contributors to conservation of biological diversity. However, the proportion of project funding which is allocated for that purpose would probably be disputed.

Cables received from the missions in response to the Secretary of State's cable 142954 in May, 1984 list numerous other projects which include components related to biological diversity. To review these cables see:

Dhaka 04237, June, 1984
Rangoo 03010, June, 1984
New De 13532, June, 1984
Jakart 11249, July, 1984
Colomb 04316, June, 1984
Kathma 03877, June, 1984
Islama 24198, Nov., 1984
Bangko 07522, Feb., 1985

Asia Regional Projects which are supportive of, although not directly related to biological diversity include the ASEAN Watershed Project G 498-0258.03 (1983-1985), the Forestry and Bio-Resource System Management Project G 498-0276 (1984-1988), and the ASEAN Coastal Resources Management Project, whose initial funding will begin in 1985.

One of the most difficult issues the ANE Bureau will face, as it tries to incorporate conservation of biological diversity into other types of projects is determination of the proportion of the overall project budget which can be justified as contributing to support of biological diversity components. Until agency-wide criteria are developed, the following criteria are suggested for ANE Bureau use: (1) the proportion of project funds dedicated to activities which are documented as taking place in or surrounding critical lands such as those identified in Part I, Chapter 2 of this document, or (2) which are clearly supportive of one or more endangered or threatened species (including the identification thereof), or (3) which are primarily concerned with education about or research on critical species and habitats and/or their management. If strict criteria such as these are not defined, virtually any tangentially related activity can be claimed as fulfilling the suggested funding level. That would clearly not be in the intent of the Amendment to the Foreign Assistance act on biological diversity.

CHAPTER 4. EXTERNAL DEVELOPMENTS

Congressional Bills: AID requiremnts and biological diversity funding

Excerpts from the July 17, 1985 Congressional Record are appended, which contain two new house bills, H.R. 2957 which addresses tropical deforestation, and H.R. 2958 which deals with AID funding for biological diversity projects.

The Conservation Community: review of AID Action

The realization that within our lifetimes at least a fifth of all plants and animals on Earth are likely to become extinct, motivates a somewhat hawkish reaction on the part of the conservation community to the U.S. Strategy on the Conservation of Biological Diversity. Comments such as those by William Burley of the World Resources Institute who called it "more of a shopping list than a strategy", and Sarah Gates of World Wildlife Fund U.S. who said "There are few specifics one can get a handle on and actually do...I'd like to see them choose the 15 most important initiatives and focus more on those - how to do them, who will do them, and how much money they will cost" reflect widespread dissatisfaction. The sluggish implementation of the recommendations in that document has engendered even more negative responses. The most pointed criticism, however, has been voiced by Thomas Stoehl of the Natural Resources Defence Council who determined that of the 253 ongoing projects which AID showed as related to biological diversity in the strategy document, only five such projects are actually dedicated to it. It is important that AID maintain credibility among the U.S. professional community if it is to exert influence over foreign governments and their scientific establishments. To that end, a more narrowly defined set of objectives which are clearly related to conservation of the species and habitats themselves is desirable. The Bureau for Asia and the Near East, in its implementation of the U.S. strategy, can make an important contribution to that goal.

PART III. RECOMMENDATIONS FOR ACTION

PART III. RECOMMENDATIONS FOR ACTION

CHAPTER 1. GENERAL RECOMMENDATIONS

Approach

Even when a concept such as biological diversity becomes incorporated into the policy of an agency like AID, its effective implementation into agency activities depends, in large measure, upon the extent to which the topic is seen as justified in the eyes of individual decision makers and in the context of the ov ·all agency mandate: in this case, economic and social development. Scientific issues, no matter how rational they may appear to the specialist, may not seem important at all to others who have a different set of priorities and a different world view. They may even be seen as frivolous if they are not obviously related to problems like hunger or disease, or economic growth. In short, anything which is not perceived as directly related to improvement of the human condiuion on the short term is automatically accorded low priority for action and funding.

In fact, there is no real basis of disagreement here, only a dispute about which comes first, degradation of the environment or human suffering and poverty, and whether study of the nature of this apparent cause-consequence relationship can yield insights for the solution of both. Furthermore, it is not always obvious (even if logical) that future economic growth will require a healthy and abundant resource base to draw upon, including a great number of species for which there is no current or even presently known use. It is therefore recommended that a study on the economic aspects of biological diversity be funded by the Asia Bureau (with possible participation of other regional and central bureaus). The results of such a study could be of great value for the ongoing policy dialog that will, of necessity, constitute the underpinnings of all AID activity on the biological diversity issue (see Part III, Chapter 2, Recommendation 1. below).

The integration of any new concept, such as preservation of biological diversity, into the activities of an established institution can be accomplished in a variety of ways. One way to categorize them, however, is as direct and indirect activities. Direct activities are usually interventions. They include things like establishing, enlarging, or protecting conservation and preservation areas and improving their management, as well as conducting basic research necessary to determine priorities and develop criteria for determination of management and constraints to use. This has also been called "hard" conservation[2].

Indirect activities (or "soft" conservation) influence attitudes so that other groups will undertake interventions. They include activities like training and environmental education. Direct activities are best employed where there is a crisis or a relatively short time frame available in which appropriate action will prevent a crisis (e.g. a decade or less). They yield results specific to the problem in a shorter time frame than do indirect activities. Indirect activities take longer to achieve significant results, but they may have a much broader impact by spreading awareness of the issue beyond the most immediate interest groups. Indirect activities are often perceived as more acceptable politically (in the national as well as international arenas) because they rarely involve confrontation or conflict with any special interest group. They achieve the new objectives largely by influencing LDC decision-makers who, operating with different sources of funding, then acknowledge and act on issues that they may have previously overlooked or underemphasized in their assessments. Once these new concerns become incorporated into the decision making process, different decisions may be met in a variety of sectors that feed back to solution of the special problem. Considering the rapid rate of species extinctions and the threats to important ecosystems region wide it is imperative that a significant proporation of donor resources be used in support of direct ("hard") conservation activities.

The development instruments at the disposition of AID for work on environmental issues include direct activities such as research, technology transfer, and environmental planning and protection, as well as indirect activities such as training, education, institutional development, policy dialog, and private sector development.

The decision about when and for what purpose a direct vs. an indirect activity will be chosen depends upon analysis of the problems faced within a defined region of space (e.g. a valley, a country) and time (e.g. five years, a generation), and the interest and willingness of the host country to solve them.

Different ecological problems faced by AID and the LDCs it serves take different dimensions. In the case of biological diversity, the presence and distribution of species is, first and foremost, dependent upon the land, water, and atmospheric conditions in which they occur. No two situations are exactly alike. Natural boundaries (e.g. the drainage basin of a watershed within a region of a country, or an ocean bounded by several countries) are the most logical ones in which solutions must be framed. However, since humans manage natural resources (and must do so increasingly as their own population concentrations rise) within political boundaries, trade-offs must be made to accomodate competing interests. When addressing problems having a regional significance, it would be useful to frame solutions in cooperation with supranational organizations such as ASEAN, and of course at the national level as well. In the absence of land-use planning by governing bodies having a wide jurisdiction, fragmentation of the resource base results, and with it the ecosystem. In many cases within Asia, such extensive fragmentation has already taken place and certain ecosystems with nigh species diversity are severely threatened. Eventually, continued resource degradation may lead to political conflicts between neighboring countries.

Direct Activities

Research

Before priorities can be set and possible interventions identified and implemented, a study of critical lands and species is needed. This direct activity would be dedicated exclusively to assessment of biological diversity and the degree to which it is threatened. The section entitled "Critical Lands and Species in Part I, Chapter 2 above was a first attempt to gather together the required background information for the Asia Bureau, as a first step to more focussed activities. This list is deficient in two ways: 1. it is incomplete, and 2. priorities have not been addressed. (see Part III, Chapter 2, Recommendation 2 below). Such information should be included in country environmental profiles. The latter effort is a longer term activity which should take place largely within the next five years. (See Part III, Recommendation 13 below). The U.S. Strategy on the Conservation of Biological Divarsity, Summary Recommendation D 37 states that AID should "assist LDCs to identify distribution of priority areas and undertake biological inventories."

As noted in The U.S. Strategy, research is also needed for elucidation of the nature of species diversity in those ecosystems that have been identified in the critical lands study. There have been many estimates about the magnitude of our lack of knowledge regarding the species which actually occur in the LDCs. Most countries which have been successful in establishing some kind of protected areas system have done so in the knowledge that *in situ* conservation is the *sine qua non* of preservation of biological diversity. But most have little hard data on exactly what it is they are protecting. What data is available is usually limited to large mammals and birds (see Appendix Part V), less for plants, and even less for insects and microbes. It is noteworthy that the information available is inversely proportional to the magnitude of species extinctions predicted for those organismal groups[1]. For some organismal groups there is very good LDC scientific representation, but for others there is little or none. Research in systematics and taxonomy is usually carried out by individual scientists who have specialized for a particular group of species. Support for this kind of work is best done by a competitive grants program (see Part III, Chapter 2, Recommendation 3 below) like the Science Advisor's P.S.T.C. program (it unfortunately expressly precludes this type of research) which would be open to any scientist in AID supported LDC's or the U.S., who is expert in the field.

The first of the seven major strategy elements in The U.S. Strategy on the Conservation of Biological Diversity is "helping (developing countries) establish and implement national policies for conserving, managing, and developing genetic resources." This is addressed in Part III, Chapter 2, Recommendation 14 below). The fifth major element of the The U.S. Strategy states that we should "promote balanced resource management and the designation and maintenance of protected areas". Part III, Chapter 2, Recommendations 16 and 19 below address this issue in part. The problem is defining what level of use lies within the "carrying capacity" of each ecosystem. This usually requires research since no two ecosystems are ever identical (because the species inhabiting them are never identical either in type or abundance). However, it is fortunate that ecosystems can be grouped by similarity. Thus, we can study one type of ecosystem in terms of its species composition and how this varies over time, both in the presence and absence of selective manipulation, and use the results to extrapolate what level of exploitation and what types of exploitation can be borne without substantially altering the system itself, or its ability to produce the commodities that interest us. If we are honest about our desire for sustained economic development (which is inevitably based on use of renewable natural resources) then such empirical studies are absolutely essential for knowledgable planning (see Part III, Chapter 2, Recommendations 4 and 8 below).

The choice of ecosystems for research on carrying capacity may be quite different than those designated in the critical habitats study. Since some of the most important outcomes of studies of carrying capacity are guidelines for sustainable levels of harvesting, the ecosystems chosen for study should be commonly represented in the region under consideration and widespread in their areal coverage. The choice should also reflect the degree to which the resource in the country concerned is threatened as well as the magnitude of its contribution to the economy. Thus, one country (e.g. Indonesia) whose economy is heavily dependent on the fisheries industry may need to study reef communities, and their management, whereas another (e.g. Thailand, whose freshwater fisheries were nearly wiped out by disease) may need to concentrate on freshwater ecosystems. Historical and sociological studies (see Part III, Chapter 2, Recommendation 4, Alternative 2), in which the use and management of natural resources by endemic human populations is in focus, can give general indications about the carrying capacity but are not sufficent in and of themselves for predictive purposes. AID has allocated $1 million for a World Wildlife Fund U.S. "Program in Wildlands and Human Needs" to be carried out in the LAC and Africa regions. If this program develops in a promising way, the ANE Bureau could consider an add-on activity in Asia. The U.S. Strategy Recommendation G 66 gives "expanded support for U.S. private voluntary organizations operating in LDCs".

Monitoring of ecosystems is an activity which is pre-requisite to predictive determinations of carrying capacity for sustainable use. The U.S. Strategy Recommendation D 35 states that research and monitoring programs should be developed for increased productivity of unprotected areas. One must first understand how an unperturbed ecosystem evolves, then apply selected stresses and document the response of the ecosystem and the species which comprise it. This constitutes study of the dynamic processes of the ecosystem, and relates as directly to preservation of biological diversity as does study of its structure (inventorying of species and communities).

Ecosystem monitoring requires long-term basic research conducted in a multidisciplinary fashion. This is because ecosystem change involves successional change in which relatively long-lived species (such as trees or corals) must complete their life cycles and replace one another, and in which the populations of other species which are dependent on this succession wax and wane. Ten years would be a minimum time frame for forest or coral reef ecosystem projects. Monitoring of most aquatic systems, due to the faster generation time of the majority of their species, can be done in three to five year projects. Even though AID does not normally fund activities exceeding five years (in rare exceptions 10) almost all other donor or research funding agencies have even shorter periods of support. What this means is that continuity of research projeects becomes the responsibility of individual investigators who solicit and receive funds for short periods of time from many different sources. This patchwork of research virtually precludes the kind of integrated, multidisciplinary approach that most specialists agree is needed, and rarely (if ever) results in a coherent program whose results can then be used by the donor. A better approach would be establishment of one or more research centers (preferably located in or near the field locations where research will be conducted) that are dedicated to monitoring of a single or several important tropical ecosystems. (See Part III, Chapter 2, Recommendation 8 below.)

Ideally one such ecosystem monitoring project should be done for each type of critical ecosystem in the Asia region. However, since such projects are likely to be expensive only one may be fundable. Projects like this could be done either by the ANE Bureau which has a region-wide focus (which will ensure dissemination and implementation of the results throughout the region) or by the Science and Technology Bureau (or as a cooperative project by both), but should be accomplished in full partnership with the mission in whose country it takes place. Science and Technology Bureau or the Office of the Science Advisor may need to provide scientific oversight and evaluation of technical results, depending on the availability of such expertise within the bureau or the mission. Funding should be a joint effort between the bureau and the mission, and in cases of exceptionally long research projects (such as those that may take place in tropical rain forests) establishment and endowment of a foundation may be the most appropriate means to support it.

Technology Transfer

Part of the difficulty in compiling existing information is that it is scattered widely in published journals and unpublished reports. Each group that needs this information as a basis for programmatic activity must gather it anew.

Furthermore, once information about critical lands and species has been gathered it must be maintained and updated, and also be readily available to those who need it. Computerized data bases represent one way of storing, organizing, regenerating, and transmitting information quickly and in different forms. The Asia Bureau should consider establishing Biological Diversity/Natural Resources data bases in at least two locations, preferably one in South Asia and the other in Southeast Asia. Transfer and application of computer technology for work on environmental problems in development is a particularly appropriate activity for AID, as this may be one type of environmental activity for which host countries may be willing to use loan funds rather than grants. An alternative to providing hardware, software, and technical expertise would be to contribute to the costs of expansion and upkeep of the widely acknowledged IUCN Data Base located in Oxford, England which is probably the most effective one that has been established to date (see Part III, Chapter 2, Recommendations 11 and 12 below).

Technical assistance should be provided for the mitigation of waterborne pollution. The pollution of freshwater is becoming critical in some places. Both urban wastes and industrial effluents are of inportance. Run-off from agricultural lands contributes a huge excess of nutrients from leached chemical fertilizers as well as pesticides. Missions should begin to address these problems in their policy dialog with host governments, and seize any opportunity to initiate projects in this area, particularly in the case of countries like Thailand which are entering middle income status and industrializing rapidly. Acquisition of pollution abatement equipment (particularly if it is associated with production of some marketable commodity such as biogas) is likely to be one of the few projects for which LDC governments may be willing to accept loan funds.

Environmental Planning and Protection

Item 4 of The U.S. Strategy 7 major strategy elements states that "balanced resource management and the designation and maintenance of protected areas should be promoted. Once the regions and species in need of greatest attention have been identified, decisions should be made as to the need for preservation (e.g. wildland designation, protected status) vs. conservation (e.g. limited, controlled use by area residents) to slow the pace or halt destructive processes and encourage regeneration. Both preservation and conservation are classed as direct interventions in support of biological diversity, with the former more exclusionary than the latter. Some habitats are so sensitive to human impact that any use results in degradation. Most, however, can sustain uses of many types in moderation. Whenever AID engages in a preservation or conservation activity it will do so in response to request by the host government. Funding for such activities may need to be channeled through appropriate PVO groups to reduce the need for direct management by ANE

Bureau which lacks a sufficient number of trained environmental specialists. Examples of the types of activities which donor agencies like AID can and should support are listed by country in the section on Critical Lands and Species in Part I, Chapter 2 above,and in Part III, Chapter 2, below. Several unsolicited proposals are included in Part V as appendices.

In general, based upon conclusions contained within the United Nations Document (see Reference [1] in Executive Summary, - relevant excerpts are given in Part V of this paper), it is clear that for the region as a whole, the study of and establishment of projects relating to conservation of biological diversity in natural forests (both montane and lowland rainforests), freshwater ecosystems, and marine coastal environments should be conducted in that order of priority.

Indirect Activities

Institutional and manpower development (including training and education), policy dialogue in support of national development planning, and private sector development are all examples of activities which indirectly influence preservation of biological diversity. Suggested programs for these areas of concern are presented in Part III, Chapter 2, Recommendations 16-20.

All missions should, as part of the CDSS and ABS exercises, to identify ways of integrating a conservation thrust into their Agriculture and Rural Development portfolio, in a way that bears direct relevance to preservation of biological diversity.

Development of institutions

The third of the seven major strategy elements of The U.S. Strategy states that "developing country conservation institutions should be strengthened and conservation training increased". Most Asian countries have established environmental or natural resources agencies in recent years (see Part IV, Chapter 1 and Part V, Chapter 2 for lists and summaries of their state of development, respectively). These entities have varying degrees of capability and influence on decision-making, but are uniformly characterized by low budgets and insufficient numbers of trained personnel. The ANE Bureau should identify a few of the most strategic Asian institutions to receive support grants for in-service training, in-country university study, and in a few cases U.S. university training (at the doctoral or post-doctoral level) of their employees. Natural resources management for sustained development should be the theme throughout. Grants for applied research and information dissemination would also help to develop a basis to enhance the effectiveness and prestige of such institutions. This approach should build on the successful Agriculture Development Council (A/D/C) model in

Southeast Asia for strengthening institutional capability in agricultural research and development through carefully focused training networks.

Training of AID Personnel having Natural Resources Management Responsibility

Although the ANE Bureau presently enjoys the services of a well qualified (contracted) Regional Environmental Officer, this position will soon cease to exist as the individual is being reassigned to the Thailand mission on a Personal Services Contract. Several other well qualified individuals have joined the ranks of Mission Environmental officers over the past few years, but a number of the individuals holding such positions have been conscripted to it as collatoral duty, and do not have adequate training to successfully initiate or manage projects dealing directly with biological diversity (as described above) or to give the needed attention to biological diversity where it is an indirect, but important component of another type of project. Even less formal training in the environmental sciences is characteristic of the ranks of Agriculture and Rural Development Officers who have natural resource management issues in their purview. It is therefore suggested that periodic training courses be mandatory for those individuals which manage projects having natural resource components, whose professional education was in a different field. Recommendation C 14 of The U.S. Strategy states that "AID should train relevant mission staff in natural resource management prior to assignment. Such training could be conducted either in the Asia region (a preference for this was voiced by Deputy Mission Directors in Thailand and India) or in the U.S. Although it would be cheaper to have such training occur in Asia, there would be some merit in having it occur in the U.S. on a yearly or alternate year basis, inasmuch as this would facilitate convening of environmental officers' meetings at AID/Washington. It would be best to have a two to three week lecture course followed by a one week demonstration visitation in the Asia region to allow academically guided, hands-on experience in natural resource management activities (see Part III, Chapter 2, Recommendation 9, Alternatives 1 or 2, and Recommendation 15, Alternative 2 below). Alternatively, formal graduate education in the U.S. could provide the needed specialization (see Part III, Chapter 2, Recommendation 15, Alternative 1 below).

Policy Dialogue and National Development Planning

The ANE Bureau should advocate and provide support for the development of Country Environmental Profiles (CP) and National Conservation Strategies (NCS) as important inputs to national and regional development planning. The first of the seven major elements of The U.S. Strategy is to "continue an ongoing policy dialogue within federal agencies and with developing countries on biological diversity, and help them establish and implement national policies for conserving , managing and developing genetic resources. The agency has begun support through the ST/FNR Environmental Planning and Management project for National Conservation Strategy development in Sri Lanka, Nepal, and the Philippines. The Pakistan mission at one time indicated that it would welcome such assistance to the GOP, but later wavered in its committment. The Thailand mission is planning to initiate a CP effort soon, and the Bangladesh mission has expressed interest. Missions should continue to follow through on all of the CP and NCS initiatives and seek, through all possible Bureau and bilateral resources, to extend country profile and NCS-type activity to other Asian countries (particularly Bangladesh and Indonesia). (See Part III, Chapter 2, Recommendations 13 and 14 below.)

The Asia Bureau should provide support for seminar/workshops for policy-makers, development planners, and economists on valuation of natural systems, and cost-benefit analysis of development programs and projects. Regional meetings could be planned and carried out in collaboration with the East-West Center Environment and Policy Institute, a logical choice in view of their leadership, ongoing work, and extensive contacts with Asian leaders in this area of study. Similar seminar courses should be held for foreign master's and doctoral students pursuing their education in fields other than environmental science in the United States, particularly targeting those who will be potential leaders upon return to their home countries. The Coolidge Center in Boston has established an innovative program of this type, and should be considered for support (see Part III, Chapter 2, Recommendation 18 below).

The Bureau, as well as other offices in AID should devote some financial resources for support of media campaigns that will educate AID professionals as well as developing country politicians and populations about the importance of environmental planning (and biological divesity concerns) in development planning (see Part III, Chapter 2, Recommendation 20 below). Such involvement can be accomplished by supporting NGOs as well as using in-house (agency) resources to best advantage. For example, a documentary film has been proposed to the Thailand mission for demonstation of the relationships between sound and faulty environmental planning and successful and unsuccessful development strategies. Such a project could be carried out in a collaborative fashion by the Asia Bureau, S&T Bureau (representated by film-maker S. Staniski), the Thailand mission, and the Siam Environmental Club, who has already contacted the mission concerning their interest. Another interesting project which explores the issue of sustainable development in the context of historically successful strategies by indigenous peoples titled Farming Tropical Rainforests is being developed by Norman Lippman, Project Director for the Mayan Society of St. Louis, and the St. Louis Ambassadors Foundation (a copy of his unsolicited proposal is appended in Part V). He is currently seeking matching funding for the South American portion of the project and would like to expand it to Asia.

Increase in AID Professional Field Staff

There is an insufficient number of direct-hire staff in the missions and central office of the ANE Bureau who are trained in ecology and natural resource management. Presently there is no environmental officer assigned to the India mission at all. Recommendation C 25 of The U.S. Strategy addresses this need and recommends an increase in staff.

Private Sector Development

The private sector, being profit motivated, is usually perceived as antagonistic to environmental interests. However, as natural resources dwindle, dwindle, and it becomes more and more cost effective to recycle rather than discard used materials, a variety of businesses have become partners in the attempt to slow the pace of environmental degradation. For example, energy generation by burning of municipal refuse, conversion of sewerage into methane for fuel, recovery of industrial solvents which would otherwise be discharged as factory effluent, etc. In some cases, products produced by private companies are directly beneficial for maintenance of biological diversity (e.g. oil dispersants used for treatment of fuel oil spills help to reduce impact of the spill on resident wildlife; microbes which degrade toxic chemicals to harmless compounds). It is anticipated that as investment into biotechnology increases, new inroads will be made to increase the effectiveness of *ex situ* preservation of species. Some rare wild species will be brought into captivity and domesticated (e.g. orchids via tissue culture). Others will be conserved only as a unique part of their genome, introduced into, propagated within, and expressed by other unrelated organisms using the techniques of genetic engineering. In many cases (e.g. the India Mission Fund for Technology Development), the Bureau and Missions will have opportunities to influence the type of businesses selected to receive loan funding. Whenever possible, this power should be exerted to the benefit (as opposed to benign neglect) of the environment and biological diversity.

Funding

Magnitude of Funding

What level of funding should the ANE Bureau allocate to programmatic activities directly related to biological diversity for the Asia region? The U.S. National Park Service spends about $18 million/year or about 3% of its operating budget on natural and social science research and monitoring[1], and certainly far more on extension activities to implement the results of this research. The House bill (HR 2958) introduced by Human Rights and International Organizations Subcommittee Chairman Gus Yatron seeks to introduce a line item of $10 million/year into the AID budget by amendment to the Foreign Assistance Act for support of biological diversity preservation worldwide. FY 85 funding for Development Assistance and Economic Support Fund activity in Asia totaled $791 million. If we were to allocate only 1.5% (a fairly modest figure) of that amount for projects in biological diversity this would total $11.8 million per year, a figure equal in magnitude to the proposed budget line item for the agency as a whole. Considering the importance of biological diversity for sustainable development and the heritage of all mankind, in the words of National Park Service Director William Penn Mott, Jr. "We've got to err on the side of preservation". Thus, my recommendation for the yearly budget allocation region-wide for projects which deal mainly with biological diversity lies between $2.0 and 2.5 million (a figure that represents 0.2-0.3% of the Asia DA and ESF funds) starting in FY87, with a minimum of $500,000 in FY86.

Ideally, the amount of money allocated to biological diversity in any given country should bear a direct relationship to the level of ecosystem and habitat destruction resulting from the exploitation of natural resources for economic activity. It should also reflect the rate of population growth. Although most experts agree that there is not necessarily a linear relationship between increase in population and degradation of natural resources, almost all would say that there is a demonstrable cause-consequence relationship (see World Resources Institute Global Possible Report). (A AAAS Study, directed by Charles Kidd, was initiated in January 1985 to explore this issue in depth). In consideration of the fact that virtually all arable land in Asia has already been converted to agricultural use and the population is expected to double by the year 2020 (World Bank, 1985), the two times as many people as are alive today are certain to exert quite an impact by exploiting the remaining natural resources as one of the only alternative means of support in the rural setting. As a practical matter, it will probably be impossible to achieve significant results in certain countries whose natural resource base has already been severely disrupted and fragmented. Therefore, in choosing which countries and which projects should receive priority for funding, some estimation of the probability for success should enter the equation.

Type of Funding

Recommendation A 2 of The U.S. Strategy says that "whenever feasible natural resource activities should be grant funded".

Biological Diversity and Other Bureau Programs

The U.S. Strategy on the Conservation of Biological Diversity, in summary recommendations C 13 and E 46 directs AID to incorporate elements supporting conservation of biological diversity into each development project affecting natural resources, and to ensure that environmental assessments that would point to such a need be conducted in the early stages of project implementation. The sectors which should give particular attention to biological diversity concerns, are, in the first place, those which may involve any type of major construction such as large dams, irrigation projects, energy generating plants, and other types of heavy industry which will inevitably contribute to habitat destruction.

Agricultural projects which plan to bring new land into production should take the need to maintain the integrity of conservation areas (whether or not they belong to the protected areas system) and surrounding "buffer zones" into account. No support should be given to any LDC project which promotes large scale transmigration of population from agricultural into forested areas. Whenever possible, integrated pest management techniques should be promoted to set an example to reduce the use of and need for widespread and heavy application of chemical and biological pesticides. Organic fertilizers, involving the following types of applications, should be used and promoted in preference to reliance on inorganic nitrate and phosphate based fertilizers: (1) intercropping systems involving legumes and inoculation of soil with the nitrogen-fixing bacteria <u>Rhizobium</u>, <u>Azospirillum</u>, and <u>Azotobacter</u>, and the phosphorus scavenging mycorrhyzae, (2) inoculation of rice paddies with the nitrogen-fixing water fern/blue green algal symbiont <u>Azolla</u>, and (3) application of dung or compost. No- or low-tillage methods should be used wherever possible to control soil erosion. (Note that formation of only 1cm of soil <u>in situ</u> may take 500-1,000 years, depending on the nature of the parent material). Rates of soil erosion are exceedingly high in the drier parts of South Asia, and in peninsular Southeast Asia.

Forestry projects should strictly avoid clearcutting, and try to influence the location of logging concessions so that they are well away from conservation areas, and <u>never</u> located in protected parks and reserves. Plantation forestry projects are most suitable for increasing the area of buffer zones around conservation areas which are naturally forested. They should not replace natural forest, but instead be planted on already deforested lands. Reliance on use of single species plantings (particularly that involving the use of exotic species) should be minimized, emphasizing instead multispecies planting. Reseach should focus on improvement of native fast growing tree species (including their introduction into tissue culture, and on the use and potential of agroforestry (in which trees are planted on agricultural lands, rather than introducing agriculture into forested areas) to supply fuelwood and cash crop needs.

Rural development projects should be located to the greatest extent possible in "buffer zones" surrounding protected or conservation areas. They should emphasize environmentally benign economic activities, which should preferentially be located downstream of the conservation area to minimize the effects of pollutants upon it. The level of economic improvement should be targeted to bring <u>stability</u> to income generation and to prevent chronic shortfalls in income needed for a dignified, and healthful quality of life. (These measures should, in combination with public education significantly reduce the incentive for poaching).

Family planning projects should be directed whenever possible to indigenous populations dwelling within conservation areas, and in regions surrounding them or located upstream of them.

Energy generation projects, when they depend upon fossil fuels should attempt to include pollution abatement equipment to minimize the long-term effects from the inevitably generated water and air pollution. Whenever possible, biomass conversion should be employed to make use of municipal sewerage to produce biogas (the nutrient rich sludge from such operations should be salvaged for use in truck farming near urban areas).

Urban planning should provide for strictly separated sewerage lines for domestic and industrial effluents. This is absolutely essential if human wastes are to be recycled for use in production of biogas and for agricultural fertilizer. (Note that the U.S. is not providing a good model itself, and countries just beginning to develop major sewerage systems and planning for location of industry should not repeat our mistakes.)

Road construction, dam construction, and large irrigation projects should strictly avoid intrusion into conservation areas and buffer zones.

Literature Cited

[1] Sun, M. 1985. Host of problems threaten National Parks. Science 228:1413-1414.

CHAPTER 2. SUGGESTED PROGRAMS: TYPES, OPTIONS, AND PROBABLE COST

Research

Natural Resources

Recommendation 1. Economic Aspects of Biological Diversity

A case study is needed on the economic consequences of continued habitat and ecosystem degradation, and of the potential economic advantage of conservation of naturally occurring biological diversity, focussing on one or two countries in Asia. It should include a section which addresses the proper accounting and estimation of costs and benefits of typical development projects. This would be a valuable adjunct to more theoretical studies that have been commissioned by the Office of Technology Assessment for their current work on biological diversity. Such a case study would help to establish the links between theory and reality, and provide valuable data and anecdotes that should be very useful for policy dialog with LDC governments. An important component of the terms of the award should be a demonstrated ability on the part of the Principal Investigator to identify host-country researchers, conduct truely collaborative research, and identify the way in which maximum use can be made of host-country data and facilities in conducting the study. The study would take approximately one year to complete.

Alternative 1. The advantage of contracting with BOSTID is that many different experts may contribute, yielding a more balanced document than would be produced by an individual. A BOSTID document would likely be more consistent in quality throughout. The cost would be approximately $120,000.

Alternative 2. The advantage of contracting with a non-profit or commercial consulting company or individual would probably be a document with better flow, and greater internal consistency than is sometimes the case in BOSTID documents. The individual doing the work is likely to spend more time in the country or countries addressed (and may thus incorporate more indigenous information than is usually the case in a desk study). The disadvantage is that the quality of a document produced by a contractor could be very good or very bad, depending on the choice. If performed by a consulting company, the cost would probably be the same as for a BOSTID study, approximately $120,000. An individual contractor may charge only 50-60% as much, i.e. $60-70,000. There would appear to be no advantage to using a company rather than an individual, except that a company may take over responsibility for the choice of the individual, whereas this choice would otherwise fall directly to the ANE Bureau.

Alternative 3. This study could take the form of a grant, for which public and private institutions could compete. As a grant to a university, it would probably take at least three years to complete, most likely being accomplished as a doctoral dissertation by an individual under the guidance of an acknowledged natural resource economist. The advantage is that the study would include considerable original thought and design as well as being comprehensive in its literature survey and peer review. The disadvantage is that it may be more narrowly focussed than a study performed by a contractor. The cost of such a grant would need to be at least $150,000 for the three year period.

Recommendation 2. Elaboration of the list of critical lands and species, and determination of priorities.

A short term study is recommended to obtain a more complete list of critical habitats and species threatened with destruction or extinction than that given in Part I, Chapter 2 and appendices of Part V of this document. A determination needs to be made as to which organizations, in addition to those cited, are conducting critical habitat assessments, in which countries of the region, and what is their state of accomplishment. A comprehensive list of critical lands and species should be developed at the earliest possible time by literature survey, meetings with LDC scientists and environmental leaders both within and outside of the LDC governments, and then prioritized. The list should indicate for each country in the region: (1) what is the current conservation status of the land or organism, both legal and actual, (2) what is the economic use if known, (3) a description of the stress which threatens its abundance or existence, (4) whatever is known about the government and private sector plans for its exploitation and/or conservation. The study could be accomplished within one year.

Alternative 1. A company or individual with good familiarity with conservation foundations and literature worldwide could be contracted with to produce this work. Approximately six months would be needed for literature survey and compilation. Approximately five months would be required for visitation and discussion with government leaders, and NGO and PVO representatives in each of the 10 countries in the region (approximately two weeks in each location) to vet the information collected for completeness, accuracy, and prioritization. The final month would be devoted to production of a document and presentation to

AID. This study would cost approximately $150,00 if contracted to a PVO (such as IUCN), an environmental consulting company or university, and $70,000 if contracted to an individual, including travel costs.

Alternative 2. A company or individual could be contracted for six months to complete the literature survey needed and produce a document compiling results, as described above, and submit one hundred copies of the document to the ANE Bureau for distribution. This portion of the work would cost approximately $50,000 if conducted by a company, and $30,000 if done by an individual contractor. Discussion with LDC government leaders, NGO, and PVO representatives would be accomplished by each mission environmental officer or other appropriate employee. The cost of this alternative would be that of the literature survey and document, i.e. $30-50,000.

Recommendation 3. Establishment of a competitive grants program for determination of the nature of species diversity in the ecosystems identified as priorities.

The appalling lack of knowledge about the species composition, and relative abundances in the great majority of tropical ecosystems needs to be addressed. Remedying of this situation can only be accomplished through serious academic research. Any program of research should be open to LDC and U.S. scientists, and evidence of a truely collaborative effort between both would be a basic requirement for an award.

Alternative 1. Establish, with ANE Bureau funding, a new section in the Science Advisor's P.S.T.C. program dealing exclusively with basic research on species new to science in any of the major organismal groups (animals, plants, fungi, protists, prokaryotes), which occur mainly in habitats which are threatened, and their contribution to the functioning of that ecosystem. Fund five grants each year at the $150,000 level (including overhead). The period of funding could range from 2-4 years. Total cost per year would be approximately $750,000 (the first year or two it would be considerably less because only 1/4 to 1/2 of each award would be transmitted the first year).

Alternative 2. Establish, with ANE Bureau funding, a new section in the BOSTID grants program which deals with the same issues as described in alternative 1 above. Fund five grants each year at a $100,000 level, with the period of that funding ranging from 2-4 years. Only LDC investigators can apply for BOSTID awards. Accordingly, there should be a stipulation that each successful grant must have a collaborative arrangement involving the participation of a U.S. expert for the systematics and ecology of the species under study. This would be an essential requirement, as scientific leadership has rarely emerged in LDCs in these areas of study (where new species are involved). The cost of this program would be approximately $500,000/year plus BOSTID overhead once it became established.

Alternative 3. Contract with the National Science Foundation, International Section or the Smithsonian Institution to award three grants/year at a maximum cost of $250,000/grant over its lifetime (2-4 years), including overhead. This type of arrangement could function in a similar fashion to the nitrogen fixation program of S&T Bureau which is contracted to the USDA. The cost of this program would be approximately $750,000/year once the program became established plus whatever overhead would be required by either institution.

Recommendation 4. Determination of carrying capacity of economically important ecosystems for sustained development.

The concept of sustained development implies renewal of the natural resource base. Exploitation (harvesting) of a given renewable resource can be carried out within a very long (theoretically unending) time frame assuming that the "carrying capacity" (the ability of the system to regenerate itself and its harvestable yield) is not exceeded. Unfortunately, we do not know what the carrying capacity of most ecosystems is because historically most have been either underexploited (because there were so few people) or overexploited (because there were too many people or too many greedy people). We have very few examples of natural ecosystems or individual resources which have been harvested at the same level for long periods of time without demise (wild truffles from France may be such a case). Highly managed agricultural systems are perhaps the best example of sustained development of renewable resources. The cost of applying the same levels of management and material inputs to other (naturally occurring) systems would be prohibitive. So what we are searching for are low management, low input schemes to use natural resources profitably and conserve them as well. In systems that regenerate themselves quickly, like freshwater fisheries, this task is not too daunting. The Office of Technology Assessment (OTA) recently conducted a study of "Technologies to Sustain Tropical Forest Resources". Far less information is available for coral reefs and reef fisheries which are apparently far more complex than either freshwater or pelagic (open water) marine fisheries. Natural resource management schemes are more often based on theoretical principles and empirical results which provides a good first approximation, but rarely yield an accurate prediction of what might happen when a reef is exploited. The USAID Indonesia Aquatic Resources Development Project is looking at the productivity component of marine fisheries, and may focus on development of reef fisheries in the eastern part of Indonesia. It would be important to reorient this project to reflect sustained production by reef fisheries rather than simply seeking methods to intensify their exploitation.

Alternative 1. A study modeled after the one done by OTA for forests should be done on technologies to sustain reef fisheries. First, a literature survey is needed to determine which publications ar already available on the subject and who are the experts (this could be contracted to an individual for six months at a cost of $40-50,000.

Then, a one day seminar should be convened with representative experts (cost: $15-40,000) to determine what are the most important unanswered questions. Based on the outcome, a series of at least ten papers should be commissioned to address each of these aspects (cost: $25-30,000).

Alternative 2. A compilation and evaluation study should be commissioned that would survey the anthropological literature for evidence of sustained harvesting of ecosystems (e.g. ancient Mayas had quite a dense population, practiced rotating agriculture slashed from the tropical forest of Yucatan, and had a highly developed civilization which lasted several hundred years being destroyed by conquest, not ecological demise). There are undoubtedly similar cases for Asia. Such a study should attempt to concentrate on Asian civilizations but need not be restricted to them. It would require six months to a year to complete. Cost may range from $30-50,000 for an individual contractor or $50-80,000 for a company, depending on the length of the study. This type of study might also be conducted by an Asian institution.

Plantation Forestry

Recommendation 5. Conduct research on endemic fast growing trees in mixed species planting to provide alternatives to introduction of exotic species in monoculture for plantation forestry.

One of the most commonly cited criticisms about plantation forestry is that it relies too heavily on the use of exotic species such as Leucaena and Eucalyptus, which may severely alter local conditions (e.g. soil water), and fail to provide niches for the dependent flora and fauna of the natural forest. Another complaint is that plantation forestry almost always relies on the use of monoculture, which suffers from all the same deficiencies as crops planted in this fashion; namely, the stands are subjected to heavy infestation by pests and require the use of pesticides which are indiscriminately damaging to harmless (and beneficial) forest insects as well. It is felt that mixed plantings of fast growing endemic tree species may provide an intermediate solution, one which yields a more rapidly generated source of fuelwood and lumber, with far less impact on other forest species and functions than continued harvesting of natural forests (particularly the clearcutting thereof), or plantation monocultures using exotic species.

Alternative 1. Establish a mixed species plantation forestry research unit in an existing school of forestry in a noted university. The Kasetsart University Faculty of Forestry in Bangkok or the Forestry Institute at Dehra Dun, India would be possible locations for such research. Funds supplied for this purpose would be used to purchase equipment, research supplies, computers for data collection and statistical analysis, and vehicles for travel to the test sites. Cost for this portion of the project would be $125-200,000 depending on the country chosen. A special fund should also be set up to provide Visiting Professorships of six months' duration for U.S. scientists with special expertise in this area of research (sabbatical researc.. and teaching). This aspect of the project would cost $50-60,000/year for two professorial salaries (six months each) and travel costs, plus overhead costs of the LDC institution. The visiting professor program should continue for at least five years for a total of $250-350,000. The grand total of this project would be approximately $400-550,000 for five years.

Agriculture

Recommendation 6. Special research projects should be designed to conduct literature and field surveys to locate indigenous cultivars and wild relatives of important food crops, other than rice, and domestic animals in Asia. (IRRI has already been quite successful in collecting rice germplasm).

Little is known about the centers of orgin and present ranges of distribution of many of the wild relatives of important traditional Asian food crops. Breeding of crop cultivars which achieved great success during the Green Revolution depended heavily on the transfer of genes for pest resistence from wild relatives. With the advent and increasing success of protoplast fusion and tissue culture techniques, and genetic engineering, it is likely that new breakthroughs in crop yields, environmental stress tolerance, and pest resistence will be made on the basis of far wider "crosses" than were ever possible using traditional breeding techniques. Still, such work is still in its' infancy, and the traditional breeding programs will continue to require new influx of genes from not too distantly related species for many years to come (and possibly forever). Any effort of this kind should be coordinated by or developed in collaboration with the International Board for Plant Genetic Resources (IBPGR). The U.S. Department of Agriculture, the National Plant Germplasm Committee, and the National Board for Plant Genetic Resources should be called upon for assistance and/or management.

The BOSTID report "Little-Known Asian Animals With a Promising Future" points out that many of the endemic animal species that are closely related to pigs and cows have potentially important germplasm for agricultural purposes, and are or will soon be endangered in their native habitats in Asia. One particularly interesting new bovine hybrid, the Selembu seems particularly promising as it exhibits most of the desirable characteristics of both parents.

Alternative 1. A block grant should be offered for open competition by agricultural and/or botanical departments at universities, commercial crop breeders, and international agricultural research centers (both CGIAR and non-CGIAR) in the U.S. and abroad. It would provide funds for research projects on at least two crops (one grain crop and one non-grain crop such as a tuber). Funding would be at the level of $500,000 for a five year period. This would provide sufficient funds for two literature surveys, several collecting trips, preparation and cataloging of seed for storage, and for introduction of vegetatively reproducing species into tissue culture, as well as some breeding experiments using the novel genetic material to be conducted and evaluated. Subcontracting would be allowable so that more institutions with differing areas of focus could compete. Extensive collaboration with experts from the countries in which the surveys and collections will be made would be essential, especially considering the heightened sensitivities regarding "ownership" of germplasm resources. Some legally binding agreements may be necessary to ensure that the LDCs involved benefit from technical advances achieved under this program.

Alternative 2. A non-competitive grant should be offered to each CGIAR institute designated by ANE Bureau agricuture experts as being the most capable and appropriate to carry out research of the type described in Alternative 1 above. Determination of the crop or crops to be studied should be made in consultation with S&T Agriculture, and may depend upon such factors as widespread increases in destruction of a given crop by pests (due to increasing pesticide resistence), greater numbers of people dependent on crops having variable performance in areas considered marginal for agriculture, etc. The same level of funding would be appropriate as in Alternative 1. More research for lower costs by scientists in LDC institutions will be offset by the need for hiring of or contracting out to specialists in systematics and ecology of the target plants (many of which may need to be brought from the U.S.), and the probable need for training in tissue culture and other techniques.

Institution Building and Strengthening

Conservation of Germplasm

Recommendation 7. Establishment or strengthening of germplasm banks of important agricultural cultivars and their wild relatives.

The rationale for support of germplasm banks was given in Recommendation 6, above. Germplasm banks should be established for those Asian crops of major importance which do not yet have them. Those already in existence which are in need of upgrading or expansion of facilities should also be considered for support.

Alternative 1. Designated support should be given to equip institutes. Technical assistance may be needed on the short term to help establish technician training. Probably $200,000 would provide sufficient start-up costs for each crop. The most appropriate institutions for establishment of such facilities should be worked out by ANE Bureau agriculture specialists in consultation with mission environmental officers, LDC government representatives from agricultural ministries, and S&T Bureau Office of Agriculture. If five crops were chosen, the project would require a total of $1,000,000.

Research Facilities

Recommendation 8. Establishment of field research monitoring centers for studies of ecosystem equilibrium, evolution, and regeneration.

Ecosystem research conducted in a multidisciplinary, collaborative fashion requires a central facility for overall planning and design of research areas, the research plots or areas themselves, a library, a computer for storing data and statistical evaluation, space for management, living quarters for scientists, and a shop for construction of special equipment.

Ideally, such centers would be located in or near a protected area so that non-disruptive research could be conducted in that area. The research center could be an independent institution, but most likely would constitute an extension of an area university. Each would be managed by Co-directors (one from the U.S., one from an LDC) hired competitively on renewable contracts, an administrative assistant and a secretary, as well as by an honorary scientific advisory board (with staggered five year terms) comprised of not more than 5 representatives from each of the two countries, and for each organismal group and ecosystem type to be studied. Research funds would be dispersed on a competitive basis as awards for grant proposals submitted for collaborative research from and between U.S. and LDC scientists. The basic criterion for each award would be complementarity to the ongoing integrated project, demonstrated excellence of the principal investigators, and the merits of the proposal itself (a miniproposal could suffice due to the relatively small research funds envisioned for each project). The advisory board would convene once a year at a mutually agreed upon international meeting, with 50% of their travel expense reimbursed. A regional or international symposium and workshop would be held periodically to formally present and publish results, and evaluate progress. Funding for each center would be given in the form of a block grant to the center. $200,000 would be needed initially to establish each facility (including construction of buildings and $100,000 worth of scientific equipment). $175,000/year would cover operating costs and 8 to 10 small grants which range from $8-12,000 each. Grants would be for travel and living expenses of the investigators, and purchase of scientific supplies. Support should be given for a minimum of five years, and for forest or coral reef ecosystems, ten. A ten year project of this kind would cost approximately $2,0000,000.

Education

Recommendation 9. Strengthening the capabilities of established institutions through the improvement or establishment of educational programs in biological diversity and natural resource management or tropical forests and forest products.

Alternative 1. Following identification of the most appropriate institution(s) as recipients for this kind of assistance, development of the curriculum should be accomplished in a collaborative fashion by one to two LDC professors relieved of their teaching duties (through salary support which would be paid at a rate of $4-8,000/year/person depending on the country involved) for a six month period together with one experienced U.S. educator (whose sabbatical salary and travel expenses would be covered at a level ranging from $20-35,000 depending on their academic rank and the cost of local housing). Funds to purchase books and other educational materials should be included, which may amount to $50-70/student. Assuming that 30 students would be enrolled in the course these one-time expenses would total $1,500-2,100. Additional operating expenses may be needed at the outset to provide for setting up of demonstration areas for student visitation. An estimated cost for this could range from $2-5,000/site. Assuming that three such areas are set up, this aspect of the project could total from $6-15,000. The grand total for each such project would thus range from $27,500 - 60,000. If five such projects were funded in Asia, the total cost would range from $82,500 -180,000.

Alternative 2. A grant should be offered on a competitive basis to a U.S. institution that would develop one or more demonstration courses in natural resource management. Salary and overhead for the equivalent of one full-time associate professor would be needed, plus travel expenses, office space and equipment, and a secretary. The cost for this portion of the project would be $60-75,000/year. Course materials would be developed and printed or purchased (cost = $50-70/student @30 students/course would amount to $1,500-2,000). Visitation arrangements would be made for students at five selected demonstration areas in Asia to include: one protected area (a national park or wildlife reserve), one selectively harvested conservation forest area, one forest plantation or villiage woodlot, one watershed project, and one social forestry (agroforestry) project (regional travel and housing could range from $500-2,000/student depending upon the location of the demonstration areas and the type of housing available. This course would be appropriate for attendance by AID environmental officers, Asian natural resource managers, Asian graduate students, and U.S. graduate students. Missions would be expected to cover travel and per diem for environmental officers, fellowships would be provided for 10 Asian students/year (cost $5-20,000 total/year), and U.S. graduate students would pay their own expenses. After an initial three year period of support, the program should become self-supporting through tuition paid by AID professionals, U.S. (and possibly European) graduate students. Therefore, as a three year AID supported project, the cost of this program could range from \$66,500 - \$97,000/year for a three year grand total ranging from \$200,000-300,000. This program would serve the entire Asia region.

Information Exchange

Recommendation 10. Enhancing the reputation of selected institutions by having them host regional workshops and regional and international conferences on progress in conservation of biological diversity.

Each designated grant would cost approximately \$25-35,000 for a 3 day regional workshop for 15-20 participants, including travel and *per diem* for participants and 1-2 expatriate advisors.

Technology Transfer

Databases

Recommendation 11. Establishment of new databases.

The availability of information is central to development of up-to-date, comprehensive Country Environment Profiles and National Conservation Strategies. The advantage of maintaining information in a computerized database is that it would greatly increase the host-country capacity to assimilate data, both from in-country and foreign sources, make it available quickly and at low cost to others, and reduce the need for producing bulky, expensive, published documents which quickly become outdated. The computer capability would also facilitate development of model systems to create management options for protected areas, and estimates of carrying capacity for sustainable development.

Alternative 1. The establishment of a new database, including hardware, software, and some operator training may range from \$60-120,000/country. Maintenance costs would normally be in the range of \$30-70,000/year, depending on the prevailing salary levels of skilled employees, and the cost of software, and repairs to equipment.

Recommendation 12. Providing access to existing databases.

Alternative 1. Access to the existing database of IUCN could be purchased by AID on behalf of one Asia regional database facility. This presupposes that one new database facility would be set up in one Asian country (or in Washington) at a probable cost of $60-80,000 for acquisition of a minicomputer, software, and technical training to operate it). This facility would act as a regional data collection and dissemination center. Hard copy of this information would be made available to any other AID-Asia country requesting it at no or low cost. The cost of running such a facility has not yet been determined, but would probably be considerably lower than establishing individual databases in each country of the Asia region. Unlike recommendation 11, this would be a one-time investment, with lower maintenance costs. However, it should be chosen only if there is substantial support for research and data collection efforts in all countries of the Asia region whose findings would be channeled to this center, and also be fed back into the IUCN database.

Policy Dialog

Resource Assessment

Recommendation 13. Promoting and assisting in development of Country Environmental Profiles containing biological diversity profiles.

Alternative 1. The cost of producing a country environmental profile normally costs $60-100,000 if conducted by LDC professionals, and $150-300,000 if produced by a U.S. contractor such as IIED. Adding a biological diversity component to each profile would probably increase the cost by an average of 30% (a fairly large proportion as some basic research may be required) so that add-on costs to produce a biological diversity profile supplement for each would range from $20-100,000 depending on the choice of contractor. Thus, the final cost per profile if produced by LDC professionals would be $80,000 -$133,000, and $200,000 - $400,000 if produced by a U.S. Contractor. No Country Environmental Profiles have been completed in AID/Asia countries. One is currently being planned in Thailand.

National Conservation Strategy Development

Recommendation 14. Promoting and assisting in development of National Conservation Strategies.

Alternative 1. National Conservation Strategies should be done by each individual country, not contracted out to U.S. firms. Assistance by expatriate advisors is sometimes warrented for periods of 6-18 months. If the NCS is conducted primarily by the country itself costs $125,00 to $200,000 to complete (including the cost of advisory assistance). A funding level of $175-300,000 would include a demonstration pilot activity.

Training

AID Personnel

Recommendation 15. Enrollment of AID personnel in pre-existing natural resource management courses having biological diversity components at appropriate U.S. universities to improve capability.

Alternative 1. Release time and tuition costs should be provided for at least one environmental, one agriculture, and one rural development officer in the Asia region each year for advanced education and improvement of technical expertise. ANE Bureau personnel dealing with natural resource managment activities should also participate. This program would be comprised of the cost of a temporary replacement for the employee (which could be accomplished by hiring of a U.S. contractor from the academic community (such as a AAAS Fellow with appropriate expertise) for a one year period at a cost of $60-80,000) plus the employee's graduate tuition ($6-8,000) and relocation expenses ($5-7,000). The yearly total would amount to $210-300,000.

Alternative 2. Release time could be reduced to two to three weeks/environmental officer if a specialized training course as outlined in Recommendation 9, Alternative 2 above were to be developed. No replacement would be required for the employee during that period of time, and he or she would be eligible to participate in not more than one such course in any five year period. Actual costs of this alternative would consist of travel and per diem expenses ($2-3,000) and tuition ($1,500-2,000) for a total of $3,500 - $5,000/person. Assuming that all 30 individuals attend this course over a five year period, two would attend each year for a total cost of $7,000-10,000/year. The total for the five year period would range from $210,000 - 300,000.

Mission Directors

Alternative 3. In addition to either of the program options detailed above, the ANE Bureau should provide a half-day seminar to Mission Directors at an upcoming Mission Director's Conference. The most significant advances in the area of policy dialog with host countries are likely to be made if Mission Directors have a command of central concepts and facts regarding the importance of conservation of biological diversity and development. An individual, company, or PVO with a strong history of involvement with the issue and preparation of AID strategy should be contracted to assist in preparation of the scope of work and put on such an event. If possible a mission director should take the lead in organization of this event. The cost of this activity would probably range between $40,000 and $60,000, exclusive of rental of meeting rooms, etc.

LDC Managers

Recommendation 16. Training courses for Natural Resource Managers

Alternative 1. Modification of specialized training courses in natural resource management and conservation of biological diversity for different resource areas (e.g. freshwater resources, marine resources).

Assuming that appropriate training courses could be established as in Recommendation 9, Alternatives 1 or 2 above, modifications could be made at a modest cost so that different versions of the course could be offered different years on a rotational basis. Initial costs to modify the course for special interests could amount to 20-40% of the cost of establishment. For Recommendation 12 Alternative 1 this would amount to $20-40,000 in additional costs, and for Alternative 2, $40-60.000 in additional costs. A fellowship program could be established to provide for attendance by Asia region natural resource managers and/or graduate students specializing for this profession. To provide for attendance by 10 students/year from the region would require a fellowship fund in the amount of $15-20,000/year. Assuming that this program were to be funded for a total of ten years, the final cost, allowing for some inflation would range from $200,000 to $300,000.

Alternative 2. A fellowship program of the type envisioned above could be established for the 100 Asian students envisioned in alternative 1 above, for one year each of advanced graduate study in an appropriate program which was established by AID or already existing at some other university in the Asia region. The costs of such a program could range from $5-10,000/student for travel, living expenses, and tuition depending on the country and educational institution chosen. Thus, the total cost of this program over a ten year period would range from $500,000 to $1,000,000, or somewhat more, depending on the rate of inflation over that period.

Alternative 3. A fellowship program to enable graduate study in appropriate U.S. universities for Asian natural resource managers and/or graduate students could be established. Due to the intrinsically higher cost of this type of program, attendance would be limited to 50 students (five/year for ten years). Assuming an average per person cost of $15,000/year for travel, living expenses, and tuition, this program would require a total of $75,000/year, and upwards of $1 million dollars for the ten year program taking inflation into account.

Recommendation 17. Training courses for plantation and social forestry managers.

The same set of alternatives as presented in Recommendation 16 above could be developed for the new study area. Cost would be roughly the same.

Education

For Leaders

Recommendation 18. Holding seminar/workshops for policy makers, development planners and economists.

Alternative 1. Each such Asia regional seminar and/or workshop held for three days, with 15-20 participants, and 1-2 expatriate advisors would cost $20-25,000 all expenses included.

Alternative 2. The Coolidge Center in Boston has a unique program to give seminars on sustainable development to LDC students studying in the U.S. in other subject areas (economics, management, engineering, etc.). Information about the cost for supporting such activities had not been obtained at the time of this writing. The objective of the program is to influence potential leaders in LDC governments and industry to consider environmental concerns in their decisions.

For Specialists

Recommendation 19. Establishment of a Fellowship Program for Study of Systematics and Ecology at U.S. Graduate Schools.

A small but well focussed fellowship program for LDC doctural students to attend selected U.S. institutions and work with selected specialists in the following disciplines is needed: (1) entomology (systematics and ecology), (2) the systematics and ecology of free-living microorganisms and their contributions to biogeochemical cycling of molecules and elements, (3) animal-plant-microbial coevolution (including dependencies, antibioses, and symbioses), (4) higher and (especially) lower plant systematics and ecology, (5) invertebrate systematics and ecology, and (6) systems ecology. It is important that doctoral students attend U.S. universaties for this training because these specialty areas are not well represented anywhere in the third world. Furthermore, the style of education there tends to emphasize the following of procedures which is appropriate for experimental biology, but less so for development of scientific judgement that is needed in the less quantitative areas of systematics and ecology.

Alternative 1. Twelve doctoral research fellowships, two in each subject area mentioned above, should be funded for a total of three years each. Cost per student would be an average of $15,000/year for 3 years. The total program cost would be approximately $550,000.

For the General Public

Recommendation 20. Media Campaigns to Engender Public Support for Conservation Programs.

Alternative 1. Production of educational and intertaining videotapes and films are a most appropriate way of engendering public support for conservation programs. By now, most villiages in LDCs have at least one television (except in the poorest of countries) and people are subjected continually to programs and advertising that promote consumption of products stemming from the natural resource base (or destructive of it), but are supplied with virtually no information to inform them about the consequences of consumption. Grade school education is beginning to address such concerns, but there is a sufficiently large adult population which has never been exposed to conservation thinking that factual but entertaining television programs on this subject would be well placed. It costs approximately \$60,000 to produce a single documentary film in a country such as Thailand, using Thai professional movie makers. The AID S&T Bureau Media Center (Mr. Stan Staniski) could produce a documentary film in any AID country for a cost of approximately \$120,000 for material expenses and travel. Films produced by commercial U.S. firms usually cost between \$250,000 and \$500,000 per project. However, contributions can be made to such projects in matching funds to support a percentage of the effort (see the film proposal on sustained use of tropical forests appended to this paper in Part V, below) for an example.

Alternative 2. Supporting PVO's such as World Resources Institute, IUCN, or World Wildlife Fund in designing and promoting an International Event to raise public interest for conservation activities. Something along the lines of Earth Day has been suggested. ANE Bureau could provide matching funds for an activity like this. Support could be given at essentially any level deemed necessary and possible, based on the project proposal.

Funding Sources

Recommendation 21. A study to develop criteria for determination of how to assess and set appropriate levels of an "environmental mitigation requirement" to be levied on AID/ANE development projects having documented environmental impact. It would be equally important to develop guidelines for how such mitigation efforts would be undertaken (e.g. determination of who would pay for the mitigation effort; establishment of a requirement that mitigation be undertaken by a secondary agency which is demonstrably independent from the primary agency in charge of the development project, and which has real authority to receive money and guarantee completion of the mitigation effort). A requirement for the scope of environmental mitigation involving restoration of biological diversity could be made a unilateral requirement or negotiated separately, with the details worked out collaboratively with each host government.

A natural resource economist who is familiar with environmental impact statements should be retained to do this type of study. It could take from one to two years to complete as it may involve considerable original research.

Alternative 1. A competitive grant could be offered and an RFP issued. The level of funding needed would probably range from $200-300,000.

Alternative 2. A PASA or RSSA contract could be established with another U.S. government agency (e.g. The National Park Service, or the Fish and Wildlife Service) to provide individual(s) having appropriate expertise who has an advanced graduate degree and motivation to do this research. This alternative may be somewhat less expensive, costing $150-200,000 for the life of the project.

Alternative 3. A AAAS Fellow could be hired at a cost of approximately $50-100,000 depending on whether the project takes one or two years to complete.

Alternative 4. A non-competitive grant could be given to a selected institution such as the NRDC, Brookings Institute, East-West Center, or IIED. The funding level would be $200-300,000.

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BIOLOGICAL DIVERSITY IN THE ASIA REGION:

ISSUES AND OPTIONS FOR ACTION

VOLUME II

by Susan E. Campbell
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ANE/ASIA TR/EFE

August 28, 985

PART IV. BACKGROUND INFORMATION

TITLE VII—INTERNATIONAL ENVIRONMENTAL PROTECTION

SHORT TITLE

SEC. 701. This title may be cited as the "International Environment Protection Act of 1983".

ENDANGERED SPECIES

SEC. 702. Chapter 1 of part I of the Foreign Assistance Act of 1961 is amended by inserting immediately after section 118 (22 U.S.C. 2151p) the following new section:

"SEC. 119. ENDANGERED SPECIES.—(a) The Congress finds the survival of many animal and plant species is endangered by over-hunting, by the presence of toxic chemicals in water, air and soil, and by the destruction of habitats. The Congress further finds that the extinction of animal and plant species is an irreparable loss with potentially serious environmental and economic consequences for developing and developed countries alike. Accordingly, the preservation of animal and plant species through the regulation of the hunting and trade in endangered species, through limitations on the pollution of natural ecosystems, and through the protection of wildlife habitats should be an important objective of the United States development assistance.

"(b) In order to preserve biological diversity, the President is authorized to furnish assistance under this part to assist countries in protecting and maintaining wildlife habitats and in developing sound wildlife management and plant conservation programs. Special efforts should be made to establish and maintain wildlife sanctuaries, reserves, and parks; to enact and enforce anti-poaching measures; and to identify, study, and catalog animal and plant species, especially in tropical environments.

"(c) The Administrator of the Agency for International Development, in conjunction with the Secretary of State, the Secretary of the Interior, the Administrator of the Environmental Protection Agency, the Chairman of the Council on Environmental Quality, and the heads of other appropriate Government agencies, shall develop a United States strategy, including specific policies and programs, to protect and conserve biological diversity in developing countries.

"(d) Each annual report required by section 634(a) of this Act shall include, in a separate volume, a report on the implementation of this subsection. Not later than one year after the date of enactment of this section, the President shall submit a comprehensive report to the Speaker of the House of Representatives and the Chairman of the Committee on Foreign Relations of the Senate on the United States strategy to protect and conserve biological diversity in developing countries.".

INTERNATIONAL WILDLIFE RESOURCES CONSERVATION

SEC. 704. (a) The Secretary of State and the Secretary of the Interior, in consultation with the heads of other concerned Federal agencies, shall undertake a review of the effectiveness of existing United States international activities relating to the conservation of international wildlife resources and shall develop recommendations to substantially improve existing capabilities. On the basis of this review, the Secretary of State and the Secretary of the Interior shall, within six months after the date of enactment of this Act, transmit to chairman of the Committee on Foreign Relations of the Senate and to the chairman of the Committee on Foreign Affairs of the House of Representatives a report—

(1) describing the programs of all Federal agencies concerned with international wildlife resources conservation programs;

(2) recommending an integrated United States plan of action to assist foreign governments and international organizations in conserving wildlife, taking into account the projections in the Global 2000 study;

(3) analyzing the extent to which the Department of State and other relevant Federal agencies are currently involved in—

(A) the establishment of effective liaison with international, national, and local governmental and nongovernmental agencies, organizations, and persons involved in or knowledgeable of wildlife resources conservation abroad;

(B) the provision of expert international wildlife resources conservation staff assistance and advice to United States Embassies, Agency for International Development missions, United States overseas military installations, and other United States governmental or private interests;

(C) facilitating the provision of advice or assistance to governments, agencies, or organizations which wish to enhance their wildlife resources conservation capabilities abroad;

(D) the acquisition and dissemination of reliable data or information concerning—

(i) the conservation status of species of wild fauna and flora;

(ii) the conservation status of lands and waters upon which wild fauna and flora depend;

(iii) existing or proposed laws, proclamations, statutes, orders, regulations, or policies which pertain to the taking, collecting, import, or export of wildlife resources, or to other aspects of international wildlife resources conservation;

(iv) the potential impact upon wildlife resources abroad of actions authorized, funded, or carried out by the United States Government; and

(v) opportunities to initiate or enhance the efficiency of international wildlife resources conservation by the transfer of United States expertise through technical assistance, training, exchange of publications, or other means;

(E) maintaining liaison, for the purposes of providing information needed to make sound conservation decisions, with persons responsible for implementing actions abroad which are authorized, funded, or carried out by Federal agencies or other persons under the jurisdiction of the United States; and

(F) the performance of any other activities which may be relevant to the United States obligations, authorities, or interests in the field of international wildlife resources conservation;

(4) recommending steps which could be taken to increase the capabilities of the Department of State and other relevant Federal agencies in carrying out the functions described in paragraph (3), including estimates of the costs of taking those steps and estimates of the personnel required to increase those capabilities; and

(5) analyzing the desirability of delineating geographic regions abroad (which would be known as "International Wildlife Resources Conservation Regions") and assigning qualified members of the Foreign Service to be responsible for wildlife resource conservation issues in those regions.

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Mr. WEISS. Mr. Speaker, if the gentleman will yield, the gentleman from Pennsylvania [Mr. WALKER] is correct.

Mr. FAWELL. Mr. Speaker, I withdraw my reservation of objection.

The SPEAKER pro tempore. Is there objection to the request of the gentleman from New York [Mr. WEISS]?

There was no objection.

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RIGHTS OF CONSCIENTIOUS OBJECTORS

(Mr. OBERSTAR asked and was given permission to address the House for 1 minute and to revise and extend his remarks.)

Mr. OBERSTAR. Mr. Speaker, protection of the rights of Americans who have conscientious objections to military service is a long-established tradition of the United States.

THE GLOBAL ENVIRONMENT

(Mr. YATRON asked and was given permission to address the House for 1 minute and to revise and extend his remarks.)

Mr. YATRON. Mr. Speaker, last week I introduced H.R. 2957 and H.R. 2958 to address two critical international environmental problems: tropical deforestation and biological diversity.

Every year an area approximately the size of Pennsylvania is deforested. If this loss is not arrested, the consequences for both developed and developing nations could be catastrophic. Tropical forests are an essential source of food, medicines and other basic necessities for millions of people. Forests also help maintain soil quality, limit soil erosion, preserve climatic stability, modulate seasonal flooding, stabilize hillsides, and protect marine resources. They also contain two-thirds of the world's approximately 4.5 million plant and animal species. The devastating effects of deforestation are tragically displayed in the horrors of the African famine.

Biological diversity, which refers to wildlife preservation—both plant and animal—is related to tropical deforestation but is more comprehensive in scope. While the effects of wildlife loss parallel those of deforestation, the implications can be even more severe for the developed world. Scientists estimate that by the year 2,000, as many as 2 million species may be lost forever. The United States is becoming increasingly dependent on these diverse species for new medicines, food sources, and a host of critical industrial products. For example, our corn crop has been helped by the increased resistance to disease provided by crossing with Mexican wild grasses. The tropical periwinkle plant is important to the treatment of leukemia and other forms of cancer.

My bills are the result of extensive hearings I have conducted on these issues, as chairman of the Foreign Affairs Subcommittee on Human Rights and International Organizations. They do not authorize new spending, but seek to strengthen existing provisions of the Foreign Assistance Act pertaining to tropical deforestation and biological diversity. They call on the administration to accelerate efforts to incorporate measures for preserving forests and wildlife into foreign development assistance, design new projects and programs, and ensure that ongoing activities do not destroy these critical resources.

Clearly, deforestation and wildlife loss warrant an immediate, intensified effort. I appeal for your support for these measures to ensure U.S. military and economic security and sustained growth in the developing world.

The bills follow:

H.R. 2957

A bill to amend the Foreign Assistance Act of 1961 to protect tropical forests in developing countries

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That chapter 1 of part I of the Foreign Assistance Act of 1961 is amended—

(1) by redesignating section 118 (22 U.S.C. 2151p) as section 117;

(2) by striking out subsection (d) of that section; and

(3) by inserting after that section the following new section 118:

"SEC. 118. TROPICAL FORESTS.

"(a) IMPORTANCE OF FORESTS AND TREE COVER.—In enacting section 103(b)(3) of this Act the Congress recognized the importance of forests and tree cover to the developing countries. The Congress is particularly concerned about the continuing and accelerating alteration, destruction, and loss of tropical forests in developing countries, which pose a serious threat to development and environment. Tropical forest destruction and loss—

"(1) result in shortages of wood, especially wood for fuel; loss of biologically productive wetlands; siltation of lakes, reservoirs, and irrigation systems; floods; destruction of indigenous peoples; extinction of plant and animal species; reduced capacity for food production; and loss of genetic resources; and

"(2) can result in desertification and destabilization of the earth's climate.

Properly managed tropical forests provide a sustained flow of resources essential to the economic growth of developing countries, as well as genetic resources of value to developed and developing countries alike.

"(b) PRIORITIES.—The concerns expressed in subsection (a) and the recommendations of the United States Interagency Task Force on Tropical Forests shall be given high priority by the President—

"(1) in formulating and carrying out programs and policies with respect to developing countries, including those relating to bilateral and multilateral assistance and those relating to private sector activities; and

"(2) in seeking opportunities to coordinate public and private development and investment activities which affect forests in developing countries.

"(c) ASSISTANCE TO DEVELOPING COUNTRIES.—In providing assistance to developing countries, the President shall place a high priority on conservation and sustainable management of tropical forests and shall—

"(1) engage in dialogues and exchanges of information with recipient countries—

"(A) which stress the importance of conserving and sustainably managing forest resources for the long-term economic benefit of those countries, as well as the irreversible losses associated with forest destruction, and

"(B) which identify and focus on policies of those countries which directly or indirectly contribute to deforestation;

"(2) support projects and activities—

"(A) which offer employment and income alternatives to those who otherwise would cause destruction and loss of forests, and

"(B) which help developing countries identify and implement alternatives to colonizing forested areas;

"(3) support training programs, educational efforts, and the establishment or strengthening of institutions which increase the capacity of developing countries to formulate forest policies, engage in relevant land-use planning, and otherwise improve the management of their forests;

"(4) help end destructive slash-and-burn agriculture by supporting stable and productive farming practices in areas already cleared or degraded and on lands which inevitably will be settled, with special emphasis on demonstrating the feasibility of agroforestry techniques and on other kinds of small-scale, affordable, resource-conserving, low-risk, local projects which use technologies and methods suited to the local environment and traditional agricultural techniques and feature close consultation with and involvement of local people at all stages of project design and implementation;

"(5) help conserve forests which have not yet been degraded, by helping to increase production on lands already cleared or degraded through support of reforestation, fuelwood, and other sustainable forestry projects and practices, making sure that local people are involved at all stages of project design and implementation;

"(6) support project and other activities to conserve forested watersheds and rehabilitate those which have been deforested, making sure that local people are involved at all stages of project design and implementation;

"(7) support training, research, and other actions which lead to sustainable and more environmentally sound practices for timber harvesting, removal, and processing, including reforestation, soil conservation, and other activities to rehabilitate degraded forest lands;

"(8) support research to expand knowledge of tropical forests and identify alternatives which will prevent forest destruction, loss, or degradation, including research in agroforestry, small-scale farms and gardens, small-scale animal husbandry, wider application of traditional practices, and suitable crops and crop combinations;

"(9) conserve biological diversity in forest areas by—

"(A) supporting and cooperating with the International Union for Conservation of Nature and Natural Resources, the World Wildlife Fund, United States Government agencies, other donors (both bilateral and multilateral), and other appropriate government, intergovernmental, and non-governmental institutions in efforts to identify, establish, and maintain a representative network of protected tropical forest ecosystems on a worldwide basis;

"(B) whenever appropriate, making the setting aside of protected areas a condition of support for activities involving forest clearance of degradation; and

"(C) helping developing counties identify tropical forest ecosystems and species in

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need of protection and establish and maintain appropriate protected areas;

"(10) engage in efforts to increase the awareness of United States Government agencies and other donors, both bilateral and multilateral, of the immediate and long-term value of tropical forests;

"(11) require that any program or project under this chapter significantly affecting tropical forests (including projects involving the planning of exotic plant species) be based upon careful analysis of the best sustainable use of the land and take full account of the impacts of the proposed activities on biological diversity; and

"(12) deny any direct or indirect assistance under this chapter for—

"(A) activities which would result in the conversion of forest lands to the rearing of livestock, unless it has been demonstrated that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and is the least harmful way of doing so;

"(B) the construction, upgrading, or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively undegraded forest lands, unless it has been demonstrated that there exist adequate safeguards to prevent unplanned forest destruction and that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and is the least harmful way of doing so;

"(C) the colonization of forest lands, unless it has been demonstrated that the soils in the area are capable of sustained agriculture, that there exist adequate safeguards to prevent unplanned forest destruction, and that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and is the least harmful way of doing so;

"(D) the construction of dams or other water control structures which flood relatively undegraded forest lands, unless it has been demonstrated that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and is the least harmful way of doing so.

"(E) the procurement or use of logging or timber processing equipment, unless it has been demonstrated that all timber harvesting operations involved will be conducted in an environmentally sound manner which minimizes forest destruction and that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and is the least harmful way of doing so; and

"(F) actions which invade or significantly degrade national parks or similar protected areas which contain tropical forests or introduce exotic plants or animals into such areas.

"(d) PVO'S AND OTHER NONGOVERNMENTAL ORGANIZATIONS.—Whenever feasible, the President shall accomplish the objectives of this section through projects managed by private and voluntary organizations or regional or national nongovernmental organizations in the region or country where the project is located.

"(e) COUNTRY ANALYSIS REQUIREMENTS.—Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of the actions necessary in that country to achieve the goals of this section and of the extent to which the actions proposed for support by the Agency meet the needs thus identified.

"(f) ANNUAL REPORT.—Each annual report required by section 634(a) of this Act shall include a report on the implementation of this section.".

H.R. 2958

A bill to amend the Foreign Assistance Act of 1961 to protect biological diversity in developing countries

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 119 of the Foreign Assistance Act of 1961 (22 U.S.C. 2151q) is amended—

(1) by adding at the end of subsection (b) the following sentence: "For each fiscal year beginning with fiscal year 1987, not less than $10,000,000 under this part shall be allocated for these purposes."; and

(2) by striking out subsections (c) and (d) and inserting in lieu thereof the following:

"(c) COUNTRY ANALYSIS REQUIREMENTS.—Each country development strategy statement or other country plan prepared by the Agency for International Development shall include a detailed plan to assist that country in the conservation of biological diversity. Each such plan shall include, as appropriate, assistance in carrying out all the types of efforts specified in subsection (b).

"(d) LOCAL INVOLVEMENT.—To the fullest extent possible, projects supported under this section shall include close consultation with and involvement of local people at all stages of design and implementation.

"(e) PVO'S AND OTHER NONGOVERNMENTAL ORGANIZATIONS.—Whenever feasible, the objectives of this section shall be accomplished through projects managed by appropriate private and voluntary organizations, or international or regional or national nongovernmental organizations, which are active in the region or country where the project is located. For each fiscal year beginning with fiscal year 1987, the Agency for International Development shall allocate not less than $3,000,000 under this part for projects managed by such organizations.

"(f) ACTIONS BY AID.—The Administrator of the Agency for International Development shall—

"(1) cooperate with appropriate international organizations, both governmental and nongovernmental, and recognize the coordinating role played by the International Union for Conservation of Nature and Natural Resources and the World Wildlife Fund;

"(2) look to the World Conservation Strategy (which was prepared by the International Union for Conservation of Nature and Natural Resources, the World Wildlife Fund, and the United Nations Environment Program, and is now widely accepted) as an overall guide for actions to conserve biological diversity;

"(3) engage in dialog and exchanges of information with recipient countries which stress the importance of conserving biological diversity for the long-term economic benefit of those countries and which identify and focus on policies of those countries which directly or indirectly contribute to loss of biological diversity;

"(4) support training and education efforts which improve the capacity of recipient countries to prevent loss of biological diversity;

"(5) whenever possible, enter into long-term agreements in which the recipient country agrees to protect ecosystems or other wildlife habitats recommended for protection by the International Union for conservation of Nature and Natural Resources or as a result of activities undertaken pursuant to paragraph (2), and the United States agrees to provide additional assistance necessary for the establishment and maintenance of such protected areas;

"(6) support, as necessary and in cooperation with the International Union for Conservation of Nature and Natural Resources and other appropriate institutions, efforts to identify and survey ecosystems in recipient countries worthy of protection;

"(7) review the Agency's environmental regulations and revise them as necessary to ensure that ongoing and proposed actions by the Agency do not inadevertently endanger wildlife species or their critical habitats, harm protected areas, or have other adverse impacts on biological diversity (and shall report to the Congress within a year after the date of enactment of this paragraph on the actions taken pursuant to this paragraph);

"(8) enure that environmental profiles sponsored by the Agency include information needed for conservation of biological diversity; and

"(9) deny any direct or indirect assistance under this chapter for actions which invade or significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas.

"(g) ANNUAL REPORTS.—Each annual report required by section 634(a) of this Act shall include, in a separate volume, a report on the implementation of this section.".

TRADE CRISIS IS AT OUR DOORSTEP

(Ms. KAPTUR asked and was given permission to address the House for 1 minute and to revise and extend her remarks and include extraneous matter.)

Ms. KAPTUR. Mr. Speaker, the trade crisis is at our doorstep. The time for coming to grips with it is now. We must tackle it with all the resources in our economic arsenal. The trade imbalance has more than one cause. One is the overinflated dollar overseas brought on by massive budget deficits here at home. But even the if the budget deficit were gone tomorrow, there is no logic that says all the harm to our manufacturing and agricultural industries would then be reversed automatically. Some businesses that are being wiped out are in need of special attention. But there is a whole lot more to it. We must look at the trade barriers that our trading partners use against us, like excluding our products and even the undervaluing of currency by countries like Japan. And finally, we must look at our own lack of industrial competitiveness in some areas. Any relief given to domestic industries by our Government must be accompanied by a commitment to modernize and improve productivity here at home. We as a nation must regain that competitive edge that for decades led the way in the industrial marketplace. After all, under the Constitution, we here in the House take an oath of office to provide for the common defense and secure the blessings of liberty, including our standard of living, for ourselves and our posterity. Restoring a positive balance of trade is the place to begin.

I call to the attention of my colleagues an article from the Wall Street Journal of July 11 on ~~this topic~~ as follows:

ment of the Senator from Ohio (Mr. GLENN).

The amendment (No. 129) was agreed to.

Mr. LUGAR. Mr. President, I move to reconsider the vote by which the amendment was agreed to.

Mr. PELL. I move to lay that motion on the table.

The motion to lay on the table was agreed to.

AMENDMENT NO. 130

(Purpose: To strengthen United States programs to protect endangered species)

Mr. PELL. Mr. President, I send an amendment to the desk and ask for its immediate consideration.

The PRESIDING OFFICER. The clerk will report.

The legislative clerk read as follows:

The Senator from Rhode Island (Mr. PELL), for himself and Mr. Cranston, proposes an amendment numbered 130.

Mr. PELL. Mr. President, I ask unanimous consent that further reading of the amendment be dispensed with.

The PRESIDING OFFICER. Without objection, it is so ordered.

The amendment is as follows:

On page 36, add the following at the end:

Section 314A: The Foreign Assistance Act of 1961, as amended, is amended by adding at the end of section 119 the following new subsections:

"(e) Each Country Development Strategy Statement (country plan) shall include a detailed and specific plan to assist the recipient country in the conservation of biological diversity. Each such plan shall include, as appropriate, assistance to countries in the identification, acquisition, and protection of wildlife habitats, of representative ecosystems, and of significant or unique natural areas. Each Country Development Strategy Statement shall take account of the information derived from the activity undertaken pursuant to subsection (h).

"(f) The Administrator of the Agency for International Development, and the Directors of other appropriate United States agencies, are authorized and directed to enter into long-term agreements with recipient countries to protect wildlife habitats, representative ecoysystems, and significant or unique natural areas in the recipient country.

(g) Of the amount by which funds appropriated to the Agency for International Development for agriculture and forestry exceeds the amounts appropriated for agriculture and forestry in fiscal year 1986, at least fifty percent shall be available only for countries which enter into long-term agreements pursuant to subsection (f). Funds made available by this subsection may be used in support of the long-term agreements.

(h) The Administrator of the Agency for International Development is authorized and directed to support the creation of biological inventory programs in recipient countries, to support programs to identify critical ecosystems in developing countries, and to make surveys of national parks and proposed protected areas where such surveys will enhance the protection of endangered species or the protection of critical ecosystems."

(B) In subsection (d) of Section 119 of the Foreign Assistance Act of 1961, as amended, strike "subsection" and insert in lieu thereof "section"

Mr. PELL. Mr. President, I offer this amendment to strengthen the existing provisions of law to protect endangered species.

In 1983 Congress enacted the International Environmental Protection Act of which I am proud to have been the principal sponsor. Among other issues, that law authorized U.S. assistance to developing countries "in protecting and maintaining wildlife habitats and in developing sound wildlife management and plant conservation programs."

In response to this provision, AID has, in conjunction with other Federal agencies, devised a strategy to conserve biological diversity. The amendment I am proposing follows up on that strategy.

The amendment has four principal components:

First, it requires that each AID country plan include assistance to protect wildlife habitats, representative ecosystems, and unique natural areas;

Second, it directs AID to enter into long-term agreements to protect wildlife habitats and representative ecosystems;

Third, it rewards countries that enter into long-term agreements to preserve endangered species by channeling one-half of the increase in AID funding over fiscal year 1986 levels for agriculture and forestry to these countries;

Fourth, it directs AID to assist countries in making inventories of critical ecosystems and in making surveys of protected areas.

The costs of this amendment are minimal. The issues however are very basic.

It is estimated that more than 1,000 plant and animal species will become extinct each year and that if present rates of tropical deforestation and ecosystem disruption continue into the next century, 20 percent of all species on Earth may become extinct within the next human generation.

The extinctions projected in the coming decades will be largely due to human activities. They will occur on a scale that render natural biological extinction trivial by comparison. This loss of species and ecosystems due to human activities is resulting in the progressive impoverishment of the Earth's biological systems. This, in turn, reduces the ability of natural systems to support human populations.

For example, the center of origin of many food plants are in the tropics. As tropical areas are converted, ancestral stocks of these plants are jeopardized or lost. Only three species—corn, wheat, and rice—produce two-thirds of the total world grain crop. The food supply of the entire world now depends on maintaining a balance between the genetic systems of these and a few additional crops, and their pests and diseases. In the future, new sources of food may need to be developed from as yet undiscovered germplasm.

The U.S. Government is in a unique position of world leadership to help conserve biological diversity. Most of the areas that need to be protected are in developing countries. There is a clear and close relationship between the poverty of the people of those countries and biological impoverishment—and this will intensify if current trends are not altered. Through its own aid programs and through the multilateral assistance programs it can influence, the U.S. Government can play a major role in reversing these negative trends which affect our economic and security interests as surely as they affect the well-being of people in the developing world.

Mr. President, I ask unanimous consent that a letter from Brent Blackwelder of the Environmental Policy Institute, on behalf of a coalition of environmental groups, be printed in the RECORD at this point.

There being no objection, the letter was ordered to be printed in the RECORD, as follows:

ENVIRONMENTAL POLICY INSTITUTE,
Washington, DC, May 15, 1985.

Senator CLAIBORNE PELL,
Senator ALAN CRANSTON,
U.S. Capitol, Washington, DC.

DEAR SENATOR PELL AND SENATOR CRANSTON: We commend you for your efforts to address a serious global resource issue, the loss of biological diversity, as the Foreign Assistance Act is debated this week. The rapid disappearance of species this century is depriving civilization of a vast genetic pool. A significant percentage of prescription medicine now comes from species found in tropical moist forests which are rapidly vanishing.

Your amendment to Section 119 is a welcome and much needed step toward solving this problem. Your amendment would provide each country's development strategy plan to include measures to conserve biological diversity and would provide for A.I.D. to enter into long-term agreements with recipient countries to protect wildlife habitats and unique natural areas. By offering financial incentives for protection of critical habitats out of amounts appropriated for forestry and agriculture, your amendment offers the hope of succeeding in its objective.

The Natural Resources Defense Council, the Environmental Policy Institute, the National Audubon Society, and the National Wildlife Federation support these legislative initiatives in your amendment.

Sincerely,

BRENT BLACKWELDER, *Director,*
International Resources Project.

Mr. LUGAR. Mr. President, the Senator from Rhode Island, my distinguished colleague, has presented number of important and interestin ideas in this amendment. It is a amendment which I know from pe sonal experience is important and i fact is being pressed by a number o important environmental organiz tions in our country that have an i terest in international aspects of t environment.

Unhappily, and I say this respectf ly to my colleague, this amendme arises late in the game: namely, dur the course of this debate. The full i plications of this amendment can clearly be foreseen, and they are important.

I have expressed these views privately to my colleague. I would hope to explore much more fully those implications and hold a committee hearing.

I would like to suggest, respectfully, to my colleague that the Foreign Relations Committee conduct a hearing, or hearings, on the Pell amendment, and I would pledge to work with him on having a markup so that we would have definitive action on the amendment. In that way, the public policy interests might be better served in refinement of those ideas, but I must confess I am not able to comprehend them on first impression.

Mr. PELL. Mr. President, I appreciate very much indeed the words of the Senator from Indiana. I concur in his generous offer and ask that my amendment be withdrawn.

The PRESIDING OFFICER. Without objection, it is so ordered.

AMENDMENT NO. 131

(Purpose: To require reports to the Congress on the foreign debt crisis in Latin America)

Mr. KENNEDY. Mr. President, I send an amendment to the desk and ask for its immediate consideration.

The PRESIDING OFFICER. The clerk will report.

The legislative clerk read as follows:

The Senator from Massachusetts (Mr. KENNEDY) proposes an amendment numbered 131.

Mr. KENNEDY. Mr. President, I ask unanimous consent that further reading of the amendment be dispensed with.

The PRESIDING OFFICER. Without objection, it is so ordered.

The amendment is as follows:

On page 64, between lines 16 and 17, insert the following:

REPORTS ON FOREIGN DEBT IN LATIN AMERICA

SEC. 914. (a) The Congress finds that—

(1) the foreign debt of Latin American countries has soared from $27 billion in 1970 to over $350 billion in 1983;

(2) the foreign debt of Latin American countries is a serious obstacle to their economic progress, threatens their stability, and endangers the democratic processes in those nations;

(3) the economic and political futures of many of the Latin American countries hang in the balance and depend upon a successful resolution of the foreign debt crisis; and

(4) the confidence of the American people in the United States system of banking is also involved in a successful resolution of the foreign debt crisis.

(b)(1) Not later than October 1, 1985, the Secretary of State shall prepare and transmit to the Congress a report on—

(A) the magnitude of the foreign debt crisis in this hemisphere;

(B) the impact of the foreign debt crisis on the economies of the nations of Latin America;

(C) the degree to which the national security interests of the United States are implicated in this crisis; and

(D) the steps being taken and the policy being pursued by the United States aimed at dealing with this crisis.

(2) Not later than October 1, 1985, the Secretary of the Treasury shall prepare and transmit to the Congress a report on—

(A) the degree to which the foreign debt crisis affects the system of banking in the United States; and

(B) the steps being taken and the policy being pursued by the Department of the Treasury aimed at dealing with this crisis.

On page 64, line 18, strike out "Sec. 914." and insert in lieu thereof "Sec. 915."

Mr. KENNEDY. Mr. President, this amendment requests the Secretary of State and the Secretary of the Treasury to report to the Congress on the magnitude of the foreign debt crisis and on the implications of the crisis for U.S. national security interests and on what steps the United States is taking to deal with the crisis.

Mr. President, perhaps the most perplexing and troubling aspect of Congress never-ending debate about Nicaragua is that, in our fixation with the Sandinistas, we have lost sight of what is, without doubt, one of the most serious threats to democracy in this hemisphere in the past 25 years, the foreign debt crisis. According to the report of the Inter-American Dialogue published a year ago:

No single year in the last 50 was more disastrous for the economies of Latin America and the Caribbean than 1983 * * * The very economic and political futures of many of the Latin American countries are in the balance.

In the face of such a serious threat to the stability of our hemisphere and to the future of democracy in Latin America, there seems to be little if any sense of urgency, either in Congress or in the administration. One searches in vain, for example, for any mention of the foreign debt crisis in the foreign aid bill.

It is time that we acknowledged the following facts:

This crisis is unique in our history. The foreign debt crisis has no analog in the history of our hemisphere. It is not simply a problem of working out a series of repayment schedules or of rolling over the debt ad infinitum. The magnitude and the complexity of this crisis are simply too great to treat it with a business as usual attitude. Developments inside the United States have, in fact, made the problem much worse, not better. As the report of the Inter-American Dialogue put it:

The present combination of large public sector deficits (in the United States), high interest rates, and an overvalued dollar overwhelms the efforts of Latin American countries to emerge from the debt crisis and to restore sustainable growth * * * Unless the United States puts it financial accounts in order, its own economic prosperity and that of the whole hemisphere will be at risk.

Which brings me to the next point.

The stakes are high. Vital interests of the United States—at home and abroad—are seriously implicated in the foreign debt crisis. If the new democracies of Argentina, Brazil, Uruguay, and Peru are not permitted to succeed, Nicaragua may be just a taste of what the future holds for countries that are of far greater importance to the United States than Nicaragua could ever be. And it is of no less importance to hundreds of U.S. banks whose very survival may be in the balance if these loans go bad. Our banking institutions are precarious enough as it is. It would be no exaggeration to suggest that a default on over $350 billion in loans could have a catastrophic effect on our entire system of banking.

People are suffering today. Last week, I met with the Governor of the State of Rio de Janeiro, Lionel Brizola, who told me that millions of people are going hungry today because of the pressure on the central Government of Brazil to make regular payments on its debt. This kind of hardship can only lead to the kind of political instability that will undermine the fledgling democracy in Brazil.

Both Congress and the administration must recognize that the crisis of the foreign debt in Latin America is not just a technical banking problem; it is quintessentially a problem of foreign policy. Our Nation's vital interests are at stake.

This amendment is a modest effort to focus our attention and to focus the attention of the administration on this crisis. This amendment simply requests the Secretary of State to report to the Congress, before the end of this fiscal year, on the following matters:

The magnitude of the foreign debt crisis in this hemisphere; the impact of the foreign debt crisis on the economics of the nations of Latin America; the degree to which the national security interests of the United States are implicated in this crisis; and the step being taken and the policy being pursued at the present time by the United States to deal with this crisis.

This amendment also requests the Secretary of the Treasury to submit a comparable report to Congress on the degree to which the foreign debt crisis affects the system of banking in the United States; and the steps being taken and the policy being pursued by the Department of the Treasury aimed at dealing with this crisis.

Mr. President, this is an extremely important matter, one of enormous significance to the countries in Central and South America, many of which have moved now toward democratic institutions and democracies: Argentina with Alfonsin, Brazil, and other countries in the hemisphere. The problems are very deep and they do affect American banking institutions.

It seems to me that it would be wise for us, as a matter of public policy, to have information of this nature available to the Members of the Senate, the Congress, and the American people.

I have had the opportunity to talk this over briefly with the floor manager and the ranking minority member. I hope they would be willing to accept this amendment.

Mr. CHILES. Mr. President, I rise to echo the concerns expressed by my colleague from Massachusetts on the

LEGISLATIVE DEVELOPMENTS

excerpted from "State of the Environment in Asia and the Pacific Vol. II UNEP"

Background

Most countries in the ESCAP region have developed general legislative frameworks for environmental protection, many of which incorporate specific laws intended to control air and water pollution, protect natural resources and regulate land use. Some countries even have developed national environmental protection legislation in consonance with overall constitutional provisions.

However, the most well-intentioned legislation by itself cannot either remedy past environmental degradation or protect the environment from further harm. An equally important commitment must be made in terms of implementation. In thisrespect, enforcement appear to be critically inadequate in the ESCAP region. This inadequacy is often caused by factors such as poverty, illiteracy, insufficient funding for manpower and technical equipment, insufficient legal expertise familiar with the legal aspects of environmental management, relatively weak environmental institutions and a lack of training programmes and experienced personnel.

Constitutional Provisions

The effectiveness of environmental legislation is further reinforced in several countries in the ESCAP region by making constitutional commitment for environmental protection and enhancement. The failure to have constitutional provisons on environment in some countries may be partly due to the fact that the constitutions of ESCAP countries generally preceded the emerging environmental consciousness. Among the few countries that have made a direct constitutional provision for environmental protection are the People's Republic of China, India, Indonesia, Malaysia, Papua New Guinea, Republic of Korea, Thailand and Vanuatu. Other countries, such as Japan and Pakistan, have made only an indirect provision. In most cases, however, both direct and indirect constitutional provisions have only a symbolic value. They cannot be enforced in State courts. Therefore, some ESCAP federal nations are having difficulty translating federal law and constitutional provisions into effective action at the State and local levels.

The kind of institutional difficulties engendered by different layers of political responsibility within individual nations is exemplified

/by India

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• Nepal is one country in the South Asian subregion where environmental protection is not the responsbility of a specific department, but is a matter of co-ordinated attention among several departments. Thus, the National Commission for Conservation of Natural Resources, composed of representatives of relevant Ministries, was set up to advise the government on matters of natural resource conservation strategy, to help develop policy and guidelines, to help co-ordinate integrated projects, and to review their implementation. An Environmental Management Project has also been established under the Department of Soil Conservation.

• The government of Pakistan has created an Environment and Urban Affairs Division under the Ministry of Housing and Works. The Division is responsible for planning activities related to the environment, pollution and ecology. Furthermore, a Pakistan Environmental Protection Council and a Pakistan Environmental Protection Agency have recently been established to plan and implement environmental programmes. Among other things, they provide leadership and general policy guidance for the direction and co-ordination of environmental programmes as well as the legislative aspects of preserving the environment and controlling pollution.

• Sri Lanka established the Central Environmental Authority (CEA) pursuant to its National Environmental Act of 1980. Among other things, the CEA conducts research, specifies environmental standards and criteria, and publishes reports and information to educate the public.

• Among the countries of the Pacific subregion.

• Australia has established a Department of Home Affairs and Environment that is responsible for environmental policies under the jurisdiction of the Federal Government, while State Departments and Authorities are responsible for environmental matters at the State level. The Australian Envrionmental Council (AEC) was established in 1972 to provide a forum for consultation between the Commonwealth and State and Territory Governments on appropriate environmental matters.

• Cook Islands has a Directorate of Conservation set up under authority of the Conservation Act of 1975.

• New Zealand has a separate Ministry of the Environment by a central environmental secretariat in the Commission for the Environment, established in 1972.

/• Papua

NCT Vol II

- Papua New Guinea has a Ministry of Environment and Conservation.
- Most of the island countries of the South Pacific (e.g., Fiji,

Nauru, and Tuvalu) have no specific government agency responsible for environment matters. The South Pacific Regional Environment Programme (SPREP) may stimulate the creation of environmental protection agencies in thos countries.

CAMPBELL

LEGAL, REGULATORY, AND INSTITUTIONAL ASPECTS OF ENVIRONMENTAL AND NATURAL RESOURCE MANAGEMENT IN DEVELOPING COUNTRIES

Produced Under the AID/NPS Natural Resources Project

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LEGAL REGULATORY AND INSTITUTIONAL ASPECTS OF ENVIRONMENTAL AND NATURAL RESOURCE MANAGEMENT IN DEVELOPING COUNTRIES

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Project Tiger, Delhi Zoological Park, New Delhi 1

Wildlife Preservation Society of India, 6 Astley Hall, Dehra Dun, Uttar Pradesh

Botanical Survey of India, P.O. Botanic Garden, Howrah 711103

Wildlife Conservation Society, Savinaya Society, Behind Patel Park, Bhavnagar 364001

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-- Data Center for Natural Res., 18 Spencer Road, Fraser Town PO, Bangalore 560005

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PAKISTAN: Pakistan Wildlife Appeal, c/o Packages, Ltd., Rumi Road, Lahore 14

World Wildlife Fund -- Pakistan

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EXCERPTED FROM: "State of the Environment in Asia and the Pacific" pp. 292-295.

Non-Government Organizations (NGOs)

Since environmental issues are multidimensional and multisectoral in nature the role of Non-Governmental Organizations (NGOs) in assisting and supplementing government-sponsored institutions in coping with environmental issues is clearly recognized. UNEP and Sahabat Alam Malaysia carried out a survey of important NGOs active in the field of the environment in the region and identified over 250 prominent NGOs. A recent survey conducted by Indian Government however, indicated presence of over 500 NGOs in the country and over 200 were found actively environment activities. It can therefore, be safely mentioned that there would be over 2,000 NGOs as the region, which are contributing to the cause of environmental protection and enhancement. In many countries (such as Australia, India, Indonesia, Japan, Malaysia, New Zealand, the Philippines and Sri Lanka) NGOs are found effective in environmental matters. They have an impressive record of assistance in promoting environmental education and creating environmental awareness among the people by interaction and consultation with government officials and people from all walks of life such as consumers, industrialists and academics. The contribution of NGOs in developing and enhancing people's attitudes, scientific knowledge, technical skills, judgement and orientation regarding the environment, has been and is continuing to be significant. Several national NGOs (specially in Malaysia) have branches spread all over the country. However, most of them suffer from lack of funds and information from official agencies. Even though several countries (such as India, Indonesia, Japan, the Philippines, Sri Lanka etc.) assist NGOs in the dischar of their functions, the support is generally inadequate. In some cases, the governmental agencies do not consider NGOs as partner in their environmental promotion efforts. In general, environmental NGOs need to be further support and strengthened if the environmental objectives of the region are to be fulfilled.

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In describing NGOs as an instrument of environmental protection, special mention must be made of the outstanding contribution of some global and regional organizations. The International Union for Conservation of Nature and Natural Resouces (IUCN) and the International Council of Environmental Law (ICEL) have succeeded in promoting a world-wide awareness of environmental problems and putting together action programmes for conservation coupled with an active use of natural resources. Regional NGOs such as Asian Environmental Society (Japan) have made outstanding contribution in bringing many regional environmental issues to the fore.

Subregional Institutions and Programmes

Three subregional programmes have been established in the ESCAP region to reinforce the environmental protection and management programmes of the individual nations. These programmes are the ASEAN Environment Programme (ASEP), the South Pacific Regional Environment Programme (SPREP) and the South Asia Co-operative Environment Programme (SACEP).

In the ASEAN subregion of south-east Asia, the intergovernmental co-operative programme on economic and social activities has been expanded to include environmental management. In December 1978, at a meeting at Jakarta, the ASEAN Expert Group on the Environment was established as an intergovernmental working group of the ASEAN Committee on Science and Technology. After a series of meetings, an ASEAN Environment Programme (ASEP) was established, which received the endorsement of the ASEAN Ministers of the Environment at a meeting at Manila in April 1981. The eight priority areas of the programme include environmental management of marine and terrestrial resources, methods and procedures in environmental management in general, environmental impact assessment, nature conservation, industry and environment, education and training and information. The Ministers concerned have endorsed the concept of sustainable development and have pledged to generally include environmental consideration in the economic planning process.

The ASEAN Environment Programme went into its second phase in early 1983. Known as ASEP II, it is expected to consolidate its previous activities and develop into a more comprehensive programme. Greater emphasis will be given to education, training, information and collection of environmental data for dissemination to ASEAN member countries.

In the South Pacific, a similar intergovernmental programme on environmental management has been established. With the support of ESCAP UNEP South Pacific Bureau for Economic Co-operation and South Pacific Commission (SPC), the South Pacific Regional Environment Programme (SPREP) was established. Lunched in 1979, the Programme has completed one phase. One of the major achievements of the programme has been the acceptance of the concept of sustainable development by the participating States. An Action Plan for Managing the Natural resources and the Environment of the South Pacific has also been adopted.

The main elements of the Action Plan comprise environmental assessment, environmental management, domestic and international legal instruments, institutional arrangements and financial support. In the environmental assessment component, concerns about pollution control and natural resource preservation are secondary to attempts to ensure sustainable economic development. In the management component, emphasis is on sustainable use of natural resources. The training of management personnel at all levels is geared to this end, and the rural population is to be informed of this need. In the legal component, the Programme secretariat has undertaken a review of international and regional conventions relevant to environmental management of the South Pacific region. Further, a draft convention for the protection and development of the natural resources and environment of the South Pacific region and two protocols one for the prevention of oil pollution by dumping and the other concerning co-operation in combating pollution emergencies have been prepared for the study of regional experts.

The third intergovernmental mechanism in the region is the South Asia Co-operative Environment Programme (SACEP), which was initiated with the assistance of UNEP, ESCAP, UNDP and other agencies in February 1981. The countries of the subregion have adopted a declaration having six main principles of co-operative endeavour. One of the main principle is the commitment of the countries to ensure sustainable development of natural resources for the continued benefit of the people.

There are 15 programme areas under four major heads: environmental management; management of natural resources, including forestry, wildlife, conservation of mountain ecosystems and watersheds, corals, mangroves, deltas and coastal areas; energy and environment; and legislation education and training. Specific project proposals in several areas (e.g., environmental impact assessment, technical [illegible] for development of [illegible] and [illegible]able resources, environmental legislation, energy and environment, environmental education and training) were approved in the first meeting of the Governing Council held in January 1983 for implemention.

Furthermore, UNEP has promoted the development of three regional seas programmes with a view to ensure sustainable development of ocean resources. This first phase of the programme consists of development of Protocols and Action Plans for regional seas programmes, while the second phase is the co-operative implemention of an Action Plan by the countries concerned.

The ASEAN Regional Seas Programme is being implemented in its second phase. An oil spill contingency plan also has been developed for ensuring international co-operation in containing accidental oil spills. Phase one of the South Pacific Regional Seas Programme is nearing completion, and its second phase is being launched. To develop regional seas programme for south Asian seas, a meeting was convened in March 1984. These Regional Seas Programmes generally address problems of monitoring pollutants, prevention and control of pollution from land-based and vessel-based sources and conservation of marine resources.

An interim committee for Co-ordination of Investigations of the Lower Mekong Basin (Mekong Committee) was established with the participation of concerned countries located in the basin area. The Interim Mekong Committee, comprised of Thailand, Viet Nam and Lao PDR, has inter alia been concerned with the environmental problems associated with the development of natural resources and improvement of resource use. A separate Environmental Unit was established in 1976 by the Committee to ensure enduring benefits from water resources development in the basin. Several projects (e.g., co-ordination of environmental planning; studies and surveys of biomes and species; monitoring of environmental parameters; correction and enhancement measures including recyling of wastes, rehabilitation of endangered species of fish and control of aquatic macro-vegetation) have been undertaken.

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TAGS: SENV, OSCI, KSCA, TPHY, IN
SUBJECT: LEADERSHIP CHANGES IN THE MINISTRY OF
- ENVIRONMENT AND FORESTS

REF: NEW DELHI 000198

1. MR. J.A. KALYANA KRISHNAN HAS REPLACED DR. T.N. KHOSHOO AS SECRETARY IN THE DEPARTMENT OF ENVIRONMENT, MINISTRY OF ENVIRONMENT AND FORESTS. DR. KHOSHOO HAS RETURNED TO THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) WHICH HAD LOANED HIS SERVICES TO THE GOVERNMENT OF INDIA IN 1980 AT THE TIME OF ESTABLISHMENT OF THE DEPARTMENT OF ENVIRONMENT. MR. KRISHNAN AN INDIAN ADMINISTRATIVE SERVICE (IAS) OFFICER FROM UTTAR PRADESH CADRE, HAS A MASTERS DEGREE IN MATHEMATICS. HE HAD EARLIER WORKED IN THE [illegible] OF DEFENCE (UNDER SECRETARY) AND [illegible] AND EDUCATION (JOINT SECRETARY). PRIOR TO HIS CURRENT APPOINTMENT MR. KRISHNAN WAS THE DEVELOPMENT AND AGRICULTURE COMMISSIONER FOR THE STATE OF UTTAR PRADESH. MR. KRISHNAN IS KNOWN FOR HIS ADMINISTRATIVE AND ORGANIZATIONAL CAPABILITIES, AND IT IS EXPECTED THAT UNDER HIS LEADERSHIP THE DEPARTMENT OF ENVIRONMENT WILL PROVIDE EXCELLENT GUIDANCE TO THE GANGES RIVER CLEAN-UP PROGRAM

2. IN ANOTHER CHANGE IN THE DEPARTMENT OF FORESTS AND WILDLIFE, MR. H.S. PANWAR HAS BEEN DESIGNATED AS THE DIRECTOR OF THE WILDLIFE INSTITUTE OF INDIA. MR. PANWAR, WITH EXTENSIVE FIELD EXPERIENCE, WAS APPOINTED DIRECTOR OF PROJECT TIGER IN 1982 AND SERVED TO THE SATISFACTION OF ALL CONCERNED. MR. PANWAR IS EXPECTED TO ASSUME CHARGE AT THE INSTITUTE BY LAST WEEK OF JUNE.

3. MR. SAMAR SINGH, JOINT SECRETARY, DEPARTMENT OF FORESTS AND WILDLIFE, MINISTRY OF ENVIRONMENT AND FORESTS, IS EXPECTED TO BE REPLACED BY MR. RANJIT SINH DURING THE FIRST WEEK OF JUNE 1985. MR. RANJIT SINH IS CURRENTLY THE COMMISSIONER OF BHOPAL AND HAS EARLIER WORKED AS SECRETARY, FORESTS AND WILDLIFE, MADHYA PRADESH.

4. EXCEPT FOR MR. KRISHNAN, EMBASSY SCIENCE OFFICE HAS EXPERIENCE IN WORKING WITH THE OTHER OFFICIALS. WE EXPECT THAT SUPPORT FOR USG COOPERATIVE EFFORTS AND INITIATIVES EVEN WITH THESE CHANGES WILL CONTINUE. THERE IS SUFFICIENT EVIDENCE OF CONTINUING GOI INTEREST IN COLLABORATION WITH THE UNITED STATES AND SCOPE FOR FURTHER EXPANSION OF ONGOING ACTIVITIES.
BARNES

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

2-11 March, 1982

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National Research Council
March 6-8, 1985

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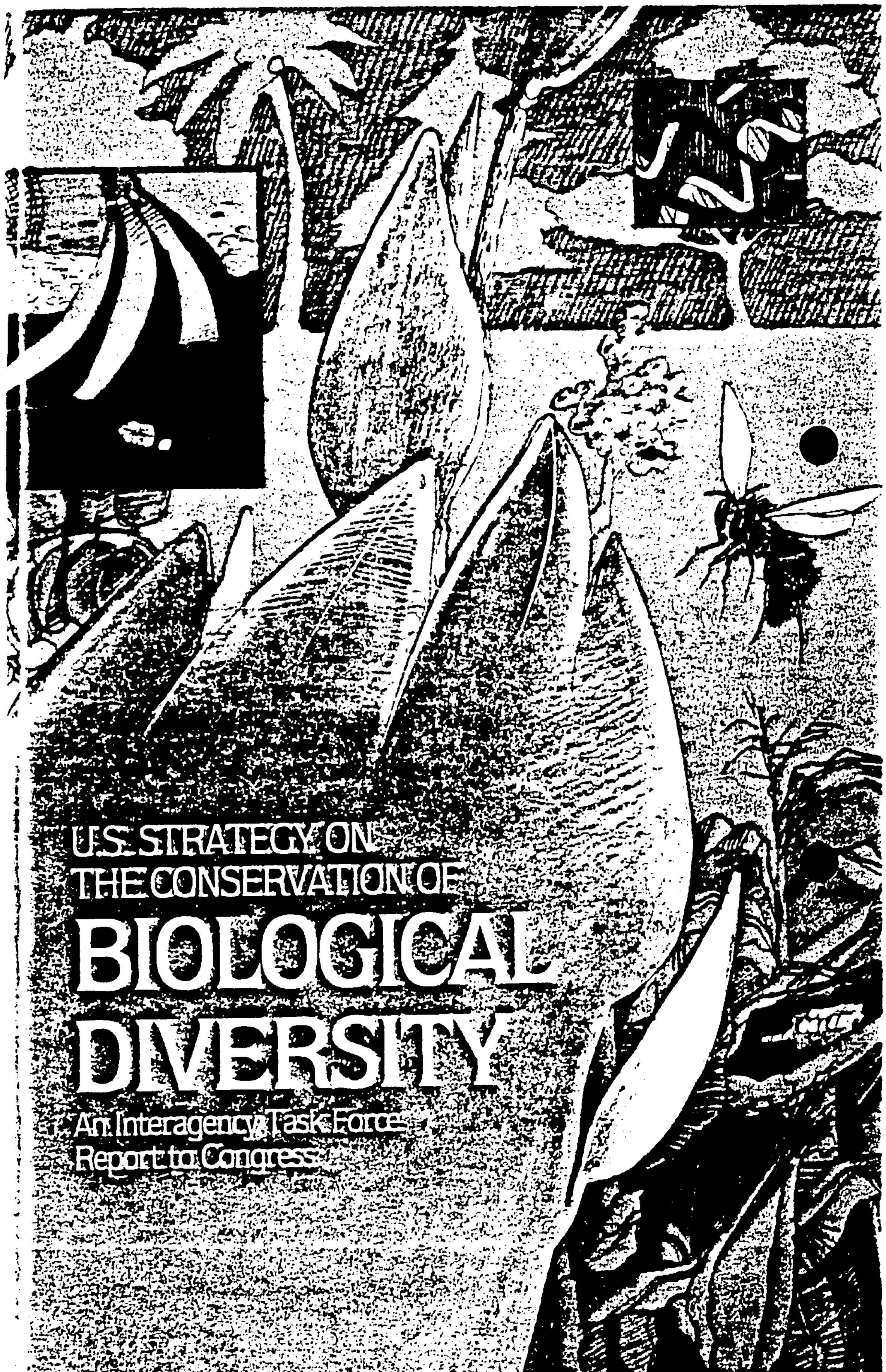

This document is appended separately to this volume

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Conservation of Biological Diversity in Developing Countries

BOSTID-USE ONLY

A Summary of Discussions of a Planning Meeting
Jointly Organized by the
Board on Science and Technology for International Development
Office of International Affairs, National Research Council
and the
Agency for International Development

Joseph Henry Building
2100 Pennsylvania Avenue, N.W.
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March 6&7, 1985

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Introduction

The subject of biological diversity has received considerable attention in recent years as information about potential or actual extinction of species and the importance of germplasm in "biotechnology" have been given wide circulation, and as concerns about the impact on diversity of development activities have engaged public opinion and the attention of development agencies.

The Board on Science and Technology for International Development (BOSTID), as part of its responsibility under a grant from the Agency for International Development (AID) to advise on critical issues in science and technology related to development, was considering a possible assessment of the institutional and research needs in developing countries associated with biological diversity, particularly maintenance of germplasm collections and natural habitat, and the best ways of using limited resources to the greatest effect (i.e. economic justification) in identifying, domesticating, and saving important species. This interest coincided with a similar analysis being undertaken by AID's Asia Bureau in preparation of a strategy for AID to implement in its development assistance programs. A jointly sponsored planning meeting was therefore arranged to consider:

1. the need for, and terms of reference of, a possible BOSTID study, which would bring to the attention of policy officials and others in developing countries and donor agencies the rationale for conserving biological diversity, and the research agenda that could develop the required techniques and information;

2. research areas of particular relevance to development assistance that would be realistically feasible for AID to fund under its current and projected program; this includes both small competitive grants to developing country and U.S. cooperating scientists, and possibly larger AID mission-funded loan or grant projects within countries requesting assistance.

To facilitate this process, the meeting was planned as an informal interaction among experts in the various fields of biology with AID counterparts representing the interests of the various Bureaus and Missions in regions of the developing world.

The importance of preserving biological diversity and its relationship to development has three broad components: conservation and genetic improvement of known, economically important species; domestication and improved exploitation of species with underexploited economic value; and, conservation of species with potential economic importance.

Since major crops and other species of well-established importance are topics of attention by organizations such as the International Board for Plant Genetic Resources, the meeting focussed on the less attended problem of conservation and diversity of species of little-known or unknown importance.

The emphasis on economic value (rather than any other measure of importance) recognizes that resources are not available to identify and characterize the importance of all existing, and especially endangered species, and that economic arguments may be most persuasive in justifying funding for supporting research programs and maintenance of habitat or germplasm collections by governments and technical assistance agencies. The underexploited genetic resources of the developing nations can be transformed into a powerful motor for social and economic progress through the development of new, sustainable agroforestry and farming systems. The assumption is, further, that massive worldwide overexploitation of common property resources (forests, aquatic resources, grazing) and pollution, that constitute the major threats to biological diversity, will continue until government policymakers and their donor counterparts recognize the threat these activities constitute to both short- and long-term economic and social development, and resolve to take remedial action. However, to improve the situation, clear-cut economic justification must be provided and a set of positive, economically viable alternatives offered. It is also assumed that there is sufficient scientific information currently available to support, enlarge upon, or modify the kinds of recommendations on which BOSTID and AID programs have been based in such areas as forestry and coastal resource management.

A series of meetings on biological diversity have already taken place, and reports published which indicate broad research priorities and strategies; these include:

1. Proceedings of the U.S. Strategy Conference on Biological Diversity, November 16-18, 1981. U.S. Department of State, Washington, D.C.

2. Ecological Aspects of Development in the Humid Tropics. 1982. National Research Council Committee on Selected Biological Problems in the Humid Tropics. National Academy Press, Washington D.C.

3. Conserving International Wildlife Resources: the United States response. A report to Congress by the Secretary of State and the Secretary of the Interior. December, 1984.

4. U.S. Strategy on the Conservation of Biological Diversity: An Interagency Task Force Report to Congress. 1985. U.S. Agency for International Development, Washington, D.C.

Summary of Discussions, March 6 & 7

The following summarizes the main points:

1. Regional land- and water-use planning and economic evaluation

capability should be developed in every country for mixed farming, rangeland, forest, freshwater, marine, and wetlands systems (including those exposed to such stresses as heat and toxic pollutants). This capability is essential to the future economic development of these resources.

2. The need to emphasize restoration and reforestation of degraded ("waste") land is stressed. Recovering land that was formerly productive, rather than expanding operations into previously unexploited areas such as primary forest (which contain resources with their own intrinsic economic value that also maintain important ecosystem functions), is a clear priority for land-use planning.

3. Encouragement should be given to identification of unconventional or unorthodox solutions in experimental agronomy, agroforestry, and reforestation research. Too often there are no rewards within the bureaucratic structure for innovative risk-taking, and what ensues is the traditional, orthodox short-term approach, with all its limitations.

4. Emphasis should be given to innovative use of genetic resources to solve development problems. Examples include domestication or commercialization of new livestock or crops for appropriate needs in developing countries, use of parasitoid or predator species for control of disease vectors or crop pests, and development of new natural product industries from indigenous biomass materials. By demonstrating the applicability of these resources, in environmentally sound, sustainable systems, consciousness of their economic value can be enhanced.

5. Exchange of information and germ plasm among and between countries and missions in developing and industrial countries are two of the important mechanisms for exploiting underdeveloped genetic resources and for maintaining diversity. Both should be encouraged and supported. However, introduction of new ("exotic") species should always be done cautiously. Monitoring the actions of other countries in this regard may help to define priorities in one's own region.

6. Traditional native uses of resources of any kind should be used as indicators of possible new products for future economic development. They may help identify areas and species so important to local economies that they deserve special attention for conservation efforts.

7. The value of biological resources needs to be studied from the human perspective, including the impact of reduction or elimination of diversity upon the quality of life of the individual as well as the culture of the community.

8. There is a need to develop a list of priority geographical and

ecological areas for international conservation efforts, using such criteria as the endemism of species, their vulnerability, urgency of current or threatened degradation, lack of knowledge about them, based on information obtained by work such as that undertaken by IUCN, the World Wildlife Fund, and the World Resources Institute.

9. The concept of placing a small (percentage) "tax" on large projects (dam construction, irrigation canal building, road construction, etc.) for the support of research and projects on biological diversity is felt to be an innovative yet reasonable way to reallocate AID resources. The funds derived from this taxation would be used to:

a. do a more thorough assessment of the diversity of the area than is normally done in an environmental impact assessment;

b. select and manage parks and reserves in the region;

c. establish financial support for unorthodox research approaches (e.g. to investigate specialized biochemical compounds in indigenous plants, evaluate their function for plant survival in terms of their effect upon the animals which may feed upon or be repelled by them, and assess the potential for their medicinal or other use).

10. Country-based surveys of biological diversity, leading to formation of databases on vertebrates and higher plants as well as other groups of economic or other particular interest, are recommended. They are also relatively inexpensive. In Nicaragua, for example, where these resources were the least known in all of Central America, it took an estimated cost of only $40-50,000 per year for a study of eight years length (1977-85) to establish the living resources of that country as the best-known in the region. This effort was highly effective in helping officials to conceptualize and plan resource management. The emphasis should be on immediate, active use of the information, in the formulation of a conservation strategy, including establishment of parks and reserves (e.g. centers of endemism will be revealed by the survey), rather than on collection of specimens for academic reasons. These efforts should always be conducted so as to enhance the scientific and institutional capabilities of the country. They should be coordinated with detailed studies of specific organisms and ecosystems of particular interest for economic development (e.g. pests, migration areas, conservation or restoration project areas) to develop a dynamic and flexible, growing base of information on genetic resources and environmental concerns in the country

11. The need for research conducted through intensive, long-term, ecological monitoring of selected sites is considered to be a particularly high priority, as was recommended in Research Priorities in Tropical Biology (e.g. La Selva, Manaus, Mulu, Chamela, savannahs). To understand ecosystem functions, the

performance of individual organisms within populations (in addition to the average performance of species or groups) needs to be studied. These long-term studies need to be operational, evaluating the effects of introduced perturbations (to simulate harvesting, or other intended or unintended destruction) as well as naturally occurring fluctuations and drifts in species composition and abundance. Such studies will give important information about the mechanisms and rates of species loss. (Ecosystems are dynamic. Relatively scarce species at one stage, e.g. climax forest, may be critically important at another stage in the long-term cycle, such as during post-drought- or post-fire recovery.) Regeneration of many disturbed systems (e.g. tropical rain forests, coral reefs) often takes decades. Therefore the funding of research that can teach us how to accomplish regeneration or prevent demise requires long-term investment.

12. Understanding the role of chemicals produced by species in coevolutionary processes, as well as those introduced by man for manipulation and control of "unwanted organisms", is important both for maintenance and management of the systems. It is necessary to increase our understanding of the role that chemicals play in plant-animal, plant-insect, plant-microbe and animal-animal interactions. Chemicals act as attractants, antifeedants and toxins. An increased understanding of their role in the environment will provide basic knowledge for

a) improving reproductive efficiency in plant-pollinator interaction

b) an understanding of allelopathic effects and hence chemical factors affecting seedling establishment

c) the ways in which plant chemicals determine the utilization of pastures for grazing, and

d) the role of chemicals in biological control.

Practical applications may result from the recognition of natural plant products as non-destructive, biodegradable insecticides and herbicides, and in their medicinal use.

13. The concern for sustainable exploitation, conservation and preservation of genetic resources is not limited to, or even principally the responsibility of, conservationists and natural resource agencies, but must pervade agriculture and other developmental programs of the developing world and donor agencies.

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CONCLUSIONS

The executive summary of the AID Task Force report to Congress (February, 1985) states that "since biological diversity is a measure of economic potential as well as genetic wealth, provisions for conserving biological diversity must be incorporated into development planning...and should be an integral part of all development programs." There was unanimous agreement with this tenet by all participants at this meeting. Specific ways in which the agency can accomplish its stated goal were proposed by panel scientists and AID participants, and are summarized below as "institutional guidelines".

A. Policies and AID Capacity

Ecologically valid land and water use assessment and planning capabilities need to be strengthened in developing countries as a top priority.

1. Recognition must be engendered throughout AID and at all governmental levels in the host countries that there is presently a completely unbalanced relationship between the degree of dependence on natural resources and the funds allocated to evaluation and planning, and the implementation of plans for their sustained use. For example, huge investments are made to build massive irrigation projects (mainly canal building) for agricultural development, with little or no attention given to the watersheds that are the actual catchment basins and regulators of the water. The tacit assumption is made that the source of the water will remain constant and reliable over time. There is often an information and motivation gap that lies between the current, enlightened policies which accurately recognize the need for attention to preservation of biological diversity, and the general practice in developing countries and the donor community.

The key to successful implementation of policies in AID clearly lies at the mission level because that is where action occurs. Regional bureaus, however, have an obligation to ensure that all missions in their jurisdiction do act on agency policies. Thus, the development of strategies or guidelines by the regional bureaus for preservation of biological diversity (as is currently being done by Asia Bureau) is seen as an appropriate way to call attention to the issues as they relate to real problems and conditions in the regions (bridging the gap between theory and practice), as well as providing mechanisms to ensure that the country development strategies developed by missions do indeed address them. The Science and Technology Bureau's Biological Diversity Task Force should develop a global strategy for conservation of biological diversity to serve as guidelines for AID activities in concert with those of other multi-national organizations.

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In the countries themselves, publicly owned resources (e.g. forests) are usually not valued at market rates or considered as the joint property and heritage of all citizens (even when so guaranteed by constitutions), but are treated as though they were free commodities for exploitation by favored private investors. This often leads to the exploitation of intrinsically renewable resources in such a way that use outstrips regeneration and they become nonrenewable.

Public relations activities both within and outside of the agency to spread this message should be increased, and are the responsibility of all AID professionals whose activities bear on the topic.

2. Country profiles are a most appropriate mechanism for gathering and storing information about biological diversity and should be expanded or created as a basis for planning. Development of National Conservation Strategies is the next logical step to comprehensive natural resources management at the country (federal) government level. Characterization of ecosystems and biotopes as well as assessments of species composition and abundance should always be an important part of such work. The species assessments should not be restricted to species lists alone, but also include the ecological realities of the study sites (taking dominance and rarity into account as well as related environmental factors governing species occurrence and distribution).

Country profile studies of biological diversity should be based initially on vertebrates and higher plants. Concentration on these two groups is suggested not because they are necessarily more important than other organismal types, but because they are often easier to recognize, their classification usually does not require sophisticated equipment, and they are represented by fewer species than many other organismal groups (e.g. insects, microbes). Thus, a more thorough assessment is possible than could be done by considering all groups of organisms at the outset (often an important practical consideration). Another reason these two groups are a good focus is that they serve as indicators of overall ecosystem functioning. If the diversity of the plant community (as primary producers) suffers, it is inevitable that diversity of dependent animal and microbial species will also be reduced. Vertebrates, as highly specialized animals which are also long-lived, tend to occupy the upper levels of the trophic pyramid. Their disappearance, when not related to simple over-exploitation, is often the best indicator of severe ecosystem imbalance at the lower levels. Country profiles should be complemented by more detailed studyies of specific species, species groups, or ecosystems as appropriate to the national development plans. These might include detailed studies of insect populations important in vector borne disease or crop pests, studies of phytoplankton important in food chains of key fisheries, or studies of symbionts of species currently being domesticated or introduced into new environments. The database system should be dynamic and continuing; people should start planning now with whatever information is available.

Together with institutionalization of a country environmental profile, the government in question should be encouraged, and if necessary, assisted with funding and technical support, to develop a National Conservation Strategy. It is important to recognize that a country environmental profile is not completed once a publication is issued. Rather the information comprising it is a point of departure for assessment and comparison of future changes in biological diversity and land use. Since natural resource planning and management involves predictions which need to be based on documented trends and cause and effect relationships, databases used for development should be kept up-to-date, and preferably be computerized for easy access and retrieval, and manipulation.

3. <u>Wise conservation for sustained development includes strategies for preservation as well as utilization of selected natural resources</u>. Conservation and preservation of ecosystems and habitats are indispensable to the long-term development of every country, both directly and indirectly, in terms of sustained agricultural productivity of both food and commercial crops, as important national heritage, for tourism, and esthetics, and as current and future natural resources for the materials based economy. Since all economic and social development is related to the physical surroundings within which such activities occur and are dependent upon them, conservation activities, and even establishing preserves, clearly lie within the mandate of an Agency such as AID. Furthermore, there is currently no other U.S. governmental agency which controls sufficient funds in tropical areas and has the international focus of AID to make significant progress on these goals. <u>An agency level policy statement is needed to validate establishment of ecological preserves as an appropriate development activity</u>.

4. <u>The criteria which were identified as important for the selection of ecosystems or habitats for preservation or conservation activities, and their prioritization are listed</u>. The same criteria can also be used to help determine which natural resources are most appropriate for sustained exploitation or replacement by other managed systems:

a. <u>economic importance</u> of the species, biotope, or ecosystem to the survival of subsistence level human populations inhabiting the area in question or surrounding regions, or as the current or future basis for economic development of other groups and industries within the country.

b. <u>urgency</u>: because the resource is being rapidly depleted or destroyed, as compared to one whose spatial representation and abundance are maintained or expanding.

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c. state of knowledge: previously undocumented species or ecosystems as opposed to those which have been thoroughly documented and studied.

d. representation of genotypes/phenotypes: species with unique features (e.g. perennial corn) or centers of endemism, as opposed to species which are abundant and have commonly represented morphological and functional characteristics.

f. diversity: certain areas, such as the valleys of the equatorial Andes or the marine environments of south Asian archipelagos, have exceptionally diverse ecologies and on a worldwide scale are exceptionally rich sources of genetic resources.

g. hierarchies of dependence: ecosystems having a protective function for other subordinate ecosystems should receive special attention (e.g. forests on steep slopes which prevent soil erosion should be protected in preference to forests of the same type downstream that occur on flat land; sediment load in rivers affecting estuarine and reef systems downstream.)

h. constraints to regeneration of stressed species or systems: e.g. the length of time required for recolonization or for completion of life cycles to reestablish a critical number of individuals needed to maintain a species such as "100 year" flowering bamboo, or to ensure the continued functioning of an ecosystem such as a coral reef.

i. political conditions, at the national and local level, which will allow such activities to take place and endure, and will allow U.S. support and involvement.

Clearly, more information is required than is available at present in almost all countries, before these criteria can be applied.

5. Well-trained, motivated, environmental professionals in adequate numbers are fundamental to the success of programs within AID and host country agencies. Some AID missions currently do not have environmental officers, even though they are mandated by policy. Many of the individuals who hold this title are not adequately qualified for the position. In-service training should be established and enrollment encouraged by incentives, particularly in the case of forced placements during personnel cutbacks. The lack of career ladders and active recruitment of environmental specialists needs to be addressed by senior management.

Guidelines are being developed for mission environmental officers through the AID/NPS (National Parks Service) expanded information base project to assist them to identify, evaluate, and plan environmental priorities and programs, but few of these address preservation of biological diversity in a direct way.

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Existing guidelines, together with the AID regulations and procedures for environmental analysis, should be reviewed, edited, supplemented, and compiled as an "AID Environmental Officer's Manual". Development of a manual would be best carried out either by, or in close collaboration with, a current or former AID environmental officer with scientific qualifications who can represent the managerial and practical aspects of the position as well as the theoretical and factual sides. It is very important to ensure that there is a library of appropriate literature available in every mission for the use of the environmental officer.

6. Education, training, and institution-building are essential tools for AID in carrying out its mandate, and to the countries themselves in managing their resources effectively. Frequently, biological conservation is seen as peripheral, or worse, as antithetical to development, and there is generally either a shortage of qualified people or of professional positions for them. Attitudes are best influenced during one's youth. Environmental concepts should accordingly be introduced into primary and secondary school curricula, as well as being taught at the university level in the countries we serve. Without the increased training of host country scientists and their involvement in the acquisition and management of information concerning biological diversity, conservation schemes will be doomed always to be superficial or even wrongly devised. Furthermore, it may be appropriate and effective to fund postgraduate seminars or other short-term training for foreign nationals receiving a U.S. university education in other disciplines (e.g. economics, engineering, political science), in conjunction with an effort to determine and target those that are most likely to become political leaders in their home countries.

7. Funding of defined conservation/preservation activities should be linked to the development activities which most directly compromise environmental quality of the systems in question. When conservation activities compete for funding with topics such as agriculture, they are almost always perceived as less important in strict economic cost/benefit terms, particularly in the short run. Since environmental damage can often be directly correlated with the consequences of large development projects (e.g. dam or road building, or major agricultural development schemes, in which the costs associated with restoration are underestimated or neglected entirely in project estimates), it would seem logical for a certain percentage of project budgets to be earmarked for both short-term and ongoing conservation/preservation activities, defined within the framework of national land-use planning. This should be encouraged by AID in all large country projects irrespective of the source of their funding. The level of such an "environmental maintenance tax" levied upon projects funded by AID should be proposed by the office responsible for development and funding of the major project, and be discussed at the Project Identification (PID) stage and agreed upon at the Project Paper (PP) stage of

development. These funds would be used in an integrated manner by the mission to support environmental planning and restoration in the host country; they would not necessarily be tied to use in the specific projects from which they were drawn. The actual percentage should bear some demonstrable relationship to the degree of dependence on the renewable resource in question and/or the degree to which it may be threatened by the project. Appropriate changes in the Project Handbook regulations would need to be made. AID programs must include appropriate oversight and advisory function to ensure compliance and equity throughout all of the AID regions.

8. New mechanisms are needed for support of efforts to conceive, understand and exploit biological diversity sustainably. In some cases long term stability of programs is required, beyond that which is normally possible in AID projects. AID might, for example, experiment with participation in multi-donor consortia (which reduces risk from changes in any one agency) for some long-term centers for research on biological resource management. Similarly, as has been done in Israel and is being done in Portugal, AID might consider participation in the endowment of a bi-national insitute for genetic resources research. Such opportunities are particularly likely to occur in major initiatives between countries, and in the negotiation of new science and technology agreements, and AID policy should be to consider at all such opportunities the establishment of long-term cooperative agreements for genetic resources conservation research.

B. Projects Needed

1. Establishment of databases on vertebrates and higher plants, as well as other groups of economic or particular interest, and on habitats and ecosystem characteristics, should be done as a first step to preparation of country environmental profiles and national conservation strategies. Computerized databases are desirable as a basis for research and networking activities, and as a way of maintaining an up-to-date accounting of country and regional resources. AID should work closely with host governments and country NGOs in funding and setting-up such projects.

2. Exchange of germ plasm and associated information is fundamental to success of both conservation and development. Conservation of germ plasm requires access to information about its importance, and contemporary distribution (endemism as well as *in situ* and *ex situ* representation). Information about the degree to which it is threatened, or threatening within the new ecological context in the case of introduction, is also particularly important. Application of new technologies, especially computerization of data, its management and on-line access for networking activities, and development, as well as use of *in vitro* techniques for maintenance and exchange of actual germ plasm lines, all promise to be very

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cost effective activities in terms of the advantages conferred to developing and developed countries alike. Incorporation of these topics into AID activities can be accomplished either by establishing them as separate, funded projects (each having representative sectoral activities) or by incorporating them into a variety of other, related but more traditional sectoral projects.

3. Projects that assist countries in establishing or enhancing environmental ministries and departments for the purposes of policy identification, planning, regulation, and enforcement are particularly desirable because they are action-oriented institution-building activities, and serve to transfer responsibility for preservation of biological diversity from AID to the governments in question. Preliminary contacts with the host governments may be appropriately made by BOSTID, with the assistance of AID, to engender scientific interest.

4. It may be desirable in some cases for the AID Mission to assist a host government establish an ecological preserve or in situ germ plasm bank by providing technical assistance and/or funding. Such an activity may be warranted when there is a clear indication of the ecological or economic value of the ecosystem or species therein.

5. Development of natural specialty products is an important aspect of economic development that should be given greater emphasis, particularly in the humid tropics where the environmental conditions are more suited to the production of timber and fiber than food (especially the food varieties prevalent in temperate zones). In choosing new products for development (e.g. oils, gums, resins, and other biochemical tree products), their comparative economic advantage in regional and world markets should be investigated.

6. Projects for long-term studies of management of critical processes should be undertaken in a few locations, such as the Andean tropical valleys, and the eastern Pacific reef and coastal zone marine systems, where there are both long-term research opportunities and exceptional centers of endemism. One might consider development of a small network of centers with multi-donor support, similar in some ways to the CGIAR network of agricultural research centers.

C. Research Needed

1. Country-based surveys of biological diversity are prerequisites to establishing organism and ecosystem databases. In many countries only limited information is available; in the tropics no more than one-in-six organisms has even been named. Well-trained systematists are needed to establish the basic information needed

for valid land-use decisions to be made. It may be as important to assess rare species as commonly represented ones, as no a priori assumptions can be made about the potential value of any organism without knowing something about it. As basic research is involved here, the PSTC and BOSTID research programs may be the most suitable sources of funding. However interdisciplinary team research projects involving U.S. and host country researchers are probably more effective means of obtaining such information than the traditional one- or two-researcher grants. A team approach and establishing a center in each country involved would be the best way to contribute to institution-building and further the training of host country scientists in systematics, taxonomy, and ecology.

2. There is a need to acquire information about the functioning of ecosystems over time. Long-term monitoring of a few study sites (selected in the country environmental profile context) is needed, emphasizing demography of the populations of important species, as well as the performance of tagged individuals within such populations. The types of research needed are summarized in Ecological Research in the Humid Tropics (see Appendix 2.d).

Determining the critical minimum size of functional ecosystems for planning of preserves may only be approachable in connection with such detailed studies. Assessment of the "carrying capacity" information needed for economic projections of productivity and development of long term cost-benefit analysis certainly depends upon it. Similarly key information on species requirements for restoration of degraded environments, or for sustainable management of complex farming systems or forest production systems may require such long-term analysis of functioning ecosystems.

Monitoring projects should not be seen as passive, but as interactive, involving alterations of the system to better understand the nature of sustainable productivity (while maintaining and monitoring unaltered control sites). This should involve studies of sustained, selective harvesting of healthy nearly natural systems, as well as restoration schemes for degraded ones. Study of contemporary and historical management and uses of species in traditional systems (e.g. social forestry, agroforestry) is particularly important, both for identifying new products for economic development and for estimating maximum sustainable yields. Endowing foundations in each geographic region may be the most practical and appropriate way for AID to provide the long-term support that such multidisciplinary, basic research requires.

Research teams should, whenever possible, be comprised of regional scientists, although initial leadership and continual representation by U.S. specialists is desirable to ensure the highest quality of the research. Appropriate oversight should be developed in AID to assure that the best expertise is available to monitor scientific progress.

3. Specific regions (and ecosystems) identified at the meeting as having exceptional priority for study and protective action are:

a. wetlands, coral reefs, estuaries, and sea-grass beds in all tropical regions of the world;

b. the Atlantic coast forest of South America;

c. the East Andes slopes of Peru, Ecuador, and Colombia;

d. the Malay Peninsula;
e. East Kalimantan in Indonesia.

f. the forests and sources of agricultural crops in Central America -- Guatemala, Honduras, Nacaragua, etc.

g. the tropical forests of Cameroon, Zaire and Nigeria, and the sources of agricultural crops in East Africa.

Peru, Ecuador, and Colombia in South America have AID missions, but the Atlantic coast forest which is mainly in Brazil does not lie directly within AID's purview (although Brazil does have an AID representative). This raises important policy questions that may be in need of further debate. In such cases where a resource of both regional and international significance is threatened, should the Agency be willing to allocate funds to help focus world attention and prevent its demise even when there is no mission present to administer them? Alternatively, can AID work with State and other agencies to direct use of other funds for key areas -- i.e. IDB or IBRD for work in the Brazilian coastal forest? Are there still AID reflows of Partners for Progress travel funds in Brazil that could be so used?

4. Whereas the pressure for conversion of tropical forest to agriculture and grazing land is unlikely to abate, and it is generally accepted that the type and quality of soils in the tropics is one of the most basic constraints to use of the land in any other way than for growing trees, it would be valuable to expand efforts to characterize and classify tropical forest soils in the Tropsoils, Soil Management Support Services, and the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) programs to which AID contributes support. Such research should include not only chemical, geological, and geographic components, (to determine specific purposes to which a land tract could be profitably and safely converted), but should also consider the composition of the natural vegetational cover as the basis for more rapid screening (requiring fewer technical materials) than can be accomplished by the former methods. The value of high altitude and satellite remote sensing methods for such classification should not be overlooked, although at the present state of resolution it is useful only to a limited extent.

5. Research directed towards locating, collecting, and introducing into appropriate germ plasm banks indigenous cultivars and their ancestors is needed, where they will be cataloged and maintained. In some cases, in situ protection, and/or subsidized maintenance may be indicated (e.g. for those crops which are only propagated vegetatively). Such studies and the follow-up projects should be done in conjunction with social and anthropological study of the human populations, including the uses to which the crops are put and the methods of their preparation as food or other products. Availability of such germ plasm is very important, if not essential, for modern crop plant breeding, and as sources of new food crops.

6. Both research and demonstration projects for restoration of degraded land (such as "waste land", saline soils, eroded land) involving the use of exclosures, seeding and restocking programs, or deposition of organic wastes (e.g. sewage sludge that is not suitably free of pathogens for direct use on crops), should be included in AID programs. The justification for such an approach is that degraded land was formerly managed profitably, is usually close to markets and population centers, and often close to essential amenities such as water. It may be more expensive in the short run to rebuild lost productivity than to open and conserve new lands, however (even without counting the externalities of protection of genetic diversity) it will often be as economic in the long run to rebuild degraded local systems rather than to exploit (and degrade, requiring rebuilding) other more remote land, which may itself be more sensitive to degradation and intrinsically less profitable.

7. The identification of new biochemical products could be expedited by developing simpler methods to screen for them. Once an interesting resource has been identified, developing new products should also include efforts toward domestication of the species in question as an important consideration for long-term sustainability of a growing market. It is important to note that once a specialized, naturally-derived product achieves success on the world market its abundance is often reduced by the demands created by that very success. Therefore, any such project should engage the involvement of a resource economist to assess feasibility and prospects.

8. There is need for research on systems for sustainable harvesting of lightly-managed tropical ecosystems. This research should be based on analysis of existing ethno-systems where they are attractive -- Bali, Amazonia, Malaysia -- and on modern economic botany and zoology.

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D. Other Studies Needed

1. A general review is needed of what is known about the economic value of biological diversity, in terms of what we know about species roles in ecosystem stability and function, ecosystem roles in development schemes, and in terms of quantifiable losses known to have been caused in development projects by reduction in the number of species, as well as the loss of certain species, or reduction of ecosystem complexity. It should include the direct economic impact of watershed management, siltation, and other activities and consequences that bear on the long-term sustainability of agriculture and other industries (e.g. hydropower). It is important to recognize in this context that AID is a social development agency as well as an economic development one, so questions referring to the quality of life (including the value or cost of health and ethnic culture, which are both inextricable from environmental considerations) should be included. The report should be written in terms understandable to the nonspecialist decision-maker in developing country ministries, and their counterparts in development assistance agencies. This is suggested as a BOSTID project, and should be co-funded by relevant offices of AID.

2. Case study documentation of successful schemes for sustained agriculture, fisheries, forestry, and grazing in various biotopes is needed. There are, for example, few (if any) cases of sustainable harvested tropical forests known. When they are identified, an assessment of the traditional techniques and management systems the people use to maintain them should be done, with particular attention to problem-solving approaches. The specific ecological factors that contributed to the success (e.g. yearly flooding in flood plains, volcanic soils) should also be noted and analyzed.

3. A compilation and review of critical areas, including rationale and possible guidance as to the status of their need for conservation or preservation should be done. Such studies should be based upon work by and conducted in collaboration with IUCN, the World Wildlife Fund, and the World Resources Institute.

4. Identification of priority research topics in biological diversity is needed that would lead to understanding of the importance of species, their habitat and dynamic ecological processes affecting their conservation and diversity. In many aspects of biological diversity so little is known that it is impossible to assess relative priority for research. What is required is to identify topics which, in the opinion of the research community, would be most likely to increase understanding of the importance of diversity and its potential contribution to human welfare.

5. Environmental assessment and impact statement requirements should be reevaluated and possibly revised to require long term cost-benefit considerations, based not only on determination of the carrying capacity of the ecosystem in question but also on projection of the eventual effects of the proposed project on associated (dependent) ecosystems and industries. Clearly, such a study could not be accomplished until approaches and methods for long term cost-benefit analysis have been more fully developed as indicated in our recommendations for research. This type of study could be conducted by BOSTID or contracted out to an institute such as the East/West Center or a university.

6. A compilation and evaluation of computerized databases known to be relevant to biological diversity should be conducted to determine the type and extent of information currently available and planned for. The project should include both databases of scientific facts and management options. Instructions about how they may be accessed (including cost and payment arrangements) and contributed to should be included in the report. This study could be accomplished in a few months' time, and could be contracted out to an individual or organization.

7. A fundamental problem in the protection and conservation of genetic resources is how to appropriate financing for the countries where the conservation must take place, from the benefits reaped abroad from the resources. This is not simply accomplished by "each doing its own part", since the orignal sources of maximum diversity are concentrated, often in very poor countries. Studies are required of new financing institutions and mechanisms to solve this problem.

8. A study of the potential of tropical freshwater fish to contribute to the food supply, including their potential for sustained productivity, culture, and the possible impact on diversity should be undertaken in the BOSTID series Managing Tropical Animal Resources organized by the Advisory Committee on Technology Innovation.

APPENDIX

1. Proceedings of the U.S. Strategy Conference on Biological Diversity November 16-18, 1981. U.S. Department of State, Washington, D.C.

a. The United States should support efforts to identify, establish, and manage a worldwide system of conservation areas representing the major ecosystem types, particularly those which are unique, fragile, and/or highly diverse.

b. Diversity can be maintained only by incorporating conservation planning into development planning. Protected areas should be a component of development plans. In addition, methods and techniques for sustainable agricultural, forestry, and fisheries production, which also provide for maintenance of biological diversity, should be developed. Demonstration projects using these methods should be encouraged.

c. A coordinated international program to analyze the current status of the Earth's ecosystems and the rates of conversion from a wild to an altered state should be developed.

d. Information and education campaigns should be expanded in the United States and elsewhere to familiarize the public and policymakers with the importance of maintaining biological diversity.

e. The United States should support research in tropical ecology and conservation biology. Development assistance projects should incorporate greater support for training developing country scientists and resource managers to improve national capacity to manage biological resources for diversity.

f. Greater emphasis should be given to education and training in organismal and population biology, systematics, comparative taxonomy, and organization/management of germ plasm collections. Continued support should be given to institutions which hold these collections.

g. International efforts to inventory the world's wild and domesticated plant, animal, and microbial resources and to maintain collections should be evaluated.

h. Open exchange of genetic material and information related to these resources should be encouraged worldwide. Data bases should be compatible for maximum accessibility to information.

i. Monitoring of the ecology of populations and morphology, physiology, and genetics of germ plasm of economically important populations should be undertaken before long-term strategies for fisheries, livestock, and crop management are formulated.

j. Information on traditional local uses of plant and animal resources by indigenous peoples should be gathered so that we may identify species or varieties of potential economic significance.

k. The United States should cooperate more fully with the existing international organizations which are concerned with the maintenance of biological diversity (e.g. UNEP, FAO, MAB, IUCN).

2. Ecological Aspects of Development in the Humid Tropics, 1982. National Research Council Committee on Selected Biological Problems in the Humid Tropics. National Academy Press, Washington, D.C.

a. Ecological information and environmental considerations must be an integral part of development project planning; they must be "given equal weight with agricultural, economic, and engineering factors from the outset of project design.

b. Development agencies must encourage and support ecological research that will provide essential knowledge for finding new technologies that, in turn, lead to environmentally balanced, long-term strategies for development.

c. Conservation of natural areas in the vicinity of a development site should be an integral part of a project plan: these areas provide a background against which to assess environmental changes and preserve options for future development.

d. Planning can be made much more effective by expanding and improving natural resources evaluation. Information on climate, soils, vegetation, wildlife, and water resources is essential to environmentally sound planning and facilitates wise selection among project options.

Key ecological factors of significance in planning include, but are not restricted to:

- o determination of hydrological cycles, biogeochemical cycles, energy flow patterns, food chains, and biotic interrelationships within the ecosystem
- o definition of regulatory functions within the ecosystem, especially succession, predator/prey relations, and biotic factors affecting nutrient and energy balance
- o study of destabilization of irreversible effects produced, by analyzing various kindsof resource use
- o selection of ecologically sound development concordant with the principle of long-term, sustainable resource production
- o establishment of linkages between the specific project site and a regional development perspective (Page 241).

e. Development agencies must strengthen communication linkages in search of maximum dissemination among tropical countries of information on results of natural resources research, on project successes and difficulties, and on technological innovation. Opportunities for direct communication between tropical country counterparts should be enhanced.

3. Conserving International Wildlife Resources: the United States Response: A Report to Congress by the Secretary of State and the Secretary of the Interior. December, 1984.

a. Substantial acquisition and dissemination of international wildlife resources information into and out of federal agencies already takes place. An important objective of an integrated U.S. plan, however, should be to develop improved access to and exchange of information relating to conservation status, conservation projects, laws and regulations. (The IUCN computerized database is suggested as the most appropriate central repository).

b. Research provides a basis for decision making and for testing techniques and technologies....Enhanced research efforts should focus on developing data and information on conservation needs and priorities.

c. For wildlife resources conservation to succeed, it must be based on sound biological data and management techniques and supported by the governments and peoples where the wildlife and their habitats are located. Training and public awareness programs can be made more cost-effective,...and should have high priority for any increase in allocated financial resources.

4. U.S. Strategy on the Conservation of Biological Diversity: An Interagency Task Force Report to Congress. February, 1985. (Led by the AID Task Force on Biological Diversity.)

a. Continue an ongoing policy dialogue within federal agencies and with developing countries on biological diversity, and help them establish and implement national policies for conserving, managing, and developing genetic resources.

b. Through education programs in developing countries, increase public awareness of the need to conserve biological diversity.

c. Strengthen developing country conservation institutions and increase conservation training.

d. Support research related to biodiversity conservation and inventories of species and ecosystems.

e. Promote balanced resource management and the designation and maintenance of protected areas.

f. Encourage developing countries to recognize the effects of and deal with human population pressures on natural resources.

g. Increase coordination among development assistance agencies and support nongovernmental conservation organizations.

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MEMORANDUM June 3, 1985

TO: Participants in the Biological Diversity Meeting

FROM: Michael Dow

RE: Revised Summary of Meeting

Susan Campbell and I very much appreciated the extensive and thoughtful comments and suggestions many of you made about the draft meeting summary we circulated earlier. In the attached document we have tried to incorporate these corrections and amplifications to produce a version which accurately reflects the sense of the meeting, and is both clear and useful.

We should again like to thank all the participants for their contribution to the meeting, and particularly those who helped with the final version of the meeting summary. We look forward to keeping in touch with you as plans for future AID and BOSTID activities mature.

With all good wishes.

The Ecological Society of America

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CONSERVING BIOLOGICAL DIVERSITY IN SOUTH AND SOUTHEAST ASIAN AID COUNTRIES

by

Elliott A. Norse

In early June, 1985, Dr. Susan Campbell of the AID Asia-Near East Bureau asked ESA for a list of ecologists with expertise in biological diversity of AID nations in South and Southeast Asia. Using the Ecological Information Network, our computerized data bank of more than 800 professional ecologists interested in applying their scientific understanding to human problems, we provided the list. Within a few days, Dr. Campbell asked us to assemble as many experts as practicable for a briefing of AID officials at the earliest possible date, to discuss the areas most important for conserving biological diversity in South and Southeast Asian countries and the biological and human causes and possible solutions to losses in biological diversity. On July 2, my assistant Vera Pratt and I convened the briefing of ecologists, AID officials and invited guests at the State Department.

The attending ecologists included:

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Also attending were ESA's Public Affairs Committee Chairman, Dr. David E. Reichle, Oak Ridge National Laboratory, Building 1505, PO Box X, Oak Ridge, TN. 37830; (615) 574-7302, and:

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William Gregg, National Park Service
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Given the time constraints for assembling the group of ecologists, their presentations were largely impromptu, drawn from their personal experiences in AID nations. In addition, the schedule at the meeting allowed only a few minutes for each presentation. As a result, their contributions must be viewed as a "first cut." Many geographic areas, taxa, processes, and observations on institutions had to be omitted. These scientists could provide far more detailed, complete and useful assessments given sufficient time and resources.

Although the briefing per se was the main product of this meeting, this report summarizes some of the points made by the ecologists, and lists information of use to AID officials in the US and in-country. Following general observations and recommenaations, salient points concerning each of the countries are presented. Appendea to the report are copies of written materials, both published an unpublished, of use to AID officials interested in conserving biological diversity and sustaining development in South and Southeast Asian AID countries.

General observations and recommendations on population, economic development, science and technology, and the human factor, begin on page 3. Country synopses appear beginning on page 6 (Pakistan), page 7 (India), page 12 (Nepal), page 14 (Bangladesh), page 15 (Sri Lanka), page 17 (Thailand), page 18 (Indonesia), page 20 (Philippines) and page 23 (Fiji). A list of appended materials appears on page 24.

GENERAL OBSERVATIONS

POPULATION

The problem that underlies loss of biological diversity in all the nations discussed is human population pressure. This pressure is increasing, and loss of a major fraction of biological diversity at all three levels--genetic diversity within species, diversity of species, and diversity of ecosystems--will occur unless population pressure can be eased. Losses in diversity are already very high in some of these countries. Given present levels of education, socioeconomic structure and functioning, natural resource consumption and effectiveness of conservation, relieving population pressure is the only means of slowing the increasing rate of loss of biological diversity.

RECOMMENDATION:
AID should actively support, itself and in cooperation with other institutions in AID nations, **all** efforts consistent with generally recognized principles of

human rights and international law that help to diminish human population pressures.

ECONOMIC DEVELOPMENT

While biological diversity is of enormous benefit to economic development, economic development can either benefit or erode biological diversity. Some kinds of projects--e.g. large dams, roads built through primary forests--are virtually always more damaging than beneficial. Other kinds of development can be much more benign, causing no significant losses where they occur, and providing an economic means for improving education and efforts to conserve what biological diversity remains. Efforts to assist sustainable agriculture, forestry and fisheries can certainly be highly beneficial, by raising the standards of living and relieving pressures on wild living resources. But projects that might superficially seem innocuous or beneficial, such as planting trees, may seriously erode biological diversity, for example, when the species introduced are exotics (aliens), thereby replacing native species. Informed scientists are unlikely to give blanket approval to any kind of economic development scheme, however, without careful case-by-case examination of the physicochemical, nonhuman biological and human socioeconomic environment. Even well-meaning projects all too often have substantial adverse consequences that could have been anticipated and averted. With careful, sound development research and planning, much biological diversity can be maintained, with attendant immediate and long-term benefits to society.

RECOMMENDATION:
AID should strictly avoid the kinds of development projects that have greater negative consequences for biological diversity than benefits to it, and should concentrate its efforts in promoting sustainable economic development of kinds that are consistent with maintenance of biological diversity.

RECOMMENDATION:
AID should do everything in its power to ensure that biological diversity is maintained in existing parks and other protected areas, and should work to identify areas where parks are needed and assist in their designation and management.

RECOMMENDATION:
AID should have an in-house capability to analyze the impact upon and benefits to biological diversity of general policies and specific project proposals, by hiring as permanent employees a coterie of appropriately trained ecologists and other conservation biologists. Each country mission should have a professional biological diversity officer with at least Masters-level training in ecology, wild living resources management or conservation biology.

RECOMMENDATION:
AID should require a biological diversity impact report for each development project considered for sponsorship by AID. Projects found to have substantial adverse impact on biological diversity without more than compensatory benefits to species and ecosystems should be dropped from consideration.

RECOMMENDATION:
AID should prepare detailed, scientifically sound biological diversity profiles for each AID country, which should be used by all AID officials involved in project proposals, implementation and follow-up.

SCIENCE AND TECHNOLOGY

Certain Western high technologies (e.g. biotechnologies) can be an important adjunct to efforts to assist in conservation in AID countries, but most conservation will be achieved through two interrelated means that nonetheless call for somewhat different strategies: 1) sustainable preservation in parks and other protected areas, and 2) using non-protected lands and waters in ways that are compatible with long-term maintenance of biological diversity and ecosystem integrity (and hence, economic productivity). The MAB Biosphere Reserve Program combines elements of both of these approaches, and can serve as a model for conservation efforts worldwide. Because science still lacks the knowledge necessary to preserve the great majority of living resources in a world increasingly dominated by humankind, research in the emerging science of conservation biology is central to the success of conservation efforts. Conservation biology uses understanding of ecology, biogeography, genetics, behavior and systematics to maintain genetic varieties, species and ecosystems in both human-dominated and protected areas.

RECOMMENDATION:

AID should provide substantial support, both itself and by working with other domestic and foreign institutions, to research and training in conservation biology and management of protected and unprotected areas in accordance to the principles derived from conservation biology research. Students and senior investigators from AID countries should be brought to US institutions with strong conservation biology programs, and US students and senior investigators in conservation biology should be placed in AID countries to work with in-country institutions. And, scientists should be encouraged to transfer insights among AID countries, not just from their nations to US and vice versa.

RECOMMENDATION:

AID should support the translation and distribution of key scientific papers in conservation biology, ecology, wild living resource management, and related topics, into Spanish, French, Portuguese and other languages spoken in AID countries where most scientists and managers do not have access to English language scientific journals, and should systematically distribute these translations to all appropriate in-country institutions.

THE HUMAN FACTOR

No scientific advances can ensure conservation of biological diversity without comparable understanding of the social, economic and political factors that are causing the current massive loss of species and ecosystems. All efforts at conservation are destined to fail unless the people most directly affected find such efforts compatible with their values and in find it in their interests to see such efforts succeed.

RECOMMENDATION:

AID should greatly strengthen efforts to analyze social, economic and political determinants of project success or failure, what has succeeded and failed with previous development assistance efforts, and to understand developing trends that will affect future chances of succeeding on a sustained basis.

PAKISTAN

LEADING PARTICIPANTS: Perry, Wali

PERSPECTIVES

Some areas that are not highly diverse may be important to biological diversity at a larger scale because they are nonetheless high in endemism (species that occur nowhere else). Conserving biological diversity is impossible without understanding the sociology of people whose activities affect ecological conditions in reserves. Identification and isolation of ecosystems is not enough; there must be aggressive management to maintain their values. The recent literature on biological diversity of these areas is substantial.

RECOMMENDATIONS: PRIORITY AREAS

Chir pine (*Pinus roxburghi*) ecosystems, such as in the pass to Saidu Sharif, Swāt Valley

Desert scrub ecosystems W of Peshawar, near Kohāt

River Swāt and tributaries—an area with endemic fishes

RECOMMENDATIONS: PRIORITY SPECIES OR SPECIES GROUPS

Indus River dolphin

IMPORTANT CONTACTS

M. Rafiq & M. H. Janjua, Dept. of Zoology, Government College, Lahore (fishes of River Swat)

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Mr. Haider Ali, Divisional Forest Officer, Division of Swat, Watershed Management Project at Saidu Shorit, Swat

S. Nawaz, Dept. of Zoology, University of Peshawar, Peshawar (freshwater crustaceans)

USEFUL LITERATURE

Rafiq, M. and M. H. Janjua (1983). Some fishes from the River Swat near Chakdura, Northwest Frontier Province, Pakistan. Biologica (Pakistan) 29:337-338.

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INDIA

LEADING PARTICIPANTS: Bawa, Marzolf, Perry, Primack, Wali

PERSPECTIVES

India has 160 different types of forest ecosystems. The subcontinent has an estimated 5000 spp. of trees alone. Fully half of India's plants are endemic; the percentage is even higher in northeast India and the Himalayas. The understory is gone from most forests, which means canopy trees are not replaced by seedlings and saplings. The species composition of the remaining forests is changing. Ancestors of cultivated varieties are found in forests of Western Ghats, such as jackfruit, mangos and black pepper. Population pressure is rapidly eroding biological diversity. Fuelwood is in short supply; fuelwood costs the same as rice, and food production areas are being converted to fuelwood production. The government wants wood available for homes and industry at reasonable price, but the gap between supply and demand is widening. World Bank is trying to plant billions of trees over next several years. The famed forests of Kashmir, particularly cedar (*Cedrus deodara*) forests, have been devastated by selective logging for lumber and fuelwood. Trees reestablish only very slowly after dry, steep slopes are allowed to erode. Weather in Kashmir seems to have changed since independence; people say "It doesn't snow here any more," possibly due to deforestation. Wetlands and streams have been damaged as a result. Dr. Ralph Stuart (then of University of Michigan Herbarium) compiled a complete flora of Kashmir, which can be used to assess changes since 1947. There are some conflicts between scientists in academia and forestry departments. Establishment of black locust (*Robinia pseudoacacia*) from the U.S. and Eurasian carp (*Cyprinus carpio*) constitutes a serious problem. Karnataka Forestry Department has many U.S.-trained staff and is is very professional. The Indian Institute of Science is also in Karnataka. Politics interferes with conservation. Government statistics are often altered for political reasons; they can't be trusted. The need for firm data is acute. Foresters trained in the north work in the Western Ghats, which are so different that many management methods are harmful. But the situation is also hopeful: systematics in Indian universities fares better than in the U.S.; people already in positions can get essential training. The government's attitude about conservation has improved greatly since the 1972 Stockholm Conference.

PROBLEMS

- Degradation of forests due to grazing and collection of fuelwood and secondary forest products
- Degradation of forests by industry, for example, lands leased to paper mills
- Degradation of lands by security forces, especially in Northeast India
- Inadequate forest management practices, such as conversion of mixed, highly diverse forests to plantations of single species, often exotics, without any careful analysis of productivity and cost
- Development schemes, such as hydroelectric dams
- Inadequate Protection of national parks and forest preserves
- Lack of emphasis on the value of biological diversity at all levels of education, including education and training for professional biologists and resource managers

RECOMMENDATIONS: PRIORITY AREAS

All National Parks

Tropical wet evergreen and wet deciduous forests of the Western Ghats in Karnataka State (biological diversity is exceptionally high and population density is lower there than in most of India)

Mutamawali Wildlife Refuge

Sacred groves scattered throughout the country

Ladākh/Srinagar/Jammu areas should be separate priority forest conservation areas

Mudumalai Refuge

All forests of Andamans Islands

Forests of Upper (Eastern) Assam, particularly Digboi, Lakhimpur and Sibsagar Forest Divisions

Wet mixed forests of North Bengal, particularly Kālimpong, Alipore and Buxa Forest Divisions

All tropical freshwater swamp forests

Dry forests of the Sialik Hills

Montaine substropical and wet temperate forests of the Darjeeling and Kālimpong Forest Divisions, West Bengal; also in Khasi and Jaintia Hills, Megahalaya; Arunachal Pradesh, Nilgiri Hills, Tamil Nadu

Sustainable examples of all other forest types listed in Champion and Seth (1968)

RECOMMENDATIONS: RESEARCH

Innovative, "state-of-the-art" research is not needed; good, solid traditional research needs special encouragement. Of particular value for conservation and fuelwood-producing efforts: systematic monitoring of forest plots established before independence.

RECOMMENDATIONS: INSTITUTION BUILDING

Sending traditionally-trained U.S. foresters to India has not helped conservation of biological diversity; forest ecologists and foresters with substantial training in tropical ecology should be going instead. U.S. scientists sent to institute in Deradoon, an ideal place to introduce a biological diversity program, should go for minimum of one semester, not just a few weeks. While their rather traditional education is strong in systematics, Indian students need more training in ecological processes. The Wildlife Institute of India shows considerable potential for aiding in conservation of biological diversity as well.

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NEPAL

LEADING PARTICIPANTS: Bawa, Gill, Patten, Perry, Wali

PERSPECTIVES

Although Nepal's problems are similar to those of India, its educational institutions and infrastructure are not as well developed. In Nepal, local expertise is not always available. Unfortunately, the border area of eastern Nepal at 12,000-14,000 ft altitudes is a center for diversity of alpine plants (including rhododendrons), and these plant communities are being destroyed quickly. Recovery rate for these ecosystems would probably be very low. Lower levels of forest are virtually all gone. The focus should now be on the forest above 9000 ft. In some areas, all trees have been taken for fuelwood. Forests are still inact in a few places, but often forest integrity is illusory: junipers, which are greatly preferred fuelwood, are removed while pines are left standing. People will leave nearby pines standing but will travel two days to cut junipers. Above the timberline there is much burning of scrubby junipers to improve the herbaceous cover for grazing. This increases the amount of bare soil, and thus the rate of erosion. People also circumvent government regulations that prevent cutting live trees by setting fires that kill trees, returning later to harvest the standing snags. Unfortunately, dead trees are important ecosystem components as well for a number of reasons, including as habitats for species, such as some woodpeckers, that do not occur in live trees. There is pressure to introduce exotic plants and animals to replace vanishing native trees--with all the attendant danger that entails. People are also digging up wetlands for peat that they use as fuel.

RECOMMENDATIONS: PRIORITY AREAS

All National Parks
Upper Marsyandi River valley from Braga to Tāl
Annapūrna Himal
Royal Karnali-Bardia Wildlife Reserve
Lake Tali
High plateau grasslands along Tibetan border
Fragile alpine ecosystems around Lake Tilicho

RECOMMENDATIONS: PRIORITY SPECIES OR SPECIES GROUPS

Forestry of establishing and speeding growth of upland juniper species.

RECOMMENDATIONS: RESEARCH

Reforestation efforts must emphasize native, not exotic species. There may be potential economic benefits in moving native species (e.g., snow trout) from place to place, but this should be done with great caution, if at all.

RECOMMENDATIONS: INSTITUTION BUILDING

The International Union of Biological Sciences is beginning to run two study transects from bases to tips of mountains, examining biological diversity and land use. A new international institution called ICIMOD, concerned with integrated mountain development, is serving as a clearing house for information, and could use assistance.

IN-COUNTRY RECEPTIVENESS

While conserving alpine ecosystems in the border area would be difficult from the Indian side, the Nepalese government is less sensitive about foreign involvement in this area.

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IMPORTANT CONTACTS

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Dr. Hemanta Mishra, Dept. of National Parks and Wildlife Conservation, National Parks Building, PO Box 3712, Babar Mahal, Katmandu (also with the King Mahendra Trust for nature Conservation)

Dr. Samar Bahadur Malla, Dept. of Medicinal Plants, Thapathali, Katmandu

Mr. Pralad B. Yonzon and Dr. Malcolm L. Hunter, Jr., Dept. of Wildlife, 240 Nutting Hall, University of Maine, Orono, ME 04469 USA (red pandas)

Mr. Uday Raj Sharma and Mr. B.N. Upreti, Dept. of National Parks and Conservation, PO Box 860, Katmandu

Dr. C. Wemmer, Assistant Director of Conservation, National Zoo Conservation Center, Front Royal, Virginia, USA (Nepalese cats)

Dr. S.D. Schemnitz, US Education Foundation, PO Box 380, Katmandu

Dr. P.A. Jordan, Dept. of Fisheries and Wildlife, University of Minnesota, 1980 Folwell Avenue, St. Paul, MN 55108 USA

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BANGLADESH

LEADING PARTICIPANT: Colwell

PERSPECTIVES
It is not difficult to agree upon what areas need conserving because so much of the areas original ecosystems have already been eliminated. Only 0.22% of Bangladesh's lands are protected in any way, and it is near the bottom in this regard among the world's nations.

RECOMMENDATIONS: PRIORITY AREAS
Sundarbans mangrove forests
Chittagong Hills

RECOMMENDATIONS: RESEARCH
1) Biotechnology can be used in degrading chemical pollutants; 2) Biological control agents need to be developed for agriculture, rather than capital-intensive pest controls of Western industrialized agriculture. But in-situ conservation of the remaining natural areas is highest priority; no laboratory technology holds forseeable promise for maintaining the species and ecosystems in this country.

RECOMMENDATIONS: INSTITUTION BUILDING
Microbiological Resource Centers (MIRCENS) are important for _ex situ_ work on economically important microbiota.

IN-COUNTRY RECEPTIVENESS
The government is very supportive of efforts to improve food and water supplies; support for conservation of biological diversity is secondary.

SRI LANKA

LEADING PARTICIPANTS: Bawa, Perry

PERSPECTIVES
There is considerable information on vegetation types, areas of high endemism, etc. This small country is important for conserving biological diversity because it has unusually high endemism; the SW area has extraordinary levels of endemism--70-90%. The Mahaweli project failed to look at some areas that will be impacted, and and no projects are currently monitoring water quality, despite the dramatic impact of runoff from tea plantations that cover much of the country. No impact assessment was ever done for the coastal zone (including coral reefs) which are vulnerable to impacts from the Mahaweli project.

RECOMMENDATIONS: PRIORITY AREAS
SW area, especially rain forests
Sinaraja forest

IMPORTANT CONTACTS
Dr. Anne Baker-Dittus and Dr. Wolfgang Dittus, Research Division, U.S. National Zoo, Washington DC USA (primates)
F.R. Senanayake, 41 Gregorys Rd., Colombo 7 (freshwater fishes)
Dr. Peter B. Moyle, Dept. of Fish and Wildlife Biology, University of California, Davis, CA 93616 USA (freshwater fishes)
Dr. C.H. Fernando, Dept. of Biology, University of Waterloo, Waterloo, Ontario, Canada
Dr. Robert Dixon, Dept. of Forest Resources, University of Minnesota, St. Paul, MN 55108 USA (mycorrhizae, fungi and terrestrial vegetation)

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THAILAND

LEADING PARTICIPANTS: de la Cruz, Perry

PERSPECTIVES

Trees in the family Dipterocarpaceae dominate SE Asian moist forests and are important components of other forest types there. They are rapidly disappearing in Thailand and throughout SE Asia due to human activities, from agriculture to timbering (many are excellent for lumber), and, encouraged by funding from AID, are being replaced with exotic pine and other coniferous species, which should be stopped. Deforestation and tin mining have major impact on coastal marine ecosystems.

RECOMMENDATIONS: PRIORITY AREAS

Kanchanaburi Province bamboo forests on border with Burma

Doi Suthep

Mangrove swamps in south, both east and west sides, particularly near Phuket

RECOMMENDATIONS: PRIORITY SPECIES OR SPECIES GROUPS

Tilapia spp. in Dusit Palace are important genetic resources for aquaculture

see Mittermeier and Konstant, 1982

IN-COUNTRY RECEPTIVENESS

Government very supportive of research on conservation and biotechnology.

IMPORTANT CONTACTS

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Dr. Benjawen Rerkasem and Dr. Kanok Rerkasem, Dept. of Plant Sciences, Chiang Mai University, Chiang Mai (plants of north)

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Dr. Robert Dixon, Dept. of Forest Resources, University of Minnesota, St. Paul, MN 55108 USA (mycorrhizae, fungi, terrestrial vegetation

Dr. Samit Aksornkoae, Dept. of Silviculture, Faculty of Forestry, Kasetsart University, Bangkok

Dr. Hansa Chansang, Phuket Marine Biological Center, Phuket

Dr. Soren Wium-Anderson, Freshwater Biological Laboratory, University of Copenhagen, 51 Helsingorgade, DK 3400 Hillerod, Copenhagen, Denmark

USEFUL LITERATURE

Mittermeier, Russell A. and William R. Constant, eds. (1982). Species conservation priorities in the tropical forests of Southeast Asia. IUCN Species Survival Commission Occasional Paper #1. 58 pp.

INDONESIA

LEADING PARTICIPANTS: de la Cruz, Evans, Ledec, Lowery, Perry

PERSPECTIVES

Indonesia, especially East Kalimantan and Irian Jaya, has the highest tree diversity anywhere in the world. These islands support some of the best remaining Asian dipterocarp forests, but they are rapidly disappearing. Even the trees are poorly studied, with an estimated 5-10% as yet undescribed by scientists; the percentage is likely to be much higher for less conspicuous organisms. Indigenous agriculture is little studied; the most widely cultivated fruit tree, the chepadec, is unimproved and almost unknown scientifically; the government is uninterested because it lacks export potential. Natives have lived in and with these forests for a very long time, and have evolved agricultural methods that merit serious study and strengthening through modern scientific findings. The government's programs to move very large numbers of people from densely populated Java (which has very rich soils) to sparsely populated Kalimantan and Irian Jaya has been carried out with almost no consideration of the different farming systems required for sustainable production in the more pristine islands. Some areas are good for agriculture, but most of the soils are very poor. The result will be devastation of forests and continuing social upheaval. Transmigration should be stopped, at least until sustainable agricultural methods (based on indigenous methods) can be transferred to transmigrants. To fulfill government policy to become self sufficient in paper, Indonesia is rapidly replacing native forests with exotic pines, which has very damaging consequences for biological diversity. A fire in Kalimantan burned an area the size of Belgium during the recent El Niño episode. Unfortunately, Indonesian policy is that once land is burned, it is no longer national forest, so national forests are intentionally burned by those wanting more land. Kalimantan, Sumatra and Sulawesi will be completely logged out in 20 years if nothing is done. A key to preserving biological diversity of the remaining wildlands is intensifying production on lands already in use, not destroying remaining wildlands for inefficient agriculture and forestry.

RECOMMENDATIONS: PRIORITY AREAS

Cilacap, Java mangroves
Komodo Island
Forests of East Kalimantan and Irian Jaya

RECOMMENDATIONS: PRIORITY SPECIES OR SPECIES GROUPS

see Mittermeier and Konstant, 1982
all remaining rhinoceros habitat

RECOMMENDATIONS: RESEARCH

World Wildlife Fund is working in Indonesia, and is a logical place to start for collaborative efforts.

RECOMMENDATIONS: INSTITUTION BUILDING

Indonesia has reached the critical mass of scientists, but programs to speed transfer of insights from tropical ecologists would be very useful. The forest institute in Bogor is seriously underequipped, and needs financial assistance and revivification.

IMPORTANT CONTACTS

Dr. John Seidensticker, National Zoo, Washington, DC USA (mammals)

Dr. Kuswata Kartawinata, Herbarium Bogoriense, Bogor

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PHILIPPINES

LEADING PARTICIPANTS: de la Cruz, Mendoza

PERSPECTIVES

Common causes of coastal mangrove forest loss are conversion to shrimp and fish aquaculture, rice growing of salt-tolerant varieties and salt-making. Panay mangroves are gone now. Mangroves are very important to coastal and offshore fisheries; this is usually left out of cost/benefits equation. Collection of live juvenile "seed" shrimp for export to local and Japanese aquaculture operations is locally impoprtant mangrove use. There has been widespread deforestation by Japanese companies, affecting not only upland forests but also coastal forests in their watersheds. Because natural forests will be gone, tree plantations are seen as solution, so natural forests are being removed so that plantations can be emplaced. Agroforestry is a sustainable means of food production that is more benign for biological diversity than other methods. See attached paper by Dr. Guillermo Mendoza.

RECOMMENDATIONS: PRIORITY AREAS

All National Parks and Forests

Mangrove forests on Palawan (among the world's best developed, with some trees 150 ft tall) and southern Mindanao

Virgin lowland and upland forests of Palawan

MAB reserve at Puerto Gallera, Mindoro

Mt. Apo National Park Forest Reserve and grasslands

Mangrove swamps Pagbilao, Quezon

Bolinao, Pangasinan coral reefs and seagrass beds

RECOMMENDATIONS: PRIORITY SPECIES OR SPECIES GROUPS

Philippine eagle

Timaraw buffalo

RECOMMENDATIONS: RESEARCH

Agroforestry research, including scientific studies of indigenous methods, and research into balancing plantations with natural forests needed

IN-COUNTRY RECEPTIVENESS

Ironically, both the hostile relations between Moslem guerillas and the central government, and the granting of huge tracts of land to powerful generals, film stars, etc. can have benefits for conservation: it can prevent the kinds of activities that can destroy natural ecosystems.

IMPORTANT CONTACTS

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FIJI

LEADING PARTICIPANT: Ledec

PERSPECTIVES

There is still time to conserve Fiji's biological diversity. The importance of the biological resources to Fiji's important tourism industry is a strong incentive for in-country receptiveness to conservation efforts.

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INSTITUTIONS

The Ecological Society of America

Elliott A. Norse

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The word "ecology" entered national consciousness in the 1960s and 1970s, a time when public awareness of environmental problems increased dramatically, Congress enacted major environmental laws, and many environmental organizations were born. Insights from ecologists—including Aldo Leopold, Eugene Odum, George Woodwell, and Paul Ehrlich—were so influential to environmentalism that it is often called "the ecology movement" by the public and the media. It was actually the German zoologist Ernst Haeckel, however, who coined the word ecology (for the scientific study of the interrelations of organisms and their environments) a century before Rachel Carson's *Silent Spring* or Paul Ehrlich's *The Population Bomb*. To encourage the development of this young science, botanists and zoologists founded The Ecological Society of America (ESA) in 1915.

ESA is a nonpartisan, nonprofit, scientific professional society. It has some 6,500 members, nearly two-thirds of whom have Ph.D.s, throughout the United States, Canada, and 63 other nations. ESA members conduct pure and applied ecological research; some of them teach; and many participate in decision making in colleges and universities, federal and state agencies, industries, consulting companies, and conservation organizations. More than 1,000 members are undergraduate or graduate students. Most members belong to one or more of ESA's seven disciplinary sections (Vegetation, Physiological Ecology, Applied Ecology, Animal Behavior and Sociobiology, International Affairs, Paleoecology, and Aquatic Ecology); some belong to one of four geographical chapters (Western, Central Rockies, Southeastern, and Metropolitan Washington).

ESA's headquarters move yearly as each

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new president takes office. The society's council, which represents the interests of all ESA members, sets the organization's policies. The business office, which handles memberships, subscriptions, gifts to ESA, and an annual budget of about $700,000, is at Arizona State University in Tempe. Cornell University in Ithaca, New York, houses the main editorial office, and the public policy office is located in Washington, D.C.

Ecology is a discipline as diverse as life itself. Ecologists study demography and genetics of populations, physiological and behavioral adaptations of species to their environments, interactions among species, the distribution and dynamics of communities of species, and the flow of energy through ecosystems and cycling of elements within them. They may focus on plants, animals, or microorganisms; on freshwater, marine, or terrestrial life forms and processes; on tropical, temperate, or polar ecosystems.

In their work, some ecologists emphasize development of theories about the patterns of life; others experimentally test the theories in the laboratory or in the field. Many use sophisticated statistics or mathematical models. Ecologists work to discern basic ecological patterns and the processes that underlie them, and apply their understanding to the functioning of a world increasingly altered by humankind. Applied ecological subdisciplines essential to maintaining biological diversity and to human survival include ecotoxicology, agroecology, forest management, landscape ecology, and conservation biology.

From its birth, ESA has worked to improve communication among ecologists. It holds annual meetings with other scientific societies, including the American Institute of Biological Sciences, the American Society of Limnology and Oceanography, and the International Association for Ecology. These meetings feature symposia and contributed paper sessions on topics ranging from pollination ecology to environmental release of genetically engineered organisms. Other activities include field trips to nearby ecosystems and council meetings. The annual meetings attract several thousand senior scientists, students, and their guests.

ESA is best known as publisher of two scientific journals, the bimonthly *Ecology* (shorter papers) and quarterly *Ecological Monographs* (longer papers). Each year, they provide authors of some 200 original research papers an opportunity to communicate their hypotheses, study methods, and results to colleagues. The rigorous standards of 900 anonymous peer reviewers have brought these publications recognition as the world's preeminent journals in ecology. ESA also publishes the quarterly *Bulletin*, which contains opinion articles on scientific and environmental questions; a regular public policy column; and announcements of symposia, courses, and other items of interest to ecologists.

Basic ecological research on populations, communities, and ecosystems has provided insights essential to environmental protection and management. Since ESA's beginning, its members have also been instrumental to conservation efforts. In 1917, concern about the disappearance of North American wilderness led ESA's first president, Victor Shelford, to form the Committee for the Preservation of Natural Conditions for Ecological Study. In 1946, it became independent as the Ecologists' Union; it reorganized again in 1950 into what is now known as The Nature Conservancy. ESA's progeny has grown dramatically in size, budget, and sophistication to become one of the world's most effective organizations for conserving biological diversity.

Despite substantial progress on ecological issues since the first Earth Day in 1970, threats to the Earth's ecological integrity have increased. Ecologists acknowledged their special responsibility to help resolve major national and international environmental problems by opening ESA's Washington office in 1983. The office staff has consisted of a part-time public policy director and several volunteers. Despite its small size, the Washington office, drawing upon the expertise within ESA, has already made important contributions on such issues as the worldwide loss of biological diversity, the ecological consequences of nuclear war, and the environmental release of genetically engineered organisms. Issues for 1985 may include reauthorization of the Endangered Species Act, effects of global climatic change on biological diversity, and effects of acidic precipitation on forests.

One of ESA's most important means of improving the soundness of national laws and governmental programs is the Ecological Information Network. The network is a computerized data bank of over 750 ecologists who are willing to provide insights and information to decision makers in Congress, federal agencies, industry, and environmental organizations. The expertise of each participant is categorized by issue, such as restoration of surface-mined lands, ecological risk analysis, or remote sensing of ecosystems from space; by geographic area (states, regions, countries); by ecosystem; and by taxonomic group. Users can request experts who fall within two or more categories—for example, those with expertise in water quality, stream ecosystems, fishes, and southeastern states.

In practice, the user contacts ESA, which then runs a search and phones or mails back a list of experts, usually within one day and sometimes within 30 minutes. (Limitations on the funding and staffing of the Washington office may cause delays when demand is high.) The user then contacts the experts, who will respond, without cost, to relatively brief inquiries. Users requiring more time-consuming assistance, such as preparation of written analyses, are free to develop consultancy arrangements with the experts. Operation of the network is partially funded by the President's Council on Environmental Quality and the U.S. Fish and Wildlife Service. ESA does not charge for reasonable use of the network, but welcomes contributions from users.

ESA's Ecological Information Network is a computerized data bank of over 600 ecologists who are willing to provide insights and information to Congress, federal agencies, industry, and environmental organizations.

In 1980, to improve incorporation of ecological principles in decision making, ESA began a program of certifying ecologists on the basis of their education and experience. Certification recognizes the meeting of the minimum education and experience standards for professional ecologists.

Information on subscriptions to ESA journals, membership, gifts to ESA, applications for certification, and a brochure entitled "Careers in Ecology" can be obtained by writing to Dr. Duncan T. Patten, ESA, Center for Environmental Studies, Arizona State University, Tempe, Arizona 85287. To contact the Ecological Information Network, write ESA, 1601 Connecticut Ave., N.W., Washington, D.C., 20009, or call (202) 797-5566.

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THE WORLD'S GREATEST NATURAL AREAS:

An Indicative Inventory of Natural Sites of World Heritage Quality

By

IUCN's Commission on National Parks and Protected Areas (CNPPA)

For

THE WORLD HERITAGE COMMITTEE

Commission on National Parks and Procted Areas

INTERNATIONAL UNION FOR CONSERVATION OF NATURE
AND NATURAL RESOURCES

1196 Gland, Switzerland

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The presentation of the material in this document and the geographical designations employed do not imply expression of any opinion whatsoever on the part of IUCN, Unesco, or the World Heritage Committee concern the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries.

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time when *Homo sapiens* was evolving into his present form. Over 200 species of flowering plants occur, including birch, willows, and a wide range of grasses and mosses. Being an oceanic island, Iceland has few species of native terrestrial mammals – only the Arctic fox – but the bird fauna is extremely rich, including skuas, gulls, and many others.

Criteria: (i), (ii)

19. **Name of property**: ABRUZZO NATIONAL PARK

Country: Italy

Universal significance: This 30,000 ha site is located in the central part of the Apennine mountain chain, dominated by three mountain peaks of over 2,000 metres in the southeastern portion of the park. The beech forests of the park are among the most magnificent in Europe, many of them over 500 years old. The area is notable for providing an important habitat for brown bear, with a population of about 100; chamois, with a population of about 300; and wolf with a population of 15-20. The first two have endemic subspecies within the park. Red deer, roe deer, and wild boar were reintroduced beginning in 1971, after having been exterminated by human activity.

Criteria: (iii), (iv)

20. **Name of property**: AKAN NATIONAL PARK (Hokkaido)

Country: Japan

Universal significance: This 87,000 ha site in eastern Hokkaido is a volcanic area in the sub-Arctic which contains a human population of about 15,000 Ainu, the aboriginal inhabitants of Japan. Two of the volcanoes, Me-Akan and Atosanupuri, are active. The area contains a number of scenic lakes, including the fantastically crystal-clear Lake Ashu, whose transparency of over 40 metres is considered the deepest water visibility in the world. Lake Okan has a unique freshwater plant, the marino or bol weed, a deep green algae, which forms velvety spherical structures 5 to 8 cm in diameter, growing at the bottom of the lake.

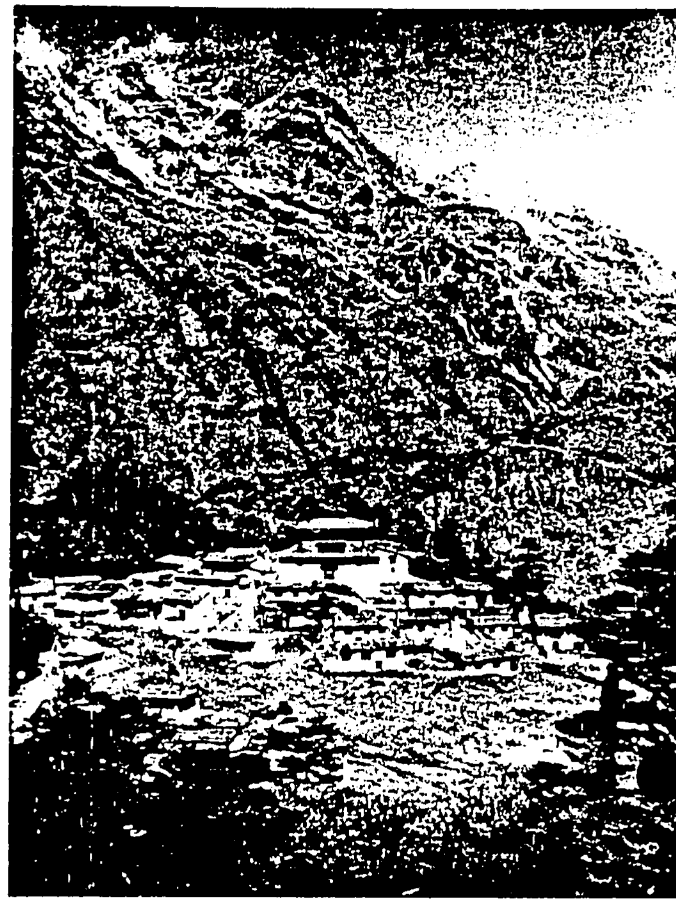
Criteria: (i), (ii), (iii), (iv) plus cultural criteria

21. **Name of property**: NIKKO NATIONAL PARK (Honshu)

Country: Japan

Universal significance: This area of 140,000 ha in northern Honshu is a harmonious blending of natural and artificial features, providing an ideal Japanese landscape. The most important cultural site is the Toshugu shrine dating from 1634-1636; it is surrounded by a vast area of mountains, lakes, and volcanoes, including four extinct volcanoes of over 2,000 metres elevation; a fifth volcano, Mt. Arsu, is still active. The landscape is still rapidly evolving, with an excellent system of lakes, swamps, and grassy plains which were lakes in the fairly recent past. Natural deciduous forests are found at lower elevations, giving way to Japanese species of conifers and finally alpine meadows. There is also an outstanding artificially planted cedar forest over 300 years old, leading up to the historical shrines at Toshugu. Mammal species in the site include the endangered Japanese serow, plus the Japanese black bear and Japanese macaque.

Criteria: (i), (iii), (iv), plus cultural criteria



Thyangbothe Monastery and Mt. Everest, Sagarmatha National Park, Nepal. (Photo peter Jackson, WWF)

22. **Name of property**: FUJI-HAKONE-IZU NATIONAL PARK (Honshu)

Country: Japan

Universal significance: This complex of 4 protected areas totals over 120,000 ha and is dominated by one of the world's most famous mountains: Fuji Yama, an important feature in the religious, social, and artistic life of Japan. With magnificent forests, scenic lakes, hot springs, and lava flows, this is one of world's most popular protected areas, with up to million visitors per year.

Criteria:

23. **Name of property**: NEMEGETU BASIN

Country: Mongolia

Universal significance: This 100 km long site contains the most important dinosaur grave yards in Central Asia, yielding large numbers of a wide variety of dinosaur species; one expedition found nearly 120 tons of fossil bones. The bones were laid down during the Cretaceous period along a major river, surrounded by ponds and lakes and a broad delta some 40 km in width; this semi-aquatic habitat was an ideal environment for the support of a large population of dinosaurs.

Criteria: (i), (ii)

24. **Name of property**: SAGARMATHA NATIONAL PARK (elected WHS 1979)

Country: Nepal

Universal significance: This site of 124,000 ha encloses the southern slopes and approaches to the world's highest mountain, the 8848m Mt. Everest or

IV. THE INDOMALAYAN REALM

1. **Name of property**: THE SUNDERBANS

Country: Bangladesh and India

Universal significance: This vast mangrove forest along the shores of the Indian Ocean is fed by three great rivers – the Ganges, the Brahmaputra, and Meghna – and lashed by occasional cyclones from the Bay of Bengal. It includes a 260,000 ha tiger reserve in the Indian part while the more extensive Bangladesh section is mostly reserved forest but no actual nature reserves have been proclaimed. It is a remarkable habitat for tigers, and the rare saltwater crocodile is found there. Marine mammals include Plumbeous, Common, Irrawaddy, and Gangetic dolphins and the Black Finless Porpoise.

Criteria: (iii), (iv)

2. **Name of property**: MANAS WILDLIFE SANCTUARY

Country: Bhutan and India

Universal significance: The Manas Wildlife Sanctuary in Bhutan covers 55,000 ha of Himalayan foothills covered with deciduous forest through which the Manas River debouches onto the plains of Assam. It adjoins India's Manas Wildlife Sanctuary and Tiger Reserve covering an area of 283,700 ha and they share a wide selection of fauna, including tiger, Great Indian one-horned rhinoceros, elephant, wild buffalo, clouded leopard, great pied hornbill and other hornbill species: many of these species are typical of the southeast Asian rainforest and find their westernmost habitats here. Manas Bhutan also has golden langur, an endemic species of monkey discovered only recently.

Criteria: (iii), (iv)

3. **Name of property**: LITTLE RANN OF KUTCH WILD ASS SANCTUARY (Gujarat)

Country: India

Universal significance: This salt marsh on the west coast of India is the last home of the Indian wild ass *Equus hemionus khur*. Covering 490,000 ha, the sanctuary provides a habitat to some 800 of these interesting and genetically important relatives of domestic donkeys. The Rann is a flat, salt-impregnated wilderness where almost nothing grows; it is covered by some 60 cm of water during the rainy season, much of it blown up from the Kutch Gulf to the southwest by strong monsoon winds. These salt flats are interspersed with slightly higher grounds of salt-free sandy soils which support grass, shrubs, and a few stunted trees and provide the sustenance for the Wild Asses.

4. **Name of property**: GIR FOREST LION SANCTUARY AND NATIONAL PARK (Gujarat)

Country: India

Universal significance: The 140 sq km national park is part of the larger lion sanctuary, which covers 1,412 sq km; it is the last home of the Asiatic lion *Panthera leo persica*, which numbered 205 at the last census in 1979. The sanctuary contains populations of a wide range of Indian fauna, including prey species for the lion such as nilgai, gazelle, sambar deer, spotted deer, and four-horned antelope and marsh crocodiles *Crocodylus palustris*.

Criteria: (iv)

5. **Name of property**: KANHA TIGER RESERVE AND NATIONAL PARK (Madhya Pradesh)

Country: India

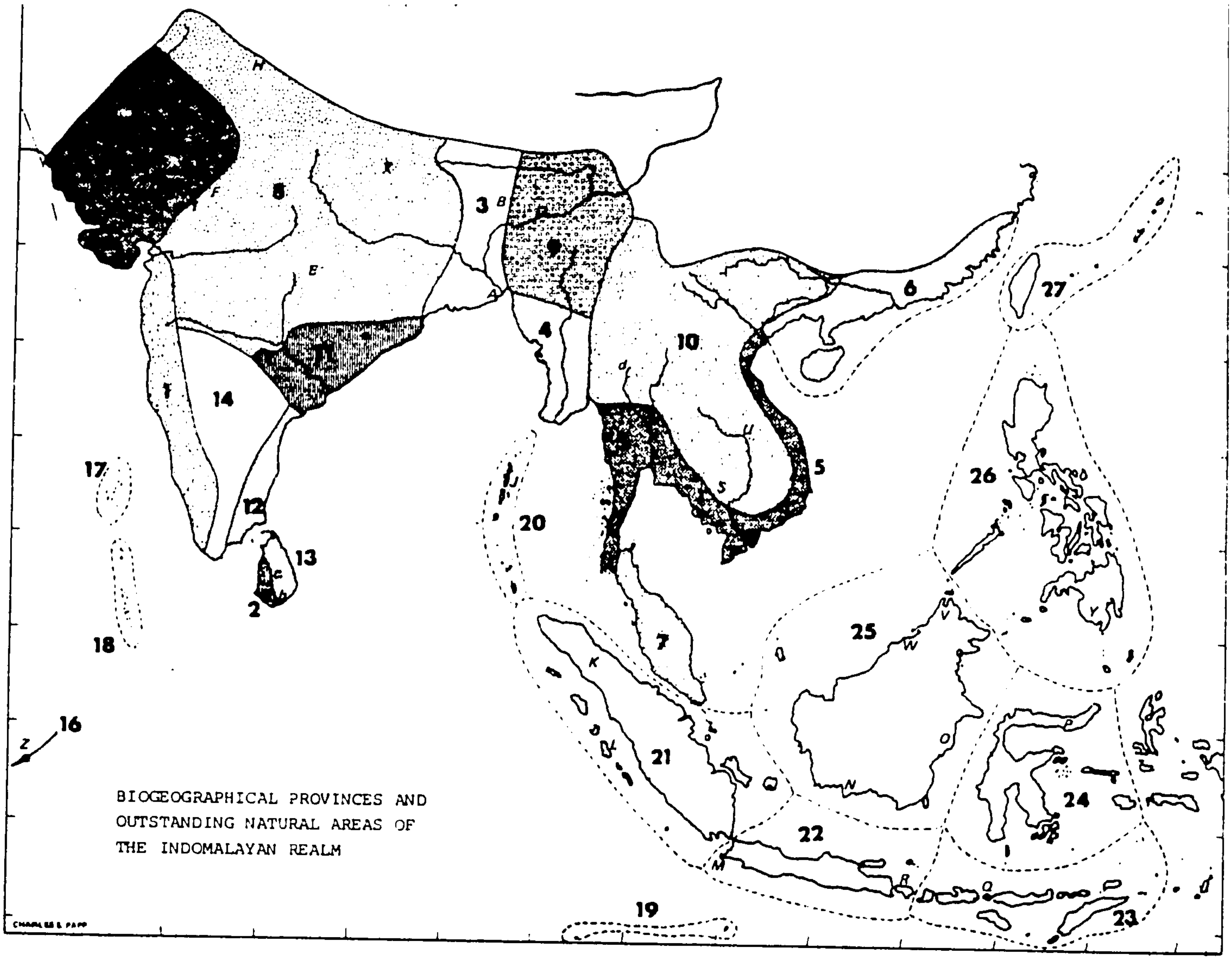
Universal significance: This site contains 45,000 ha of rolling hills in the Satpura Range, forming a vast amphitheatre some 8 km in diameter hemmed in by hills and covered with sal (*Shorea robusta*) forest interspersed with grasslands. One of India's most spectacular tiger sanctuaries, it also has the only remaining population of the southern race of the swamp deer, the barasingha; other species include sloth bear, sambar, barking deer, spotted deer, wild dog, gaur and blackbuck (the latter three being Endangered). Important research on the tiger and its various prey species has been carried out in Kanha.

Criteria: (iii) (iv)

6. **Name of property**: KEOLADEO GHANA NATIONAL PARK (Rajasthan)

Country: India

Universal significance: This small reserve of 2,800 ha is one of the most spectacular concentrations of breeding and migratory birds in the world. Once the duck-hunting preserve of the Maharajas of Bharatpur, the site is frequented by migratory ducks and geese in winter and provides sanctuary for numerous indigenous breeding birds in summer, when the natural depression fills with water to become a shallow lake; openbill stork, painted stork, 3 species of egrets, white ibis, spoonbills, Sarus cranes, and many others have important roosting sites in Keoladeo Ghana and the critically endangered Siberian Crane depends on the area for its survival.



BIOGEOGRAPHICAL PROVINCES AND OUTSTANDING NATURAL AREAS OF THE INDOMALAYAN REALM

7. **Name of property**: KAZIRANGA NATIONAL PARK (Assam)

Country: India

Universal significance: This site of 43,000 ha is the best example of the Brahmaputra flood plain, where the mighty river is unleashed at its most violent each monsoon rainy season; the annual floods have prevented any human settlement, so the area is the best remaining habitat of the Great Indian One-horned Rhinoceros, supporting about a thousand of these archaic beasts. Kaziranga is a conservation success story, as protection has brought the rhino population back to a healthy state from a perilous low of just 12 individuals in 1908. It is also the best remaining habitat of the Endangered Wild Water Buffalo (an important genetic resource) and contains healthy populations of Elephants, Northern Swamp Deer, and Tigers (all Endangered).

Criteria: (iii) (iv)

8. **Name of property**: NANDA DEVI SANCTUARY (Uttar Pradesh)

Country: India

Universal significance: This is an outstandingly beautiful natural sanctuary in the Garwal Himalayas, with a virtually inaccessible basin surrounded by 6,000 m and 7,000 m peaks and capped by the 7,817 m peak of Nanda Devi. Containing a representative sample of Himalayan fauna, including snow Leopard, Musk Deer, Goral, Himalayan Tahr, and Blue Sheep, [illegible] Sanctuary was totally isolated from mankind u[illegible] 1934, when explorers found a remarkable glacially-carved basin with rich pastures and a veritable Garden of Eden where herds of Himalayan ungulates grazed, innocent of all fear of man. While human penetration has destroyed the virgin nature of the site, there is still some of the world's most spectacular scenery and healthy populations of wildlife.

Criteria: (i), (iii), (iv)

9. **Name of property**: RANTHAMBHORE WILDLIFE SANCTUARY (Rajasthan)

Country: India

Universal significance: This site of 40,000 ha is a gem of lake and green vegetation surrounded by dry sub-desert country. The undulating Vindhya hills, with steep slopes and gently sloping flat lands on the hill tops, support lush deciduous forests with occasional open grasslands. Scattered pools and evergreen glades in small moist pockets remain even in the dry season, providing an excellent habitat for Sambar (which occurs here in its densest population, forming the only

MAP 4. OUTSTANDING NATURAL AREAS OF THE INDOMALAYAN REALM

BIOGEOGRAPHICAL PROVINCES

1. Malabar Rainforest
2. Ceylonese Rainforest
3. BengalianRainforest
4. Burman Rainforest
5. Indochinese Rainforest
6. South Chinese Rainforest
7. Malayan Rainforest
8. Indus-Ganges Monsoon Forest
9. Burma Monsoon Forest
10. Thailandian Monsoon Forest
11. Mahanadian
12. Coromandel
13. Ceylonese Monsoon Forest
14. Deccan Thorn Forest
15. Thar Desert
16. Seychelles and Amirantes Is.
17. Laccadives Islands
18. Maldives and Chagos Islands
19. Cocos-Keeling Christmas Is.
20. Andaman and Nicobar Islands
21. Sumatra
22. Java
23. Lesser Sunda Islands
24. Celebes
25. Borneo
26. Philippines
27. Taiwan

OUTSTANDING NATURAL SITES

A. The Sunderbans (Bangladesh and India)
B. Manas Wildlife Sanctuary (Bhutan and India)
C. Little Rann of Kutch Wild Ass Sanctuary (India)
D. Gir Forest Lion Sanctuary and National Park (India)
E. Kanha Tiger Reserve and National Park (India)
F. Keoladeo Ghana National Park (India)
G. Kaziranga National Park (India)
H. Nanda Devi Sanctuary (India)
I. Ranthambhore Wildlife Sanctuary (India)
J. Andaman Islands (India)
K. Gunung Leuser National Park (Indonesia)
L. Siberut Island (Indonesia)
M. Ujung Kulon National Park (Indonesia)
N. Tanjung Puting Game Reserve (Indonesia)
O. Kutai Game Reserve (Indonesia)
P. Dumoga-Bone National Park (Indonesia)
Q. Komodo National Park (Indonesia)
R. Island of Bali (Indonesia)
S. Angkor Wat National Park (Kampuchea)
T. Elephant Mountains Cardamon Mountains (Kampuchea)
U. Bolovens Plateau (Laos)
V. Kinabalu National Park (Malaysia)
W. Niah Cave (Malaysia)
X. Royal Chitwan National Park (Nepal)
Y. Rainforests of Southern Mindanao (Philippines)
Z. Valle de Mai (Seychelles)
a. Sinharaja Forest Reserve (Sri Lanka)
b. Yala Ruhuna National Park (Sri Lanka)
c. Horton Plains (Sri Lanka)
d. Huay Kha Khaeng Wildlife Sanctuary (Thailand)
e. Langbian Plateau (Vietnam)

The Indian Tiger, a species found in several of India's outstanding reserves. (Photo: WWF)

The Great Indian Rhinoceros in Kaziranga National Park, India. (Photo E.P. Gee, WWF)

known herds of this deer), Indian Gazelle, and Nilgai, along with abundant Tigers. The huge Rajput fort on top of the cliff which overlooks the main lake adds a cultural dimension to the sanctuary.

Criteria: (ii), (iii), (iv), plus cultural criteria

10. **Name of property**: ANDAMAN ISLANDS

Country: India

Universal significance: Located in the Bay of Bengal, the Andaman Islands have a fascinating wildlife and human culture; abundant undisturbed rainforest covers much of the islands, down to scenic beaches, fringing coral reefs, and abundant marine life in an area still unpolluted by soil erosion or industrial activity. Some 3000 species of plants occur, about 10 percent of which are endemic. The native people of the Andamans include pygmy hunter-gatherers of the type thought to have once been dominant in southern and southeastern Asia; particularly important groups which are in danger of cultural, if not physical, extinction include the Jarawas, Sentinelese, Onges, and Shompens.

Criteria: (ii),(iii), plus cultural criteria.

11. **Name of property**: GUNUNG LEUSER NATIONAL PARK (Sumatra)

Country: Indonesia

Universal significance: This site of 950,000 ha contains a wide range of vegetation and soil types, supporting Indonesia's richest fauna in any protected area: 105 species of mammals, 313 of birds, and 94 of reptiles and amphibians have been recorded from Gunung Leuser. Endangered species include the orangutan, siamang, tiger, golden cat, clouded leopard, elephant, Sumatran rhinoceros, and serow; for the Sumatran rhino and Sumatran orangutan, Gungung Leuser is the best habitat in the world. Scientific research has been carried out on a number of wildlife species for over 10 years. The site is a Biosphere Reserve.

Criteria: (ii), (iii) (iv)

12. **Name of property**: SIBERUT ISLAND (Sumatra)

Country: Indonesia

Universal significance: This island of 4,480 sq km has been isolated from the mainland of Sumatra for at least 500,000 years and its flora and fauna have evolved in isolation from the dynamic evolutionary events of the Sunda Shelf. About 15% of the plants are endemic to Siberut but the fauna has been even more affected by isolation, with 10 endemic species of mammals, including four primates: Kloss gibbon, Mentawai Macaque, snub-nosed langur, and Mentawai langur; each of the primates has retained primitive characteristics for their groups, making them particularly important for the study of primates. The bird fauna includes one endemic species, the Mentawai scops owl, plus 13 endemic subspecies; 27 families of Sumatran birds do not occur on Siberut, giving the avifauna composition quite a different character than on the mainland. The island also has some of the most interesting indigenous people found in Indonesia, with a prosperous hunting, gathering and gardening culture based on sago palm. This site is a Biosphere Reserve.

Criteria: (i), (ii), (iii), (iv) plus cultural criteria

13. **Name of property**: UJUNG KULON NATIONAL PARK (Java)

Country: Indonesia

Universal significance: This 60,000 ha national park is a triangular peninsula attached to the mainland by a narrow low-lying isthmus only 2 km wide; this isolation has protected what is the best fauna in all of Java. Foremost among the animals occurring is the Javan rhinoceros, of which 60 survive in Ujung Kulong (they are probably extinct everywhere else). Other endangered species include leopard, Javan gibbon, banteng, wild dog, Javan leaf monkey. The site also includes Krakatau volcano, the site of the largest volcanic eruption in recorded history; its eruption in 1883 caused tidal surges all along the coast of Java and Sumatra which killed some 36,000 people.

Criteria: (iv)

14. **Name of property**: TANJUNG PUTING GAME RESERVE (Kalimantan)

Country: Indonesia

Universal significance: This 300,000 ha reserve contains an outstanding example of swamp forests, varying from the mangrove forest at the sea edge through swamp and bog forest of several types. The reserve is noted for its dense populations of primates including orangutans, with a population density of 2 per square kilometre; at least seven other primates occur, including the spectacular proboscis monkey, endemic to the island of Borneo. Endangered species found in the reserve include clouded leopard, and false gavial. This site is a Biosphere Reserve.

Criteria: (iv)

15. **Name of property**: KUTAI GAME RESERVE (Kalimantan)

Country: Indonesia

Universal significance: This 200,000 ha reserve contains the finest example of lowland tropical rainforest in Kalimantan. There are many different forest types, depending on soils, water regime, and human disturbance. The flora is extremely rich in large trees: 180 species have been recorded in just 1.2 ha. The primate fauna is superb, with at least 10 species present including the Borneo endemic proboscis monkey and the Bornean gibbon, the latter with a population density of 12 per sq. km, one of the highest recorded; the orangutan population is also high, with a density of 3 per sq. km. Three hundred species of birds have been recorded, which includes 83% of all forest dwelling species reported from Borneo.

Criteria: (ii), (iii), (iv)

16. **Name of property**: DUMOGA-BONE NATIONAL PARK (Sulawesi)

Country: Indonesia

Universal significance: This 330,000 ha area is the best habitat for Sulawesi's remarkable assemblage of endemic species; over 90% of its terrestrial mammals are found nowhere else, along with 40% of its breeding bird species. Endangered species found in Dumoga include the babirusa, the lowland and highland anoa, the tarsier, black macaque, giant Sulawesi civet, and the Sulawesi phalanger. Another outstanding feature is the bird fauna, including two species of megapodes: the maleyo fowl, which buries its eggs in sandy soil near hot springs or other naturally heated sites; and the scrub chicken, whose eggs incubate in decomposing vegetation.

Criteria: (iv)

17. **Name of property**: KOMODO NATIONAL PARK (Nusatengara)

Country: Indonesia

Universal significance: This 60,000 ha national park is composed of three main islands (Komodo, Rinca, and Padar), located in the straits between Flores and Simboa. The reserve is famous for the Komodo dragon, locally called "ora". Discovered only in 1910, it is the most massive living lizard, with large males often weighing over 90 kg and exceeding 3 metres in length. With a total population of about 5,000, ora occur in all habitats, scavenging or hunting their own prey. The mammalian fauna is relatively poor, but it does include an endemic genus of rodent.

Criteria: (iv)

18. **Name of property**: ISLAND OF BALI

Country: Indonesia

Universal significance: This 400,000 ha island is one of the garden spots of the world. Its human population of 2.5 million has evolved a highly aesthetic relationship with the volcanic island; the rice fields and gardens are surrounded by protected mountains, sacred springs, and forests protected by custom. At the eastern most extension of the faunal realm of mainland Asia, Bali has the relics of typical fauna which until recent times included tigers. Bantang cattle, which are wild elsewhere in the world, have been domesticated by the Balinese for use in the fields.

Criteria: (ii), plus cultural criteria

19. **Name of property**: ANGKOR WAT NATIONAL PARK

Country: Kampuchea

Universal significance: While the main attraction of this national park is the incomparable complex of great temples from the Angkor Wat civilization, the wildlife of the 10,000 ha site is also significant, including Endangered species such as Banteng, Eld's deer, Tiger, Siamese Fresh-water Crocodile, and a wide range of others. It also shows the typical habitat in which one of the world's great civilizations evolved along with the wildlife which co-existed with the mighty cities; some of the stone carvings show large concentrations of Elephants, abundant fish in the Great Lake, and the now nearly extinct Kouprey (the world's rarest bovine).

Criteria: (ii), plus cultural criteria

20. **Name of property**: ELEPHANT MOUNTAINS-CARDAMON MOUNTAINS

Country: Kampuchea

Universal significance: Stretching along the southern portion of Kampuchea is a range of forest covered mountains with very high rainfall on the southern slopes which supports a tropical evergreen forest, and drier conditions on the north slope where there is tropical deciduous forest; on the Kirirom plateau is a natural pine forest, a very rare feature in this part of the world. Wildlife includes elephants, tigers, clouded leopards, and pileated gibbons, among many others.

Criteria: (ii), (iii), (iv)

21. **Name of property**: BOLOVENS PLATEAU

Country: Laos

Universal significance: The Bolovens Plateau has what is probably the most extensive and least disturbed tropical evergreen forest in the entire Anomite chain, with a rich endemic wildlife including douc languar, Lao marmoset rat, red vented barbet, bar-bellied pittar, and many others. Pilleated gibbons, elephants, tigers, and a number of other threatened species occur on this basalt plateau.

Criteria: (ii), (iii), (iv)

Tropical rainforest in Sumatra's Gunung Leuser National Park

Proboscis monkey in Kalimantan - Tanjung Puting Nature Reserve, Indonesia. Photo: J. A. McNeely

22. **Name of property**: KINABALU NATIONAL PARK

Country: Malaysia

Universal significance: This 71,000 ha site stretches from 150m elevation up to the top of Mount Kinabalu (4101 m). This is the highest mountain of Borneo, and contains a broad range of vegetation types, from the typical Malaysian tropical rainforest through mixed forest with conifers up to alpine vegetation related to Chinese and Himalayan species. With the rich vegetation, there is a similarly rich animal life, including some 12 endemic forms of mammals, several of them relics of the colder periods of the Pleistocene period. Over 400 species of birds have been recorded.

Criteria: (ii), (iii), (iv)

23. **Name of property**: NIAH CAVE

Country: Malaysia

Universal significance: This giant limestone cave 16 km inland from the sea on the north coast of Sarawak includes enormous populations of edible nest swiftlets and a rich fauna of bats. Humans have lived off the resources of the cave at least since the late Pleistocene, and the cave provides the best continuous record of human cultural evolution during the late Pleistocene-early Recent period; the earliest dated modern skull in Asia comes from Niah, dated 40,000 years old, and beginning about 20,000 years ago there is a continuous record of human burials of two types – flexed, seated burials without ceramics until about 4,000 B.C., and extended burials and cremations spanning the full Neolithic period from 1200 B.C. until modern times. The most important evidence of human stone tool manufacture and use in southeast Asia comes from this site.

Criteria: (ii), (iii), (iv), plus cultural criteria.

24. **Name of property**: ROYAL CHITWAN NATIONAL PARK

Country: Nepal

Universal significance: This 55,000 ha area of deciduous forest and grasslands in the Chitwan *dun* (interior valley parallel to the outer ranges of the Himalayan foothills) is drained by the Rapti River, whose annual floods provide a constantly changing mosaic of grasslands, riverine forests, palm thickets, swamps, and oxbow lakes. Probably Nepal's best wildlife area, it contains the only tiger population whose ecology has been closely studied over a long period of time. The park also supports about 300 Great Indian One-horned Rhino (its only habitat in Nepal and its westernmost distribution), Marsh Crocodile, and Gharial, the latter in one of the main surviving concentrations. Other important species include Gaur, Sloth Bear, and Leopard.

Criteria: (iii), (iv)

25. **Name of property**: RAINFORESTS OF SOUTHERN MINDANAO

Country: Philippines

Universal significance: The rugged mountains of southern Mindanao are covered in a dense and uncharted rainforest where a human culture known as the Tassady was able to survive undiscovered until the early 1960s. This small group of shy and graceful forest-dwellers has an intimate knowledge of the resources of the difficult forest habitat, being excellent hunters of small animals and birds and having an encyclopaedic knowledge of edible and medicinal plants. But these people are threatened by cultural disintegration as they are brought into the 20th century; their knowledge could be lost unless appropriate conservation measures are taken.

Criteria: (ii), plus cultural criteria

The world's largest seed the coco-de-mer found only in the Valle de Mai, Seychelles Photo Christian Zuber WWF

26. **Name of property**: VALLE DE MAI (Praslin Island)

Country: Seychelles

Universal significance: The Valle de Mai is the habitat of some 4,000 coco de mer palms, one of the botanical wonders of the world. This palm produces the world's largest seed, whose large size and shape captured the imagination of early travellers throughout the Indian Ocean region. Just 18.5 ha in size, the site has luxuriant tropical vegetation which shows how much of the Seychelles must have been before human disturbance. The area also contains a number of endemic species of animals and plants, and provides a habitat for the rare Praslin black parrot.

Criteria: (iv)

27. **Name of property**: SINHARAJA FOREST RESERVE

Country: Sri Lanka

Universal significance: Sinharaja is the last surviving example of a viable size of Sri Lanka's tropical rainforest. As a remnant of Gondwanaland vegetation (descending from the time when the southern continents were all joined together), it has had an extremely long evolutionary history which is quite separate from that of nearby southern India. About 60 percent of the tree species are endemic (found nowhere else), and 16 of these species are considered very rare; many of the plants are of medicinal or agricultural importance.

Parallel to plant endemism, there are many endemic animals, including mammals such as the golden plam civet and the rusty-spotted cat (possibly the world's smallest), 18 of Sri Lanka's 21 endemic birds (including 3 which are endangered), and dozens of endemic reptiles and amphibians.

Criteria: (ii), (iv)

28. **Name of property**: YALA/RUHUNA NATIONAL PARK

Country: Sri Lanka

Universal significance: Nestling in the southeast corner of Sri Lanka, Yala is a curious mixture of rocky outcrops, scrub jungle, and plains laced with fresh water lakes and brackish lagoons; its eastern boundary is the sea, with high sand dunes and broad beaches. The backbone of the area is the Menik River. The 101,000 ha site is outstanding for easily viewable elephants and leopards, whose behaviour on an island lacking tigers is much bolder. Other outstanding attractions are the Sloth Bears and the plentiful and magnificent Peacocks. Sambar and Spotted Deer occur throughout the site, often in rather large populations. The area also supports two mammals endemic to Sri Lanka, the Golden Palm Civet and the Rusty-spotted Cat.

Criteria: (iii), (iv)

Asian elephants in Yala Ruhuna National Park, Sri Lanka. (Photo F. Vollmar, WWF)

29. **Name of property**: HORTON PLAINS

Country: Sri Lanka

Universal significance: Lying in the uplands of central Sri Lanka, the Horton Plains is often considered the most scenic part of the country. Forest types vary from tropical rainforest to open grasslands, dotted with Spotted Deer, Sambar, and Elephants. About half of the plants are endemic to Sri Lanka, making this area very significant for genetic resource conservation.

Criteria: (ii), (iii)

30. **Name of property**: HUAY KHA KHAENG WILDLIFE SANCTUARY

Country: Thailand

Universal significance: Located in the remote hills of western Thailand, and draining into the famous river Kwae Kwae. There is a wide range of habitat, with dry evergreen forests along the river courses and mixed deciduous forest higher up, and dry dipterocarp on the ridges where soils are poor; there are also extensive open grasslands and scattered groves of bamboo of a number of species. The area is one of the wildlife treasure chests of the world, with no less than five species of macaque monkeys occurring within its boundaries. It contains the last herd of wild buffalo remaining in Thailand, as well as guar and bantang, three species of considerable importance as genetic resources. Tigers, leopards, clouded leopards and a host of smaller predators feed on the various species of deer which occur in the area, including the rare Fea's muntjac.

Criteria: (ii), (iii), (iv)

31. **Name of property**: LANGBIAN PLATEAU

Country: Vietnam

Universal significance: Located in the mountains of Tuyen Duc and Darlac provinces in southern drainage of the Sre Pok river, this is a very important centre of endemism for Indochina, including such endemic forms as the Langbian rat, collared laughing thrush, grey crowned crocias, short-tailed scimitar badler, and Germain's peacock pheasant.

Criteria: (ii), (iii), (iv)

V. THE OCEANIAN REALM

1. **Name of property**: MARINE LAKES OF PALAU

Country: Republic of Belau

Universal significance: Elevated above sea level more than 20 million years ago, ancient coral reefs have been eroded away to form the numerous salt water lakes of southern Palau. The salt water lakes form stable, small scale models of oceanic systems, each a naturally formed marine laboratory with different characteristics.

Criteria: (i), (ii), (iii)

2. **Name of property**: VILLAGE OF NAN MADOL (Ponape)

Country: Caroline Islands

Universal significance: Built some 700 years ago, the village of Nan Madol on Ponape shows Pacific man as he lived in balance with his marine environment. The ruins spread over some 70 ha and consist of some 92 artifical platforms (some as high as 11 metres), each made of massive pentagonal or hexagonal pillars of basalt, built up from the shallow lagoon on the eastern side of the island and separated by canals for transportation. The most spectacular monument is the chiefly burial of Nan Douwas, sometimes considered the most remarkable example of prehistoric stone architecture known from anywhere in Oceania: covering an area 60 by 65 metres and protected by walls 10.5 m high and 8.5 m thick, the structure contains a number of separate tombs built of basalt prisms and containing a great wealth of archaeological materials which allow scientists to reconstruct the life of these ancient mariners.

Criteria: (ii), plus cultural criteria.

3. **Name of property**: RAPA NUI NATIONAL PARK

Country: Chile

Universal significance: This 6,800 ha national park consists of the famous "Easter Island", with fascinating remains of an extinct megalithic culture which worked the volcanic rocks into giant statues which were erected throughout the island. There are also numerous smaller carvings, many depicting the sea birds on which the people depended for food. The scenery is spectacular, with volcanoes and rugged coastlines; being located far from any mainland, Rapa Nui has developed a number of endemic species, including about a third of its plants.

Criteria: (ii), (iii), (iv), plus cultural criteria.

4. **Name of property**: ISLAND OF TAHITI

Country: France (French Polynesia)

Universal significance: Tahiti is the quintessence of romantic Polynesia. Seen from the sea, it is a wild, rugged, untamed island, with volcanic peaks towering into the sky. Surrounded by a protective reef and calm lagoon, the coastal lowlands have been settled by Polynesians for perhaps a thousand years. But the bulk of the island is a precipitous wilderness, covered in verdant vegetation which is virtually impenetrable; giant tree ferns, wild bananas, and magnificent chestnuts cover the mountainsides. Of particular scenic interest – once the colourful coastline has been left behind – is Lake Vaihiria, the only high volcanic lake in Polynesia. Some 500 m above sea level, the lake is said by local people to be bottomless; it is populated by giant black eels, thick as a man's thigh.

Criteria: (ii), (iii)

5. **Name of property**: GUNUNG JAYA NATURE RESERVE (Irian Jaya)

Country: Indonesia

Universal significance: This 2 million ha reserve stretches from sandy tropical beaches to the permanently snow-clad summit of Mt. Jaya, at 5,030 m the highest point in Southeast Asia and the highest insular mountain in the world. It includes the widest range of vegetation classes possible in Indonesia, ranging from lowland rainforest up to ephemeral forbland. It has a large number of New Guinea's endemic species, including the monotreme echidna and a wide variety of marsupials, including forest wallaby, marsupial cat, tree kangaroo, and many others. Although no census of birds has been undertaken, the reserve is known to contain a number of birds of paradise, cassowaries, bower birds, crowned pigeons, and many species of parrots, cockatoos, and lories.

Criteria: (i), (ii), (iii), (iv)

6. **Name of property**: FOJA MOUNTAINS

Country: Indonesia (Irian Jaya)

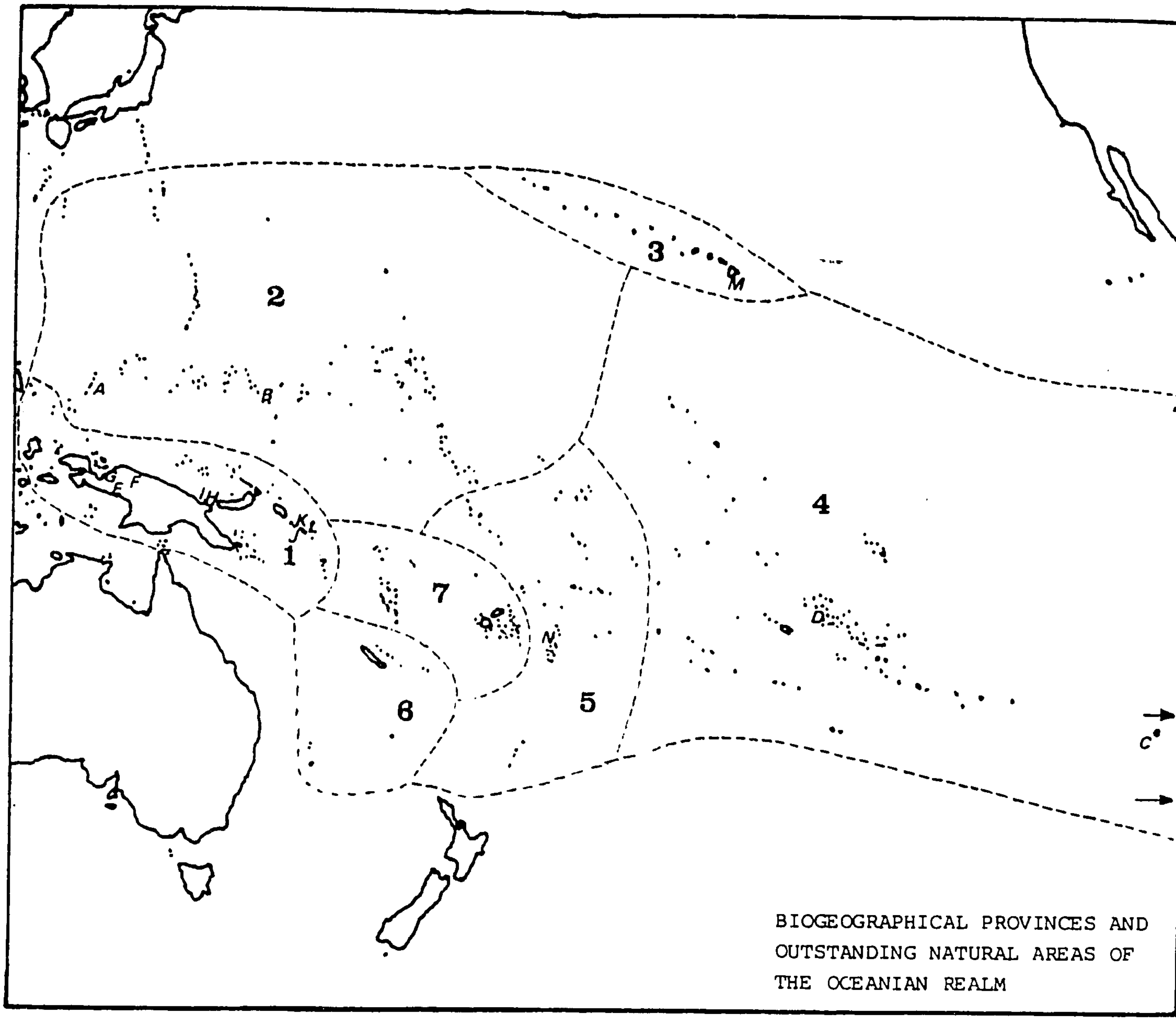
Universal significance: This area is a unique example of a tropical mountain range totally undisturbed by man, with tame mammals and an endemic species of bowerbird. Dominated by species of *Araucaria, Nothofagus, Podocarpus*, and various oaks the forest is draped with moss, lichens, and epiphytes. While there are sparse human populations in the adjacent lowlands, the Foja mountains are so rugged that there is no evidence that humans had ever visited the region until a small expedition in 1979 discovered, for the first time in the wild, the Yellow-fronted Gardener Bowerbird (*Amblyornis flavifrons*); with no human hunting pressure, the fauna is remarkably tame and easy to observe.

Criteria: (iii)

7. **Name of property**: MEERVLAKTE

Country: Indonesia (Irian Jaya)

Universal significance: This site is a large (25,000 sq km) mountain-ringed basin subject to annual flooding; it is a superb habitat for crocodiles, fish, and



BIOGEOGRAPHICAL PROVINCES AND OUTSTANDING NATURAL AREAS OF THE OCEANIAN REALM

a wide range of waterfowl. The dryland forests support thriving populations of numerous species of birds of paradise, bower birds, giant pigeons, tree kangaroos, and many other species endemic to New Guinea. Due to its remoteness and difficulty of access, the area can be expected to be, within a few decades, the least disturbed area of tropical rainforest and swamp forest remaining in New Guinea.

Criteria: (ii), (iii), (iv)

8. **Name of property**: LONG ISLAND

Country: Papua New Guinea

Universal significance: This site is a volcanic island that erupted and sterilized itself around 1700 A.D., leaving a large crater lake with a new hot volcanic cone in its centre. It is of outstanding geological and biological importance, being a relatively large island which is being recolonized by a pure tramp fauna and flora.

Criteria: (ii)

9. **Name of property**: KARKAR CALDERA

Country: Papua New Guinea

Universal significance: This site is of outstanding scenic value: It is a striking vertical-wall caldera perfectly circular in form and 1,000 feet deep, set on the top of mountainous Karkar Island. This is probably the world's best example of such a formation.

Criteria: (iii)

10. **Name of property**: RENNELL ISLAND

Country: Solomon Islands

Universal significance: This island is of outstanding geological, biological, and scenic value; it includes the world's largest raised coral atoll; one of the Pacific's largest lakes (the former lagoon, now home to sea snakes and possibly unique in that respect among lakes); home of numerous endemic bird taxa, and one of the westernmost islands colonized by Polynesians.

Criteria: (ii), (iii), plus cultural criteria

MAP 5. OUTSTANDING NATURAL AREAS OF THE OCEANIAN REALM

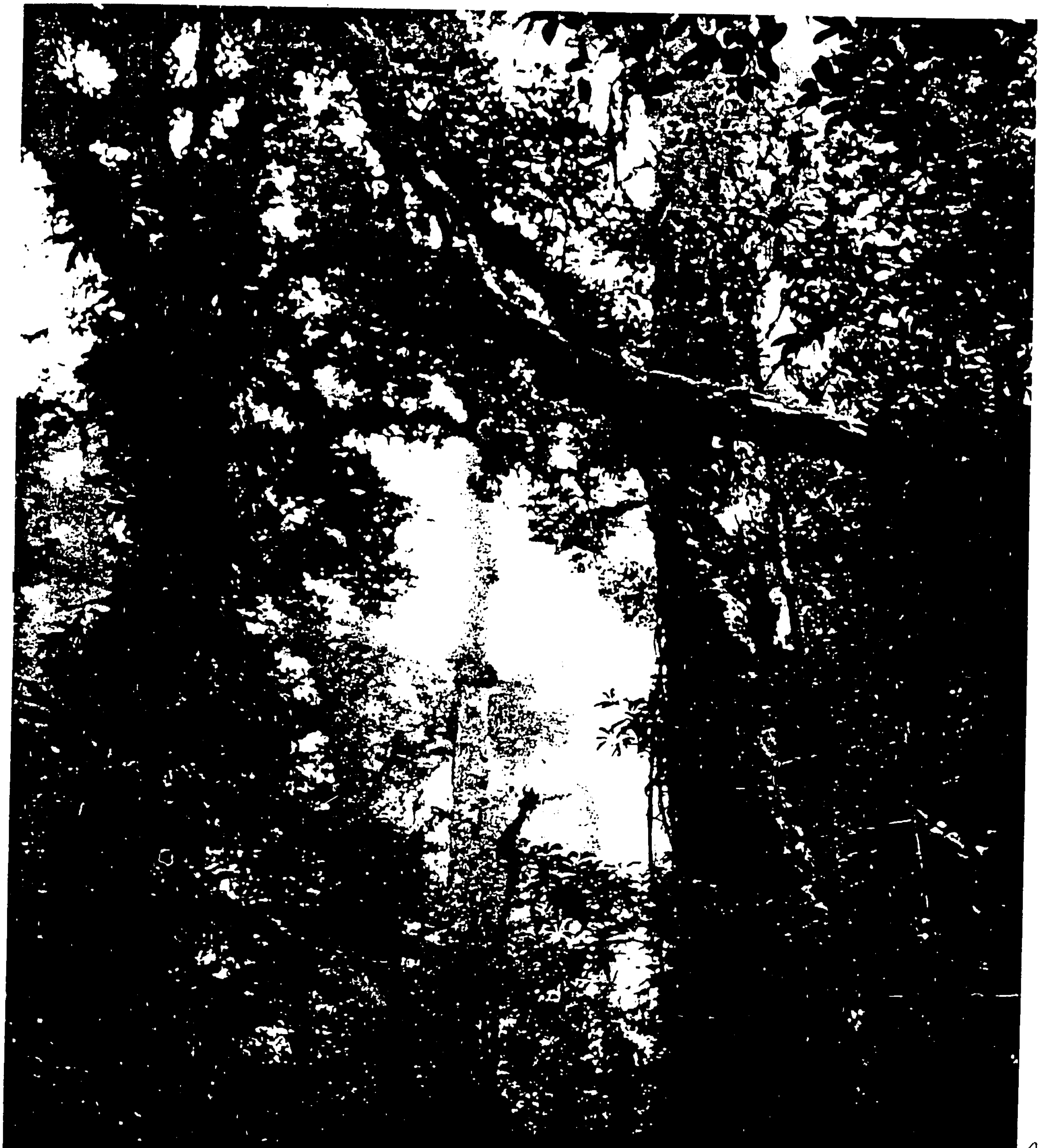
BIOGEOGRAPHICAL PROVINCES

1. Papuan
2. Micronesian
3. Hawaiian
4. Southeastern Polynesian
5. Central Polynesian
6. New Caledonian
7. East Melanesian

OUTSTANDING NATURAL SITES

A. Marine Lakes of Palau (Republic of Belau)
B. Village of Nan Madol (Caroline Islands)
C. Rapa Nui National Park (Chile)
D. Island of Tahiti (France)
E. Gunung Jaya Nature Reserve (Indonesia)
F. Foja Mountains (Indonesia)
G. Meervlakte (Indonesia)
H. Long Island (Papua New Guinea)
I. Karkar Caldera (Papua New Guinea)
J. Rennell Island (Solomon Islands)
K. Savo Island (Solomon Islands)
L. Kulambangara Island (Solomon Islands)
M. Hawaii Volcanoes National Park (USA)
N. Le Pupu-Pue National Park (Western Samoa)

Cloud forests are found in the upper elevations in Gunung Jaya, Indonesia. (Photo: Thomas Schutze-Westrum, WWF)



Country: Solomon Islands

Universal significance: This island is composed of an active volcano with sand beaches, famous for the communal nesting grounds of the Incubator Bird *Megapodius freycinet*, which lays its eggs in beach sand or near the volcano where the eggs are incubated by volcanic heat or solar heating. The birds of this family (Megapodidae) are the only birds who do not incubate their eggs by body heat; most are chicken-sized, but their eggs are 4 to 6 times the size of a chicken egg and the hatchlings are able to fly immediately upon tunnelling out of the sand. These birds are under severe pressure from egg collectors throughout their range.

Criteria: (iii)

12. **Name of property**: KULAMBANGARA ISLAND

Country: Solomon Islands

Universal significance: This island is the classic example of a symmetrical circular stratovolcano island, over 1500 m high and home to two endemic bird species. As the timber industry is rapidly logging the lowlands which form the habitat of the endemic birds, the site would belong on the List of World Heritage in Danger.

Criteria: (ii), (iv)

13. **Name of property**: HAWAII VOLCANOES NATIONAL PARK (Hawaii)

Country: USA

Universal significance: This site includes a series of active volcanoes, which are under constant observation, research, and visitation. The site includes the Mona Loa volcano, over 10,000 m high when measured from its base on the ocean floor; this makes it the largest mountain mass in the world. A side volcano, called Kilauea, is constantly active, with sulphur fumeroles, steam vents and lava flows. The site

Hawaii Volcanoes National Park, USA (Photo: 81st Fighter Wing, USAF)

also contains outstanding vegetation, including a tree fern forest, and protects a number of endangered species.

Criteria: (i), (ii), (iii), (iv)

14. **Name of property**: LE PUPU-PUE NATIONAL PARK

Country: Western Samoa

Universal significance: This site of some 2,500 ha is rough and wild, with poor soils. A lava tube 800 metres long, containing large populations of bats and swiftlets, is found in the centre of the site, surrounded by the best remaining tropical forest in Western Samoa: some 10 distinct plant communities have been identified within the park. Over 50 species of birds, reptiles and mammals are found in the area, including 21 found only in Samoa; 10 species are considered rare and endangered, of which 9 are found only in Samoa and find their most secure refuge in the national park.

Criteria: (iv)

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ANNEX I. CONVENTION FOR THE PROTECTION OF THE WORLD CULTURAL AND NATURAL HERITAGE

List of States having deposited an instrument of ratification or acceptance as at 1 September 1982

AFGHANISTAN
ALGERIA
ARGENTINA
AUSTRALIA
BENIN
BOLIVIA
BRAZIL
BULGARIA
BURUNDI
CANADA
CENTRAL AFRICAN REPUBLIC
CHILE
COSTA RICA
CUBA
CYPRUS
DEMOCRATIC YEMEN
DENMARK
ECUADOR
EGYPT
ETHIOPIA
FRANCE
GERMANY (Federal Republic of)
GHANA
GREECE
GUATEMALA
GUINEA
GUYANA
HAITI
HONDURAS
INDIA
IRAN
IRAQ
ITALY
IVORY COAST
JORDAN
LIBYAN ARAB JAMAHIRIYA
MALAWI
MALI
MALTA
MAURITANIA
MAURITIUS
MONACO
MOROCCO
NEPAL
NICARAGUA
NIGER
NIGERIA
NORWAY
OMAN
PAKISTAN
PANAMA
PERU
POLAND
PORTUGAL
SAUDI ARABIA
SENEGAL
SEYCHELLES
SPAIN
SRI LANKA
SUDAN
SWITZERLAND
SYRIAN ARAB REPUBLIC
TUNISIA
UNITED REPUBLIC OF TANZANIA
UNITED STATES OF AMERICA
YUGOSLAVIA
ZAIRE

Indonesia

Species Conservation Priorities in the Tropical Forests of Indonesia

John Mackinnon
Ismu Sutanto Suwelo

Introduction

Indonesia (Fig. 1) is one of the world's treasure houses of species diversity. Made up of some 13,000 islands stretching 6000 km, the country covers a total land area of 1,919,443 km² and spans two major biogeographical regions, the Oriental and the Australasian. The human population is the fifth highest in the world, with more than 150,000,000 inhabitants, and some of the islands such as Java, Bali and Madura are quite densely populated. On the other hand, the large islands of Sumatra, Kalimantan and Irian Jaya, which constitute about 75% of the land area of the country, are still relatively sparsely populated.

Over 1500 species of birds, 500 mammals and several thousand tree species occur in Indonesia, and the country has within its borders perhaps the most unusual mix of faunal elements anywhere on earth. The islands of Sumatra, Kalimantan (the Indonesian part of Borneo), Java and Bali are known collectively as the Sunda Islands or Great Sunda because of their shared position on the shallow Sunda Continental Shelf, which is no more than 200 m in depth and connects them with the Asian mainland. This connection was above water during the last glacial age and consequently the fauna of these islands is largely Asiatic, consisting of monkeys, apes, rhinos, tigers and sambar deer. The climate is also hot and humid, with the original vegetation being mainly rain forest. To the east of Bali are the Lesser Sundas or Nusa Tenggara, which are under the influence of Australia, both in terms of fauna and flora and in climate. The first marsupials appear in Sulawesi and the Malukus, apes and big cats are absent, and birds such as lories and cockatoos begin to replace the Asian species. The climate has a pronounced dry season and overall is generally drier than in the Greater Sundas (Veevers-Carter, 1978).

The survival of Indonesia's great species diversity is a matter of world as well as national concern, and with Indonesia's rapid population growth and speedy loss of forest and marine habitat, these valuable genetic resources, many of which are or could be used by man, are severely threatened.

The Government of Indonesia has recognized the need for conservation in order to promote the cultural and economic development of the Indonesian people in harmony with their natural environment. Government policy states that all forms of natural life and examples of all Indonesian ecosystems must be preserved for the benefit of future generations, with special emphasis on protection of the air, water, soil, plant, fish and animal resources upon which people depend (Sumardja, et al., 1984).

Conservation in Indonesia is under the jurisdiction of the Directorate of Nature Conservation and Wildlife Management (PPA), which was established within the Ministry of Agriculture in 1971 and is based in Bogor. Conservation has been achieved through the maintenance of a system of protection forests to protect water sources and soils on steep or high land, the maintenance of the system of strict nature reserves (*Cagar Alam*) and game reserves (*Suaka Margasatwa*), and the adoption of a number of laws and regulations controlling the exploitation of living resources including logging regulations, game laws, protected species laws and others (Sumardja, et al., 1984).

Faced with a multitude of conservation problems, and especially with the immediate need to preserve fuelwood and timber supplies and safeguard important river catchments, the Government of Indonesia has approved a major increase in conservation areas and protection forests. It is now planned that 30% of the land surface of Indonesia will be retained under permanent forest cover and that nearly half of this forest will be in nature reserves. Already the total area protected has risen dramatically from 4 million hectares in 1977 to a total of 11,267,540 hectares in 299 locations as of March, 1982 (Sumardja et al., 1984). Some of the most important protected areas in Indonesia are indicated in Fig. 1, and a more detailed look at protected areas on the island of Java is provided in Fig. 3.

Species Conservation in Indonesia

Selection of new reserves is done with the intention of including viable large areas of all distinct habitat types in the country. Thus, species will be conserved *in situ* by protection of their habitat. Geographical distribution and habitat preference data have been compiled for all mammal and bird species occurring in Indonesia, and there is not a single species of bird or mammal which does not have a major reserve planned within its estimated distribution. The distribution ranges of plants are not so accurately known but it is thought that here too all species will be present in at least one reserve. Most species will be contained within more than one reserve. The needs for species specific management projects are in this way greatly reduced. Eventually when island biogeographical effects play their part in trimming down the number of species surviving in isolated reserves it will be necessary to monitor populations of indicator or extinction-prone species and where necessary introduce active management such as artificially maintaining high species immigration levels between neighbouring reserves. In the meantime, however, the priority is on getting the reserves declared and physically

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established, paying attention at the species level only to those species which are not adequately protected by the protection of their habitat in reserves. These species include:

1. *Migrating species* who spend only part of their time in Indonesia and whose survival therefore depends on many factors both outside Indonesia and its reserves - e.g. migratory birds, whales, turtles etc.
2. *Resident but wide ranging species with large home ranges* - e.g. elephants, tigers, eagles, fruit bats, waterbirds who often cannot be contained or restricted within reserve boundaries.
3. *Rare species* which are represented at such low densities or which have such restricted distributions as to survive at dangerously low population levels.
4. *Species endangered by changed ecological conditions* particularly by newly introduced competitors, predators or pests.
5. *Species endangered by overexploitation* such as hunting or trade which could be exterminated despite protection of their habitat because of the impossibility of adequately guarding all the reserves.
6. *Riverine species* endangered by changes in water condition resulting from human development.

The scale of these species specific needs for attention is still quite large and the Indonesian Government has established a special Subdirectorate of Species Conservation in the Directorate of Nature Conservation to deal with these problems.

Conservation Action Priorities

1. *Migrating Species*
   Migrating birds visiting Indonesia fall into 3 main categories.

   a. Montane passerines such as wagtails, warblers, thrushes

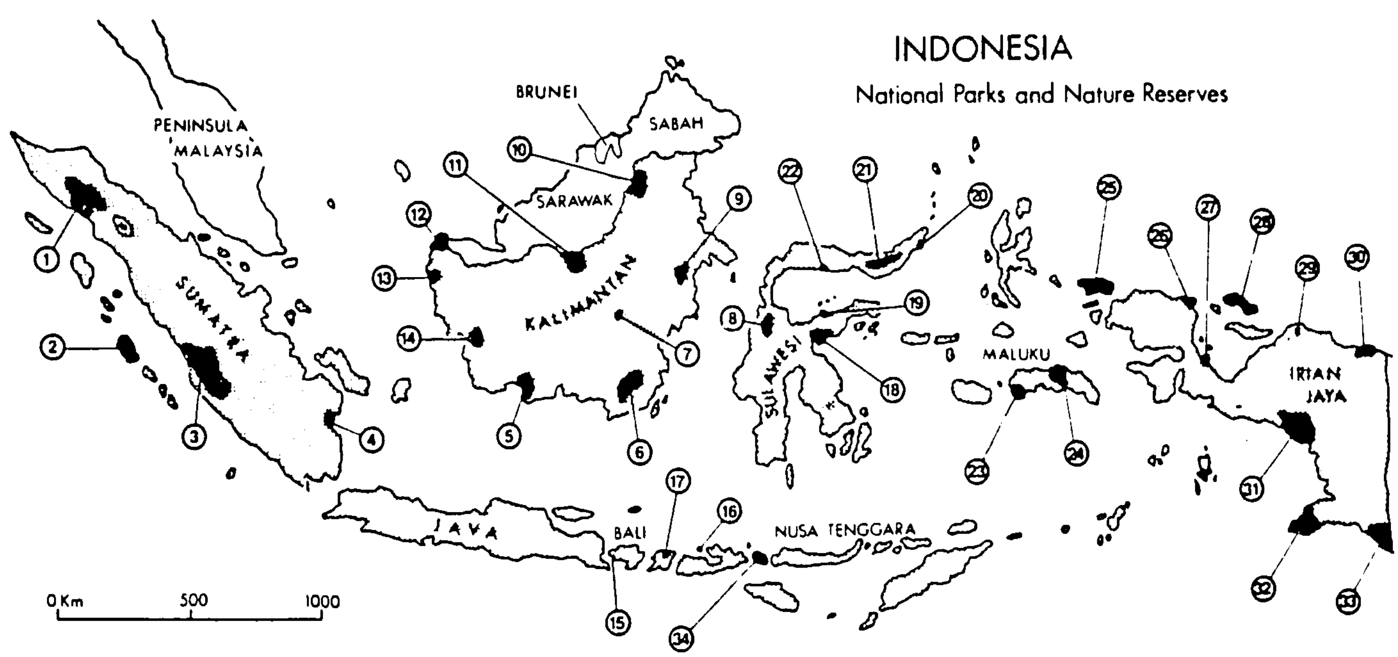

Figure 1: Map of Indonesia showing the location of national parks and nature reserves (modified from a publication by the Indonesian Directorate General of Tourism).

1. **Gunung Leuser National Park**
2. **Siberut Reserves**
3. **Kerinci Seblat Reserve**
4. **Way Kambas Reserve**
5. **Tanjung Puting Reserve**
6. **Pleihari-Martapura Reserve**
7. **Padang-Luwai Reserve**
8. **Lore Lindu Reserve**
9. **Kutai Reserve**
10. **Hulu-Bahau-Sungai Malinau Reserve**
11. **Bukit Raya Reserve**
12. **Hutan Sambas Reserve**
13. **Mandor Reserve**
14. **Gunung Palung Reserve**
15. **Bali Barat Reserve and Marine Reserve**
16. **Pulo Moyo Reserve**
17. **Gn. Rinjani Reserve**
18. **Morowali Reserve**
19. **Tanjung Api Reserve**
20. **Tangkoko-Batuangus-Dua Saudara Reserves**
21. **Dumoga Bone Reserves**
22. **Panua-Tanjung Panjang Reserves**
23. **Palau Kasa — Palau Pombo Marine Reserves**
24. **Manusela Reserve**
25. **Raja Ampat Island Reserves**
26. **Gunung Meja Reserve**
27. **Peg. Wandiwoi/Wandamen Reserve and Cendarawasih Marine Reserve**
28. **Palau Biak — Superiori Reserves**
29. **Memberamo Pegunungan Foja Rouffaer Reserves**
30. **Cyclops Mountains Reserves**
31. **Lorentz Reserve**
32. **Palau Dolok Reserve**
33. **Rawa Biru — Wasur Reserve**
34. **Komodo National Park**

etc. whose habitat needs in Indonesia are apparently adequate and no measures are being taken.

b. Waterbirds e.g. ducks, rails, pelicans etc. which are being heavily hunted in many riceland areas but for which some extensive water areas will be included in reserves and for which no other management is feasible beyond legal protected status for rare species e.g. pelicans.

c. Costal waders for which some areas of coastline are being included in reserves but many important estuaries are outside reserves and face the possibility of pollution etc. No management is at present envisaged but it would be worthwhile to plot out the main migration routes and identify the most important stopping and feeding areas to try and get these protected where necessary.

2. *Resident Species with Wide Ranges*

There are several species that fall into this category but in most cases these are common species which are often serious pests coming out of forests and reserves to eat agricultural crops e.g. some parrot species, macaque monkeys, commensal rats, wild pigs, fruit bats etc. In these cases attention for control or discouragement of these animals from coming into agricultural areas is needed but they do not constitute a species survival problem. In the case of elephants and tigers however, they do.

In Sumatra, elephant and tiger conflicts with the expanding rural population are increasing in frequency and the matter has been greatly published in news media to the point that the Minister of Agriculture is calling for control projects. This is a very difficult and sensitive area of conservation and several drafted project proposals have failed to reach the necessary support or funding to be implemented, but it is an area of high government priority, and some projects to help reduce the friction between these large, dangerous but very important species and rural human population are urgently needed.

3. *Rare Species*

Indonesia has a number of rare species - local endemics with very small distributions, for example the Javan rhinoceros, Bali starling, Bawean deer, Sumatran hare, the Mentawai primates and widespread species which occur at low population density, for example the Sumatran rhinoceros, and orang-utan.

In some cases large reserves have been established that contain all or most of surviving populations e g. Bali Barat Reserve for the Bali starling, Siberut reserve for the endemic primates, Kerinci-Seblat for the Sumatran hare, Ujung Kulon for the Javan rhinoceros, and Bawean island for the Bawean deer but in addition some attempts are being made to foster rare species by captive breeding *ex situ* e.g. Bawean deer, and Bali starling. Also the formation of additional wild populations is currently planned by ranching of Bawean deer on Madura island, the possible reintroduction of Javan rhinoceros into Sumatra, and the rehabilitation and translocation schemes for orang-utans.

4. *Species Endangered by Changed Ecological Conditions*

Indonesian examples are the endemic fish in many lakes where exotic species (e.g. *Tilapia*) have been introduced or where water hyacinths are changing local conditions.

Seed eating birds face competition from introduced munias and sparrows. The warty pig of Java faces artificially enhanced competition from the wild boar. Wildlife on all small islands are threatened by rats and cats which have been introduced.

Such problems are often extremely difficult to tackle. It is not usually possible to remove the exotic species which is causing problems and the classic conservation method for such situations is to release the endangered species on a 'clean' island as a refuge and/or captive breeding. The Javan warty pig project currently in operation will be a good test case to see what can be done in such instances in Indonesia.

5. *Species Endangered by Over-Utilization*

There are several Indonesian species endangered by overhunting or trade such as rhinoceros, wild cats, the babirusa, the anoa, crowned pigeons, birds of paradise, megapodes, some parrot species, marine turtles, crocodiles, giant clams, butterflies and many species of trees and orchids. All these endangered species are already or could be put on the protected species lists, but law enforcement in Indonesia is so difficult that this is itself no guarantee of actual protection.

Improvements to the protected species lists, improvements to control, improvements to reserve guarding, improvements of game legislation, implementation of CITES, ratification of the migrating species convention etc., all play a part in tackling these problems as does conservation education and extension work. Some management or breeding projects can be effective and in many cases the development of wildlife based industries undertaken on a sustained yield basis can in fact help to save species by giving them a value and giving people a long-term interest in their survival. Thus plans are underway to promote primate ranching, crocodile rearing, butterfly farming and parrot breeding projects which will help satisfy demands for such products as well as provide badly needed income sources to rural peoples without placing undue strain on wild populations.

6. *Riverine Species*

It is extremely difficult to protect whole rivers in nature reserves as they are so heavily used as arteries of communication, sources of irrigation, fishing areas etc. by local people. Almost no attention has been paid so far to the plight freshwater species in Indonesia but there are undoubtedly many endangered reptiles, fish, molluscs and crustaceans in the river and lake systems. Pollution and dangerous fishing methods such as the use of poisons and explosives have decimated fish population in many rivers. As fresh water rivers have high levels of local endemism many species may be lost. There are few obvious solutions to these problems but it is as well to draw more attention to the problems of this neglected group of species. It would be worthwhile to collect more information or the distribution of fresh water species so that those with very limited distribution can be identified and at the same time monitor the levels of biotic degradation in the different waterways so that the scale of this threat can be assessed.

A number of conservation action projects are currently underway, planned or already completed in Indonesia, and these are summarized in the following list:

A *General Programs of Sub-Directorate of Species Conservation*		
1 Inventorization of species distribution and status		continuing
2 Field monitoring of species status		continuing
3 Revisions to protected species lists		continuing
4. Establishment of new reserves for rare species		continuing
B. *In Situ Management Activities*		
5 Maintenance of artificial grazing areas	Ujung Kulon, Meru Betiri, Pangandaran and Baluran	continuing

6. Cutting *Arenga* palms to promote tree sapling regeneration for rhinoceros	Ujung Kulon	planned
7. Thinning of teak forests for Bawean deer	Bawean Island	continuing
8. Clearing of brush from maleo nesting areas	Sulawesi	experiments completed
9. Control of egg predators at turtle nesting beaches	various	occasional
C. ***Rehabilitation and Captive Breeding for release into Wild***		
10. Orang-utans	Ketambi (completed), Bohorok, Kutai, Tanjung Puting	ongoing
11. Gibbons	Pangandaran, Tanjung Puting	occasional
12. Bawean deer	Madura	ongoing
13. Bali mynah	Bali Barat	ongoing
14. False ghavials	Sekundur	started
D. ***Translocation Projects***		
15. Sumatran tigers	Sumatra	planned
16. Elephants	Way Kamhas, Sumatra	ongoing
17. Javan rhinoceros	Sumatra	feasibility study started
18. Orang-utans	Martapura Pleihari	planned
Captive Breeding/Rearing for Sustained Yield Harvest		
19. Crocodiles	Irian Jaya	started
20. Marine turtles	Bali/Sukamade	started
21. Macaque monkeys	Jakarta	started
22. Maleo birds	N. Sulawesi	feasibility study completed
23. Birdswing butterflies	Irian Jaya	planned
24. Cockatoos	Ambon	planned
25. Orchids	Bogor	started
F. ***Conservation-Oriented Research Projects on the Ecology of Rare Species***		
26. Orang-utan	Ranun, Ketambe, Tanjung Puting	1971 ongoing
27. Javan rhinoceros	Ujung Kulon	1967 ongoing
28. Sumatran rhinoceros	Gn. Leuser	1977 ongoing
29. Bawean deer	Bawean Island	1977-79
30. Marine turtles	various	ongoing
31. Crocodiles	Irian Jaya	1979-80
32. Javan gibbons	Ujung Kulon	1977-79
33. Sulawesi endemic fauna	Tangkoko-Batuangus	1977-79
34. Banteng	Ujung Kulon, Pangandaran, Baluran	various
35. Mentawai primates	Siberut island	various
36. Proboscis monkeys	Kalimantan	various
37. Rafflesia flowers	Sumatra, Java	occasional
38. Komodo lizards	Komodo	1970-71
G. ***Field Monitoring of Species Status***		
39. Bali tiger	Bali Barat	1978
40. Sumatran tiger	Sumatra	1977
41. Javan rhinoceros	Ujung Kulon	annual
42. Crocodiles	Irian Jaya	1979/80
43. Javan gibbon	W. Java	1978
44. Proboscis monkeys	Kalimantan	occasional
45. Rafflesia flowers	Java/Sumatra	1981
46. Fresh water dolphins	Mahakam	c. 1980
47. Fresh water sawfish	Irian Jaya	1980
48. Sumatran rhinoceros	Sumatra	various
49. Bali starling	Bali Barat	regular
50. Timor monitor lizard	Timor	1981
51. Kelasa fish	Sumatra	c. 1981
52. Marine turtles	various	various
53. Banteng	Ujung Kulon	occasional
54. Javan warty pigs	Java	ongoing
55. Kangean leopards	Kangean	1982
56. Bandasea birds	Banda Sea	1981

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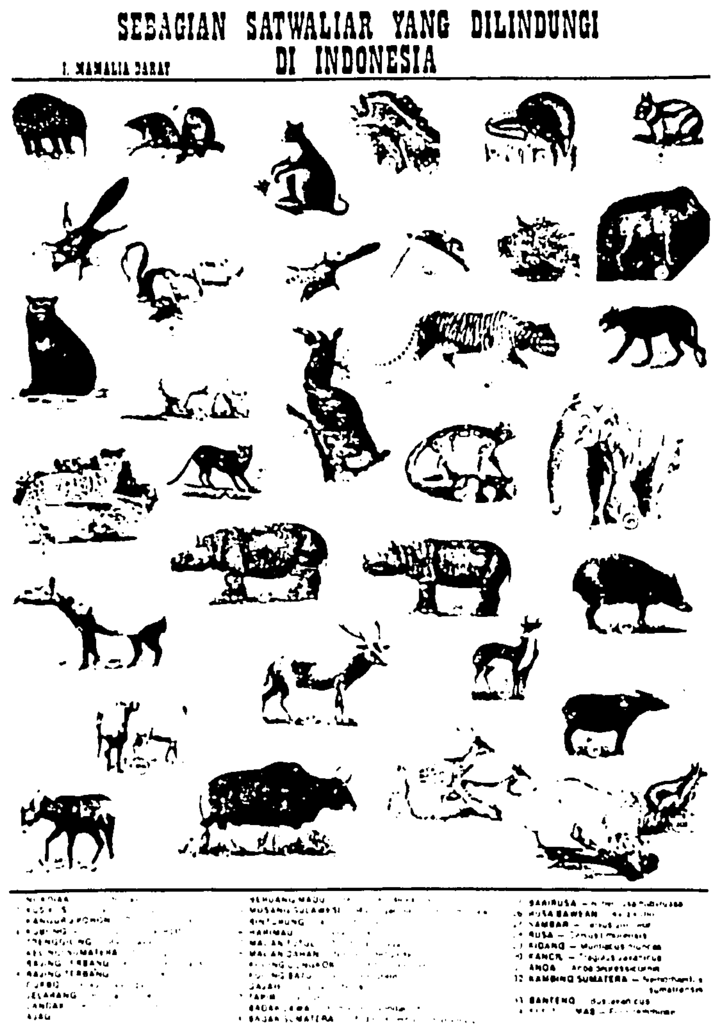

a.

Figure 2: A series of five posters depicting protected species of Indonesian wildlife. These posters also give a good impression of Indonesia's tremendous wildlife diversity. Included in the series as the following:

a. Land mammals
b. Reptiles and marine mammals
c. Land birds
d. Water birds
e. Primates

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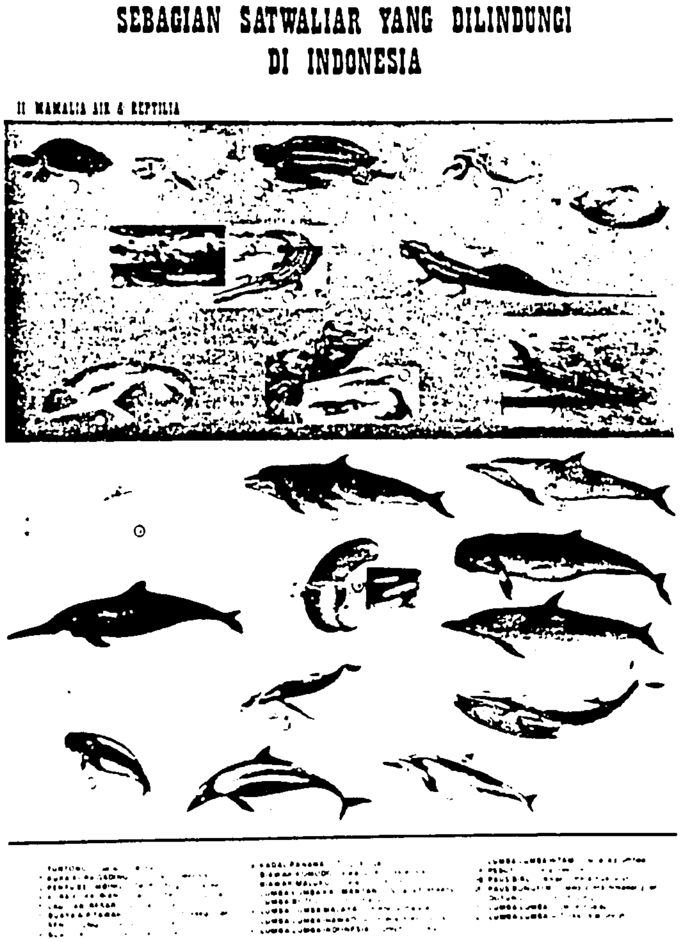

SEBAGIAN SATWALIAR YANG DILINDUNGI
DI INDONESIA
II MAMALIA AIR & REPTILIA

b.


SEBAGIAN SATWALIAR YANG DILINDUNGI
DI INDONESIA
III BURUNG DARAT

c.


SEBAGIAN SATWALIAR YANG DILINDUNGI
DI INDONESIA
IV BURUNG AIR

d.


SEBAGIAN SATWALIAR YANG DILINDUNGI
DI INDONESIA
V PRIMATA

e.

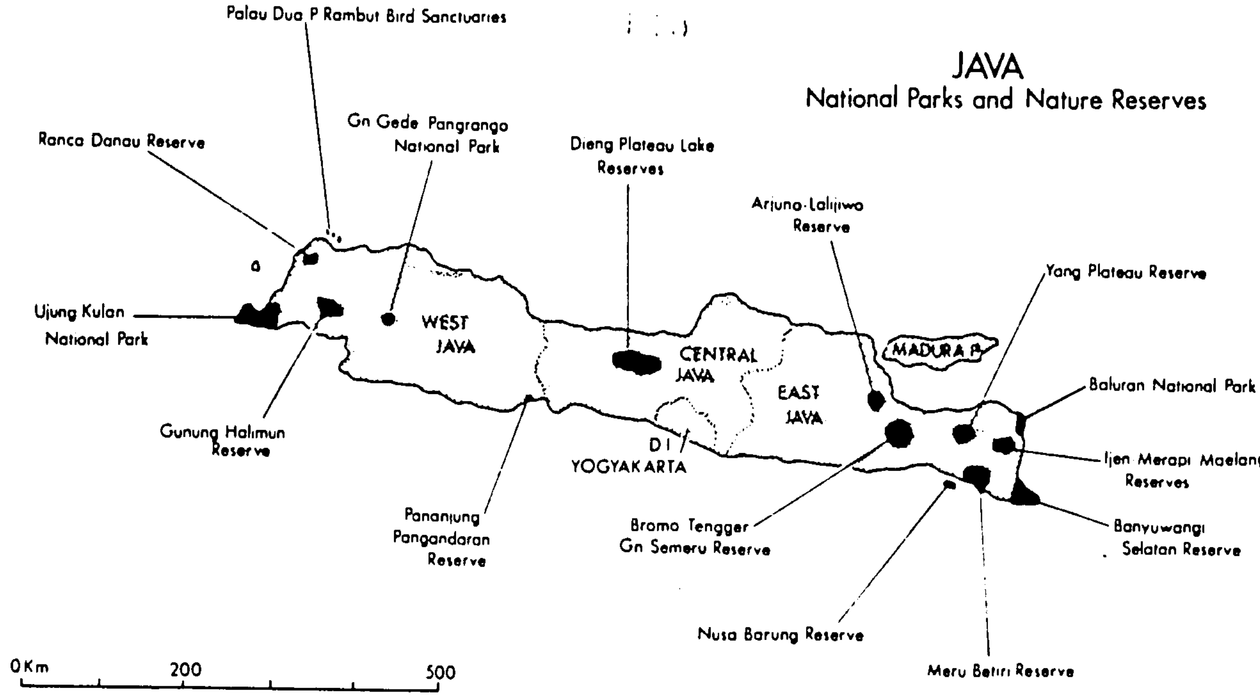


Figure 3: Map of the island of Java showing the location of national parks and reserves (modified from a publication by the Indonesian Directorate General of Tourism).

a.

b.

Figure 4: Several endangered species from Java.

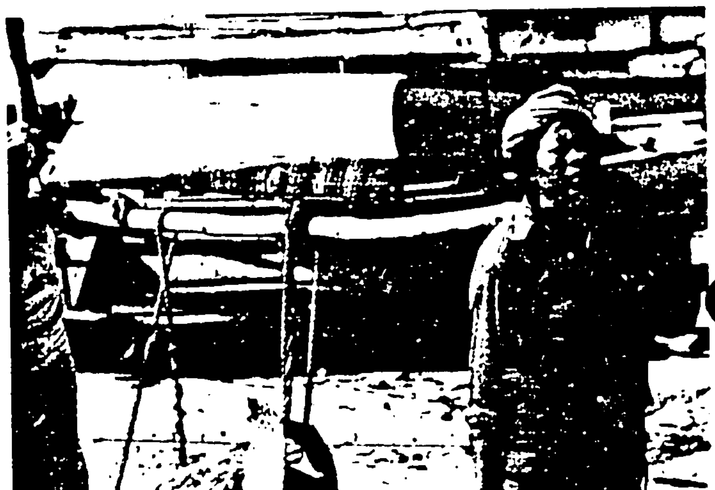
a. The Javan gibbon *(Hylobates moloch)*, a Javan endemic that is probably the rarest of all gibbons (photo by R. A. Mittermeier).
b. The Javan leaf monkey *(Presbytis aygula)*, another primate species found only on Java (photo by R.A. Mittermeier).
c. Adult male Javan rhino *(Rhinoceros sondaicus)* from Ujung Kulon National Park at the extreme western tip of Java. Once found over a large area of southest Asia, this species now occurs with certainty only in this one park (photo by M. Kappeler).

c.

a.

b.

c.



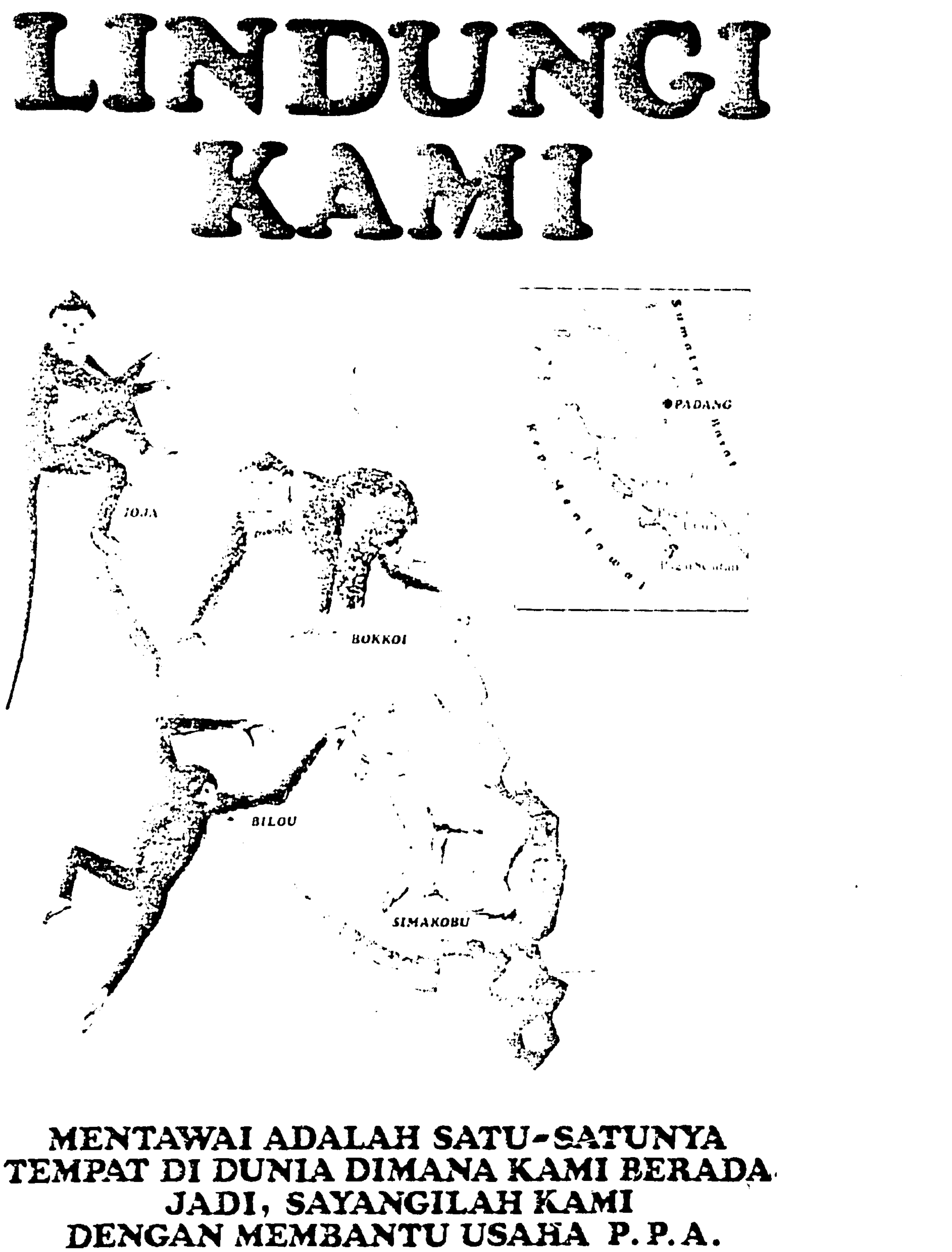
d.

Figure 5: Animals from Bali.

a. & b. The wide-ranging crab-eating or long-tailed macaque *(Macaca fascicularis)* is common on the island of Bali, and is often found in close proximity to human habitations. Temple monkeys are a tourist attraction on the island (photos by R.A. Mittermeier).

c. A domesticated banteng *(Bos javanicus)* from Bali. This species is native to southeast Asia, and wild populations still occur in a number of countries (photo by R.A. Mittermeier).

d. Green turtle *(Chelonia mydas)* being carried to a holding pen on Bali. This species is sought after for its meat (photo by R.A. Mittermeier).



a.

Figure 6: Primates from the Mentawai Islands off the west coast of Sumatra. The Four Mentawai primate species are endemic to these islands, and all are listed in the IUCN *Red Data Book*.

a. Poster produced by the Indonesian Directorate of Nature Conservation (PPA) and WWF depicting the four Mentawai primates: the *joja (Presbytis potenziani)*, and *bokkoi (Macaca pagensis)*, the *bilou (Hylobates klossii)*, and the *simakobu (Simias concolor)*.
b. The Mentawai Islands leaf monkey *(Presbytis potenziani)*. Plate from the original description of the subspecies *Presbytis potenziani siberu* by Chasen and Kloss *(Proc. Zool. Soc. London*, 1927).
c. The pig-tailed langur or *simakobu (Simias concolor)*, a *genus* endemic to the Mentawai Islands. This unusual species is most closely related to the proboscis monkey of Borneo, and is perhaps the most endangered Mentawai primate. Plate from the original description of the subspecies *Simias concolor siberu* by Chasen and Kloss *(Proc. Zool. Soc. London*, 1927).
d. Juvenile pig-tailed langur *(Simias concolor)* (photo by A. Mitchell).
e. Juvenile *bokkoi* or Mentawai macaque *(Macaca pagensis)* (photo by A. Mitchell).

b.

c.

d.

e.

a.

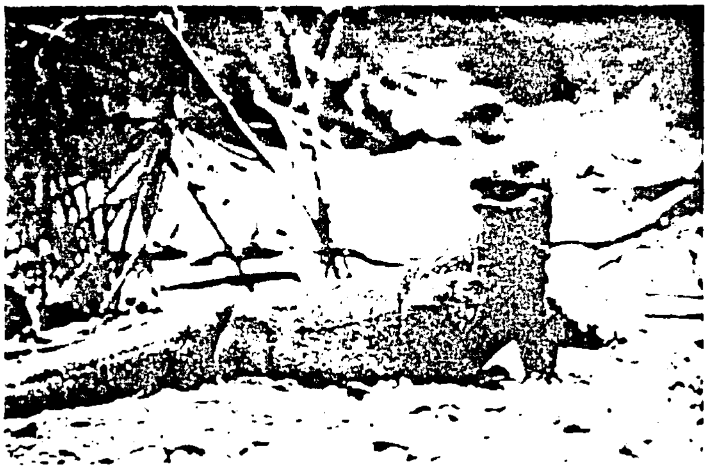
b.

c.

d.

Figure 7: Wildlife of Sulawesi, an island with a unique mix of Oriental and Australasian faunal elements.
a. The anoa *(Bubalus depressicornis)*, a species of wild cattle endemic to Sulawesi (photo by R.A. Mittermeier).
b. Limestone cliffs near Ujungpandang in southeastern Sulawesi, habitat of the moor macaque *(Macaca maura)*, one of seven macaques endemic of Sulawesi (photo by R.A. Mittermeier).
c. The crested macaque or "Celebes black ape" *(Macaca nigra)*, from northeastern Sulawesi. This is the best known of the Sulawesi macaques and is often kept in captivity (photo by R.A. Mittermeier).
d. Juvenile *Macaca tonkeana*, another Sulawesi macaque species (photo by R.A. Mittermeier).
e. Poster produced by the Indonesian Directorate of Nature Conservation and WWF depicting the unique fauna of Sulawesi.

e.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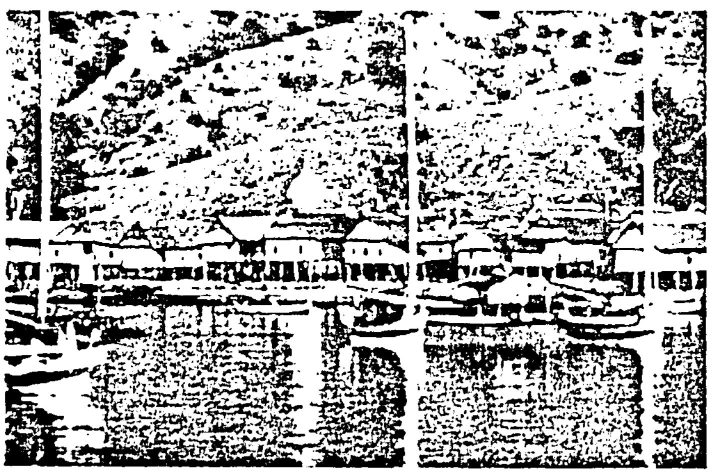
g.


h.

Figure 8: The Komodo monitor *(Varanus komodoensis)*, world's largest living lizard. This species is found only on the islands of Komodo, Rintja, Padar, western Flores and a handful of tiny islands in the vicinity, and is protected in Komodo National Park (photos by R.A. Mittermeier).

a, b & c. Komodo monitors in the wild on the island of Komodo.

d. Komodo monitors feeding on a goat used to attract the lizards for tourist viewing.

e. View of Komodo monitor habitat on the island of Komodo.

f. View of Komodo at sunset showing the mountainous nature of the terrain.

g. The village of Komodo, part of the Komodo Biosphere Reserve.

h. Tourists climbing up from Komodo village in search of the giant lizards.

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Thailand

Species Conservation Priorities in Thailand

Jira Jintanugool
Ardith A. Eudey
Warren Y. Brockelman

Introduction

Thailand covers an area of about 541,000 km² extending between 6° and 20°N latitude in mainland Southeast Asia. The country encompasses diverse kinds of ecosystems and spans the Indo-Chinese, Indo-Malaysian, and Indo-Burmese subregions of the Oriental biogeographical region. The wildlife is diversified, but most species are not very abundant, which may be a consequence, in part, of their evolutionary history. The details of geographical distribution and habitat preference remain to be compiled for most vertebrates, including mammal and, to a lesser extent, bird species. Inventories of floristic communities are in progress, and efforts are being made to identify plants of potential use to the human population.

As is true of other developing countries in the tropics, Thailand is attempting to conserve its wildlife and forest habitats in the face of increasing exploitative pressures, both internal and external. According to government inventories, the forest cover of Thailand declined from more than 53% in 1961 to only 28% in 1981. The rate of forest destruction may have been nearly 10% a year during much of the last decade. Slash and burn agriculture and illegal logging, especially of teak and other tropical hardwoods, contributed significantly to this rate. In Thailand there are six major hilltribe populations, altogether consisting of more than 300,000 people, who practice shifting cultivation. Not only hilltribe peoples, but also ethnic Thais, have cleared large areas of forested land, which may be abandoned entirely after only a few years of use. A variety of timbering activities as well as irrigation and hydroelectric projects, highway construction, resettlement programs for hilltribe peoples and others, mineral exploration, and even recreation increase the pressure on forests and wildlife.

Illegal hunting or poaching of wildlife constitutes another serious problem. Traditional food hunting continues in areas near villages, but it is not nearly as detrimental to animal populations as the more modern type of hunting for sale. "Market hunting" is very difficult to control because of the sophistication of weapons available to hunters. The ready availability of modern forms of transportation and firearms results not only in wild animals being subjected to heavy slaughter, but also in forests being cleared and burned at an alarming rate to increase the area for cultivation as squatters do not hesitate to move in and settle down even in reserved forests.

Commercial exploitation for international trade also severely reduced certain populations of wild animals, for example, macaque monkeys, especially stumptail macaques *(Macaca arctoides)*. A ban on the commercial export of all macaque species went into effect in 1976.

Pesticides and insecticides are used freely in Thailand. In some places the widespread use of insecticides on crops has caused the death of fish and other aquatic fauna, as well as birds. Such use also destroys predators and beneficial insects.

Species Conservation in Thailand

Early efforts in Thailand to protect wildlife were species-oriented. In 1921 a Wild Elephant Act was enacted, and in 1931 there were unsuccessful attempts to establish protection for the cows of wild water buffalo and some other large mammals. However, wild animals were reported to be still plentiful in every part of Thailand before World War II. Soon after the war, the impact of a rapidly expanding human population, declining economic wealth, and greater numbers of firearms and vehicles, as described above, resulted in both wildlife and their habitats being severely reduced. The Royal Forest Department and some societies, including the Siam Society, were responsible for the passage in 1960 of the Wild Animal Preservation and Protection Act B. E. 2503, which came into effect on January 1, 1961.

The Act established two major groups of wild animals: Reserved and Protected. These categories form the basis for the regulation of traffic in wildlife, to which a heavy commitment was made by private enterprise in Thailand, and are reflected in the schemes for captive breeding and restocking that are included within the Thai conservation strategy. These activities are under the jurisdiction of the Wildlife Conservation Division, Royal Forest Department.

Reserved wild animals are those considered to be rare or endangered, and are not permitted to be captured or hunted or even kept in possession except for educational or scientific purposes or for exhibition at zoological gardens. Nine species are included in this group: Javan rhinoceros *(Rhinoceros sondaicus)*, Sumatran rhinoceros *(Dicerorhinus sumatrensis)*, kouprey *(Bos sauveli)*, wild water buffalo *(Bubalus bubalis)*, Eld's deer *(Cervus eldi)*, Schomburgk's deer *(Cervus schomburgki)*, hog deer *(Axis porcinus)*, goral *(Naemorhedus goral)* and serow *(Capricornis sumatraensis*; Table 1; Fig. 1).

Schomburgk's deer was endemic to Thailand and is now extinct; the last buck was shot in 1913. Of the rhinos, the Javan is believed to have been wiped out, while a few Sumatran are presently reported in some remote areas of the country. Villagers of Sisaket Province, in the northeast, reported having seen five kouprey near the Kampuchean border in August, 1982; it is believed that some animals moved to Thailand during the rainy season. Two subspecies of Eld's deer are found in Thailand, *Cervus eldi siamensis* and *Cervus eldi thamin*. The *siamensis* subspecies may have been extirpated in the wild, but small numbers of the *thamin* subspecies are reported to exist in areas near the Burmese border. The range of the goral is limited to remote parts of northern Thailand; a few goral were recently reported in Mae Tun Wildlife Sanctuary. It is doubtful if any hog deer still exist

Table 1. Reserved wild animals of Thailand

List of Reserved Wild Animals

1. Javan Rhinoceros *(Rhinoceros sondaicus)*
2. Sumatran Rhinoceros *(Dicerorhinus sumatrensis)*
3. Kouprey *(Bos sauveli)*
4. Wild Water Buffalo *(Bubalus bubalis)*
5. Eld's Deer *(Cervus eldi)*
6. Schomburgk's Deer *(Cervus schomburgki)*
7. Hog Deer *(Axis porcinus)*
8. Serow *(Capricornis sumatraensis)*
9. Goral *(Naemorhedus goral)*

*Schedule of Reserved Wild Animals, the Wild Animals Reservation and Protection Act B.E 2503

within the former range of the species. However, a number of hog deer are being kept in captivity. The only known wild water buffalo population occurs in Huai Kha Khaeng Wildlife Sanctuary, where approximately 50-80 animals survive. Poaching is presently the main problem threatening this relict group of wild cattle. The least threatened species in the reserved category seems to be the serow, which ranges throughout every region of the country, mainly in limestone mountains and can be found in every wildlife sanctuary.

The Protected group of wild animals is composed of two categories (Table 2). The first category legally includes wild animals whose flesh is not usually used as human food, or which are not usually hunted for sport, or which destroy plant pests, or which should be protected for their natural beauty or for increasing their population numbers. Capturing live animals of this first category is permissible, but killing of these animals is not allowed except by collecting permit issued only for educational or scientific purposes. There are presently 184 vertebrate taxa declared as Protected Wild Animals of the First Category: 35 mammal, 131 bird, and 14 reptile (Table 2). Since venomous snakes pose a threat to the human population in agricultural areas, protection for reptiles is difficult to obtain, and, as a consequence, large numbers of snakes continue to be exported annually.

Protected wild animals of the second category are considered to be those that are palatable for human consumption or that are traditionally hunted for sport. Hunting of these animals can be done by securing a license. There are presently 35 vertebrate taxa declared as Protected Wild Animals of the Second Category: 12 mammal, 22 bird, and one amphibian (Table 3). Gaur *(Bos gaurus)* and banteng *(Bos banteng)*, sambar deer *(Cervus unicolor)* and barking deer *(Muntiacus muntjak)*, tiger *(Panthera tigris)* and leopard *(Panthera pardus)* are among the mammals historically included in the second category.

In Thailand the breeding program for wild animals has two objectives. Some species of rare animals, for example, Eld's deer, banteng and fireback pheasant (*Lophura diardi*), are being bred in captivity for restocking in areas where they have been depleted; no release has yet been made. A number of hog deer are being kept in captivity for study and breeding purposes; some animals introduced onto an island in the southeast are breeding successfully. Likewise, reports of sightings of kouprey on the Thai-Kampuchean border have resulted in expeditions by the Wildlife Conservation Division to capture for propagation and study individuals of this wild cattle species which was believed to have been hunted to extinction in Thailand during this century. No capture has yet been made. In contrast, animals such as sambar deer and peafowl *(Pavo muticus)* are being maintained in captivity to increase their numbers and to study the requirements for commercially farming them.

Table 2. Protected wild animals of Thailand

Schedule I. **List of Protected Wild Animals of the first category**

No.	*Protected Wild Animals of the first category*
	MAMMALIA
1	Flying Squirrels of genera *Hylopetes* and *Pteromyscus*
2	Giant Flying Squirrels of genus *Petaurista*
3	Prevost's Squirrel *(Callosciurus prevostii)*
4	Langurs of genus *Presbytis*
5	Kitti's Hog-nosed Bat *(Craseonycteris thonglongyai)*
6	Wrinkled-lipped Bat *(Tararida plicata)*
7	Large Indian Civet *(Viverra zibetha)*
8	Small Indian Civet *(Viverricula malaccensis)*
9	Large Spotted Civet *(Viverra megaspila)*
10	Otter Civet *(Cynogale bennetti)*
11	Gibbons of genus *Hylobates*
12	Asiatic Wild Elephant *(Elephas maximus)*
13	Otters of genera *Lutra, Lutrogale* and *Amblonyx*
14	Flying Lemur *(Cynocephalus variegatus)*
15	Giant Squirrels of genus *Ratufa*
16	Mongooses of genus *Herpestes*
17	Back-striped Weasel *(Mustela strigidorsa)*
18	Siberian Weasel *(Mustela sibirica)*
19	Malaysian Weasel *(Mustela nudipes)*
20	Asiatic Brush-tailed Porcupine *(Atherurus macrourus)*
21	Common Porcupine *(Hystrix brachyura)*
22	Brush-tailed Porcupine *(Atherurus angustiramus)*
23	Marbled Cat *(Felis marmorata)*
24	Leopard Cat *(Felis bengalensis)*
25	Flat-headed Cat *(Felis planiceps)*
26	Jungle Cat *(Felis chaus)*
27	Slow Loris *(Nycticebus coucang)*
28	Macaques of genus *Macaca*
29	Pangolins of genus *Manis*
30	Malayan Tapir *(Tapirus indicus)*
31	Clouded Leopard *(Neofelis nebulosa)*
32	Golden Cat *(Felis temmincki)*
33	Fishing Cat *(Felis viverrina)*
34	Binturong Bear Cat *(Arctictis binturong)*
35	Hog Badger *(Arctonyx collaris)*
36	Ferret Badger *(Melogale personata)*
37	Yellow-throated Marten *(Martes flavigula)*
38	Banded Linsang *(Prionodon linsang)*
39	Spotted Linsang *(Prionodon pardicolor)*
40	Banded Palm Civet *(Hemigalus derbyanus)*
	AVES
1	Cormorants of family Phalacrocoracidae
2	Spot-billed Pelican *(Pelecanus philippensis)*
3	Painted Stork *(Ibis leucocephalus)*
4	Black Stork *(Ciconia nigra)*
5	White-necked Stork *(Ciconia episcopus)*
6	Black-necked Stork *(Xenorhynchus asiaticus)*
7	Ibises of family Threskiornithidae
8	Hill Partridges of genus *Arborophila*
9	Long-billed Partridge *(Rhizothera longirostris)*
10	Ferruginous Wood Partridge *(Caloperdix oculea)*
11	Bamboo Partridge *(Bambusicola fytchii)*
12	Roulroul *(Rollulus roulroul)*
13	Pheasants of genus *Lophura*
14	Hume's Pheasant *(Syrmaticus humiae)*
15	White-breasted Waterhen *(Amaurornis phoenicurus)*

No.	*Protected Wild Animals of the first category*
	AVES (Continued)
16	Sarus Crane *(Grus antigone)*
17	Lapwings of genus *Vanellus*
18	Thick-knees of family Burhinidae
19	Munias and Weavers of family Ploceidae
20	Red-billed Ground Cuckoo *(Carpococcyx renauldi)*
21	Coucak or Crow Pheasant of genus *Centropus*
22	Kingfishers of family Alcedinidae
23	Laughing Thrushes of genus *Garrulax*
24	Hoopoe *(Upupa epops)*
25	Silver-eared mesia *(Leiothrix argentauris)*
26	Grey-headed Parakeet *(Psittacula finschii)*
27	Treepies of genus *Dendrocitta*
28	Great Hornbill *(Buceros bicornis)*
29	Indian Pied Hornbill *(Anthracoceros albirostris)*
30	Black Hornbill *(Anthracoceros malayanus)*
31	Racket-tailed Treepies *(Crypsirina temia)*
32	Babblers, Thrushes, Mesia, Cutia, Barwing, Sivas, Yuhinas, and Sibias of genera *Pellorneum, Trichastoma, Malacopteron, Stachyris, Macronous,* and *Chrysomma*
33	Parrots of genus *Psittacula*
34	Magpie Robin *(Copsychus saularis)*
35	White-rumped Shama *(Copsychus malabaricus)*
36	Forktails of genus *Enicurus*
37	Rock Thrush of genus *Monticola*
38	Warblers of subfamily Sylviinae
39	Black-collared Starling *(Sturnus nigricollis)*
40	Sunbirds of family Nectariniidae
41	Crested Jay *(Platylophus galericulatus)*
42	White-winged Black Jay *(Platysmurus leucopterus)*
43	Flowerpeckers of family Dicaeidae
44	Robins of genera *Phoenicurus, Rhyacornis, Thamnolaea, Hodgsonius,* and *Cinclidium*
45	Red-breasted Parakeet *(Psittacula alexandri)*
46	Cuckoo Dove of genus *Macropygia*
47	Red Turtle Dove *(Streptoplia tranquebarica)*
48	Spotted-necked Dove *(Streptopelia chinensis)*
49	Zebra Dove *(Geopelia striata)*
50	Emerald Dove *(Chalcophaps indica)*
51	Rufous Dove *(Streptopelia orientalis)*
52	Cutia *(Cutia nipalensis)*
53	Trogons of family Trogonidae
54	Ioras and Leafbirds of family Chloropscidae
55	Hill Myna *(Gracula religiosa)*
56	White-eyes of family Zosteropidae
57	Orioles and Bluebirds of family Oriolidae
58	Sanderling *(Crocethia alba)*
59	Rail Babbler *(Eupetes macrocerus)*
60	Red-winged Crested Cuckoo *(Clamator coromandus)*
61	Cuckoos of genus *Cacomantis*
62	Cuckoos of genus *Cuculus*
63	Cuckoos of genus *Chrysococcyx*
64	Drongo Cuckoo *(Surniculus lugubris)*
65	Owls of family Strigidae
66	Anhinga *(Anhinga anhinga)*
67	Hornbills of family Bucerotidae
68	White-eyed River Martin *(Pseudochelidon sirintarae)*
69	Bee-eaters of family Meropidae
70	Larks of family Alaudidae
71	Flycatchers and Niltavas of subfamily Muscicapinae
72	Brown Barbet *(Calorhamphus fuliginosus)*
73	Nicobar Pigeon *(Caloenas nicobarica)*
74	Sandpipers and Shanks of genus *Tringa*
75	Broad-billed Sandpiper *(Limicola falcinellus)*
76	Curlew Sandpiper *(Calidris furruginea)*
77	Asian Dowitcher *(Limnodromus semipalmatus)*
78	Drongos of family Dicruridae
79	Koel *(Eudynamys scolopacea)*
80	Thrushes of genera *Zoothera* and *Turdus*
81	Common Sandpiper *(Actitis hypoleucos)*
82	Wagtails and Pipits of family Motacillidae
83	Greater Adjutant Stork *(Leptoptilos dubius)*
84	Lesser Adjutant Stork *(Leptoptilos javanicus)*
85	Great Barbet *(Megalaima virens)*
86	Tits of family Paridae
87	Coppersmith Barbet *(Megalaima haemacephala)*
88	Wandering Tattler *(Heteroscelus incanus)*
89	Night Jars of family Caprimulgidae
90	Black-billed Roller *(Coracias benghalensis)*
91	Dollar Bird *(Eurystomus orientalis)*
92	Nuthatches of family Sittidae
93	Pittas of family Pittidae
94	Knots and Stints of genus *Calidris*
95	Swifts, Tree Swifts, Swallows, and Martins of family Apodidae, Hemiprocnidae, and Hirundinidae
96	Gulls and Terns of family Laridae
97	Malkohas of genus *Phaenicopheus*
98	Bulbuls of family Pycnonotidae
99	Little Grebe *(Podiceps ruficollis)*
100	Open-billed Stork *(Anastomus oscitans)*
101	Parrotbills of genus *Paradoxornis*
102	Black-tailed godwit *(Limosa limosa)*
103	Bar-tailed godwit *(Limosa lapponica)*
104	Comb Duck *(Sarkidiornis melanotos)*
105	White-winged Wood Duck *(Cairina scutulata)*
106	Pigeons of genus *Treron*
107	Jambu Fruit Pigeon *(Ptilinopus jambu)*
108	Brown-throated Tree Creeper *(Certhia discolor)*
109	Frogmouths of family Podargidae
110	Spectacled Barwing *(Actinodura ramsayi)*
111	Cochoas of genus *Cochoa*
112	Pintail Parrot Finch *(Erythrura prasina)*
113	Broadbills of family Eurylaimidae
114	Minivets of family Campophagidae
115	Turnstone *(Arenaria interpres)*
116	Barbets of genus *Megalaima*
117	Brown Dipper *(Cinclus pallasii)*
118	Herons, Bitterns, and Egrets of family Ardeidae
119	Green Peafowl *(Pavo muticus)*
120	Scimitar of genus *Pomatorhinus*
121	Ruff and Reeve *(Philomachus pugnax)*
122	Pied Imperial Pigeon *(Ducula bicolor)*
123	Peacock pheasants of genus *Polyplectron*
124	Sivas of genus *Minla*
125	Barn Owl *(Tyto alba)*
126	Greenpies of genus *Cissa*
127	Golden-crested Myna *(Ampelicens coronatus)*
128	Shrike babblers of genera *Pteruthius* and *Gampsorhynchus*
129	Blue-rumped Parrot *(Psittinus cyanurus)*
130	Hanging lorikeets of genera *Loriculus*
131	Helmeted Hornbill *(Rhinoplax vigil)*
132	Great Argus Pheasant *(Argusianus argus)*
133	Hawks, Kites, Buzzards, Goshawk, Shikra, Eagles, Vultures, Harriers, Ospreys, Falconats, Falcons, Hobby and Kestrels of Order Falconiformes
134	Woodpeckers of family Picidae
135	Plovers in genera *Charadrius* and *Pluvialis*
136	Blue Whistling Thrush *(Myophonus caeruleus)*

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No. *Protected Wild Animals of the first category*

AVES (Continued)

137 Ashy Wood Swallow *(Artamus fuscus)*
138 House Crow *(Corvus splendens)*
139 Large-billed Crow *(Corvus macrorhynchus)*
140 Black-headed Shrike *(Lanius schach)*
141 Pied Starling *(Sturnus contra)*
142 Jerdon's Starling *(Sturnus burmannicus)*
143 Common Myna *(Acridotheres tristis)*
144 Crested Myna *(Sturnus javanicus)*
145 Owls of genera *Ketupa* and *Bubo*

REPTILIA

1 Flying Lizard of genus *Draco*
2 Garden Lizard of genus *Calotes*
3 Spiny Lizard of genus *Acanthosaura*
4 Angle-headed Lizard of genus *Goniocephalus*
5 Oriental Water Lizard *(Physignathus cocincinus)*
6 False Gavial *(Tomistoma schlegelii)*
7 Gecko of genus *Cyrtodactyllus*
8 Flying Gecko of genus *Ptychozoon*
9 Hawksbill Turtle *(Eretmochelys imbricata)*
10 River Turtle or Four-toed Turtle *(Batagur baska)*
11 Spiny Hill Turtle *(Geoemyda spinosa)*
12 Impressed Tortoise *(Testudo impressa)*
13 Green Turtle *(Chelonia mydas)*
14 Loggerhead Turtle *(Caretta caretta)*
15 Big-headed Turtle *(Platysternum megacephalum)*
16 Leathery Turtle *(Dermochelys coriacea)*
17 Giant Asiatic Tortoise *(Testudo emys)*
18 Pacific Ridley's Turtle *(Lepidochelys olivacea)*
19 Elongate Tortoise *(Testudo elongata)*
20 Roughneck Monitor *(Varanus rudicollis)*

AMPHIBIA

1 Crocodile Salamander *(Tylototriton versucosus)*

*Ministerial Regulation No. 14 (B.E. 2525) Issued according to the Wild Animals Reservation and Protection Act B.E 2503

Table 3. Protected Wild Animals of Thailand

***Schedule 2.* List of Protected Wild Animals of the second category**

No. ***Protected Wild Animals of the second category***

A. MAMMALIA

1 Gaur *(Bos gaurus)*
2 Mouse Deer of genus *Tragulus*
3 Siamese Hare *(Lepus siamensis)*
4 Sambar Deer *(Cervus unicolor)*
5 Dugong *(Dugong dugong)*
6 Banteng *(Bos banteng)*
7 Tiger *(Panthera tigris)*
8 Leopard or Panther *(Panthera pardus)*
9 Asiatic Black Bear *(Selenarctos thibetanus)*
10 Malayan Sun Bear *(Helarctos malayanus)*

Fig. 1: Poster produced in Thailand depicting the country's nine Reserved Wild Animals. These include Schomburgk's deer, Eld's deer, goral, serow, hog deer, Sumatran rhinoceros, Javan rhinoceros, kouprey and wild buffalo.

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No.	*Protected Wild Animals of the first category*
	MAMMALIA (Continued)
11	Barking Deer *(Muntiacus muntjak)*
12	Fea's Barking Deer *(Muntiacus feae)*

B. AVES

1	Grey Heron *(Ardea cinerea)*
2	Purple Heron *(Ardea pupurea)*
3	Dusky Grey Heron *(Ardea sumatrana)*
4	Francolin *(Francolinus pintadeanus)*
5	Green-legged Tree Partridge *(Arborophila charltonii)*
6	Finches and Buntings of family Fringillidae
7	Red Jungle Fowl *(Gallus gallus)*
8	Night Heron *(Nycticorax nycticorax)*
9	Ducks, Garganeys, Pintails, Pochards, Shelducks, Shovellers, Teals, and Wigeon of family Antidae
10	Painted Snipe *(Rostratula benghalensis)*
11	Snipes of genus *Capella*
12	Thick-billed Green Pigeon *(Treron curvirostra)*
13	Bronze-winged Jacana *(Metopidius indicus)*
14	Mountain Imperial Pigeon *(Ducula badia)*
15	Pale-capped Pigeon *(Columba punicea)*
16	Green Imperial Pigeon *(Ducula aenea)*
17	Rails and Crakes of family Rallidae
18	Curlews and Whimbrel of genus *Numenius*
19	Watercock *(Gallicrex cinerea)*
20	Moorhen *(Gallinula chloropus)*
21	Purple Gallinule *(Porphyrio poliocephalus)*
22	Pheasant-tailed Jacana *(Hydrophasianus chirurgus)*

C. AMPHIBIA

1	Asiatic Giant Frog *(Rana blythii)*

Each year a quota is set for the numbers and species of Protected wild animals to be hunted and traded. In 1981, 12 bird taxa of the first category and six bird taxa of the second category were so listed, (Table 3), but no mammals or reptiles.

In January 1983, Thailand ratified CITES and became the 79th member country effective as of April 21, 1983. In order to guard against the smuggling of wildlife from Thailand to non-CITES countries, which continues to be a serious problem, the Wildlife Conservation Division maintains two checkpoints, at the airport and at the harbor in Bangkok. Three more checkpoints will be established, at the borders with Laos and with Malaysia, and at Chiengmai International Airport.

Habitat-Oriented Conservation Activities

The Wildlife Act of 1960, in recognition of the need to maintain critical habitat for species survival, also provided for the creation of protected areas for wild animals (wildlife sanctuaries). The Wildlife Conservation Division has jurisdiction over the sanctuaries. The first sanctuary, Salak Phra, in the province of Kanchanaburi in west-central Thailand, was established in 1965. Since then, 23 more sanctuaries have been set up. The total area included within the sanctuaries is somewhat less than 2 million hectares, or almost 4% of the country's area (Figure 1).

The first national park of Thailand, Khao Yai, spanning the provinces of Nakhon Rachasima, Saraburi, Nakhon Nayak and Prachinburi in central Thailand, was declared in 1963, following enactment of the National Parks Act of the previous year.

TABLE 3. HUNTING AND TRADING QUOTA OF PROTECTED WILD ANIMALS FOR 1982

The Wildlife Conservation Committee has determined the limit for numbers of protected wild animals to be hunted and traded per licensee for 1982. The export of these protected animals will, therefore, not exceed these limited numbers.

A. Hunting and Trading Quota of Protected Wild Animals of the First Category.

No.	Animal Taxon	Bag Limits	Trading Limits
1	White-breasted waterhen *(Amaurornis phoenicurus)*	5	30
2	Laughing thrushes of genus *Garrulax*	5	20
3	Parrots of genus *Psittacula* excluding Red-breasted parakeet *(Psittacula alexandri)* and Large parakeet *(Psittacula eupatria)*	15	60
4	White-rumped shama *(Copsychus malabaricus)*	5	10
5	Spotted-necked dove *(Streptopelia tranquebarica)*	10	20
6	Zebra dove *(Geopelia striata)*	10	50
7	Hill myna *(Gracula religiosa)*	5	30
8	Koel *(Eudynamys scolopacea)*	2	10
9	Great barbet *(Megalaima virens)*	2	10
10	Pintail parrot finch *(Erythrura prasina)*	10	50

B. Hunting and Trading Quota of Protected Wild Animals of the Second Category.

No.	Animal Taxon	Bag Limits	Trading Limits
1	Francolin *(Francolinus pintadeanus)*	5	10
2	Snipes of genus *Capella*	10	20
3	Thick-billed green pigeon *(Treron curvirostra)*	10	30
4	Watercock *(Gallicrex cinerea)*	20	50
5	Moorhen *(Gallinula chloropus)*	20	50
6	Purple gallinule *(Porphyrio poliocephalus)*	10	40

The national parks, which are under the jurisdiction of the National Parks Division, Royal Forest Department, are intended, in contrast to the wildlife sanctuaries, to provide a place for recreation in addition to protecting local flora and fauna. At present there are 42 national parks, including several marine parks, encompassing a total of more than 2.3 million hectares, or about 4.5% of Thailand's area (Figure 2).

Many of the protected areas contain excellent forest and other habitats for wild animals. The survival of relatively intact ecosystems frequently can be attributed to the location of these areas in regions peripheral to human development. All efforts are be-

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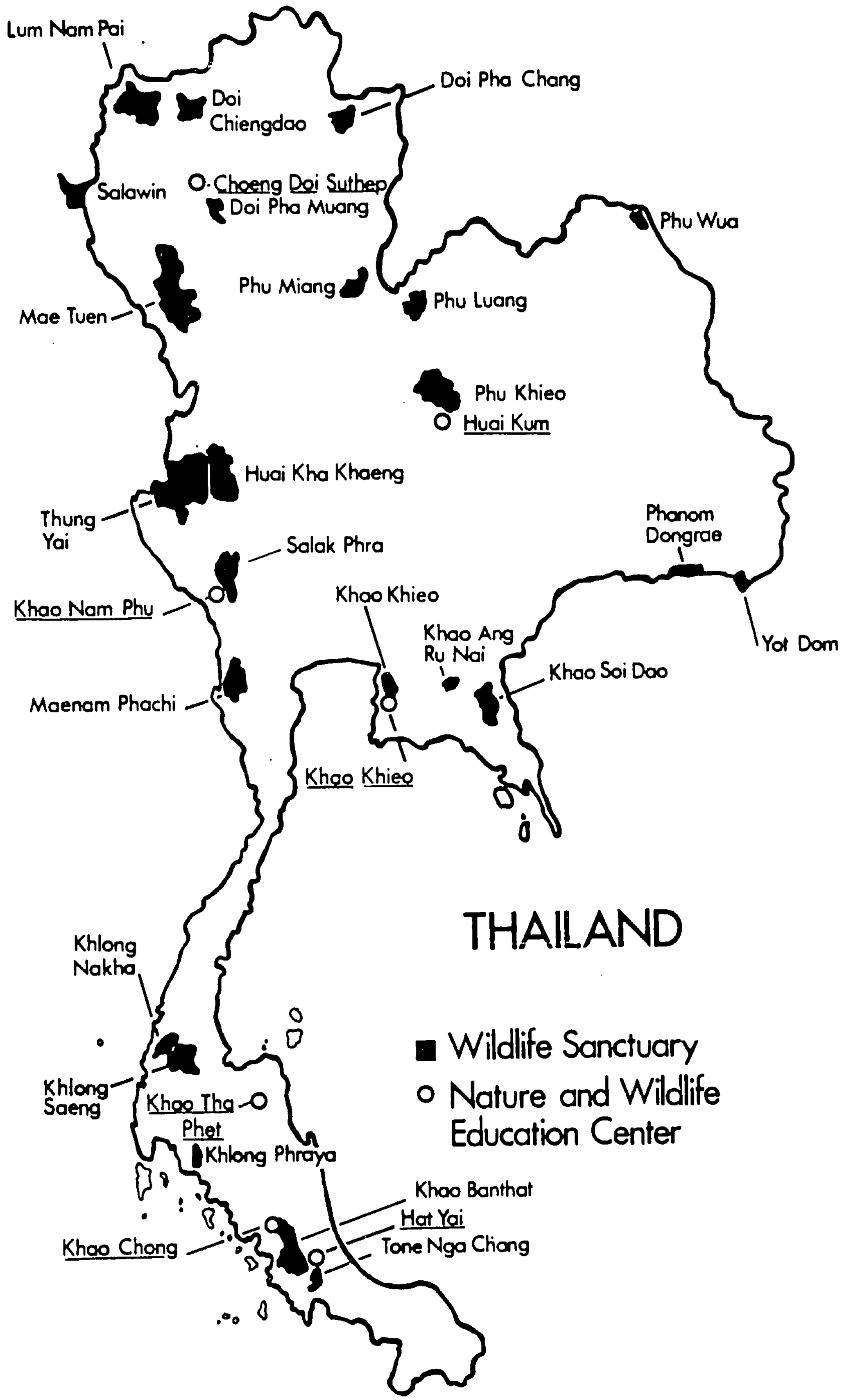

Fig. 2: Map of Thailand showing the location of existing Wildlife Sanctuaries and Nature and Wildlife Education Centers.

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ing made by the Royal Forest Department to protect the sanctuaries and national parks, but each area appears to have its own set of conservation problems, as discussed below. Based on surveys conducted by the Royal Forest Department, there seem to be good forests and other habitats for wild animals remaining, that if brought under the jurisdiction of the sanctuaries or national parks would increase the reserved areas to about 10% of the total area of Thailand. Within the Royal Forest Department there is some debate over whether the more effective conservation strategy involves strengthening protection for already existing reserves or declaring as much remaining area as possible part of the reserve system before human encroachment occurs.

Within the wildlife sanctuaries and national parks, hunting, timbering and mining are prohibited. Other activities are strictly regulated. However, hydroelectric and irrigation projects increasingly are threatening protected areas. Salak Phra, the first sanctuary, lost much of its wildlife richness as a consequence of the construction of Srinakarin Dam. Elsewhere in western Thailand, the proposed Nam Choan Dam, to be financed with the assistance of the World Bank, threatens to disrupt the migrations of large mammals such as elephant between Huai Kha Khaeng and Thung Yai sanctuaries and open up the latter to human exploitation.

Research on wildlife in Thailand is aimed at producing management techniques or at adding to our general knowledge about species. Several projects to identify species and numbers of animals and habitat requirements have been initiated in protected areas. Both Thai scientists and foreign scientists are involved in these activities. Thai researchers have concentrated on the study of bird populations, including the shore birds found at Songkhla Lake in southern Thailand. Foreign researchers, in cooperation with Thai students or Thai counterparts in the Royal Forest Department, have concentrated on the study of primate populations (see below).

Many efforts are being made to make the Thai public aware of the value of their natural heritage and of how to enjoy nature. The Wildlife Conservation Division has set up Nature and Wildlife Education Centers in seven sanctuaries, representing every part of Thailand (Figure 1). The National Parks Division also is improving its visitor centers in the national parks.

Conservation Action Priorities

The comments which follow address the problem of developing effective local conservation strategies and were prepared by Brockelman and Eudey as a consequence of their field work on primates in Khao Soi Dao and Huai Kha Khaeng Wildlife Sanctuaries, respectively.

As in neighboring countries, there are a large number of endangered species in Thailand, some of which have been identified above. The Species Survival Commission (SSC) has the same ultimate goal as the other IUCN Commissions. Our particular responsibility is to help identify the species and habitats in need of urgent attention and establish some priorities for action. This should be followed up with project proposals. We are now rethinking how species and project priorities should be set to arrive at some useful recommendations for Thailand. What should be the criteria?

The first and most obvious criterion for the SSC is the *degree of endangerment of the species.* Critically endangered species should receive more attention than vulnerable species.

A second criterion is the *probable effect of the proposed action.* Is the anticipated effect small or large, localized or widespread, measurable or highly diffuse? Is the probable effect high per dollar spent? This is clearly important. For example, the Sumatran rhinoceros is highly endangered in Thailand; as such, it is classified as a Reserved Animal, and its survival is problematical. It is doubtful if $50,000 spent on this species would have any effect; spending a comparable amount to conserve elephants, which are also endangered but more abundant, would seem to hold more promise.

A third criterion is the *feasibility of the project* — can it, in fact, be carried out? Feasibility depends on many factors, such as:

1. Available infrastructure, for administrative and managerial support.
2. Local enthusiasm and cooperation.
3. Availability of capable principal investigators.
4. Logistical and/or scientific feasibility.

The probable effect of the project and its feasibility, to a large degree, depend on another consideration, the *strategy of conservation.* By this, we refer to areas of action such as the following:

1. Protection: creation of guard stations or procurement of equipment.
2. Field information: population inventory and habitat survey.
3. Research: ecological study.
4. Management and technical training assistance.
5. Education: dissemination of information on population and habitat significance on appropriate levels.
6. Socioeconomic action involving local residents near reserved areas.

Each of these areas of action has probable effect on, and a feasibility for, a given population or ecosystem. The efficacy of each action depends heavily on local circumstances and may vary even from one protected area to another within the same region. We can make some generalizations for Thailand. Equipment for protection is budgeted by the Thai government and, at this point in time, is not lacking; we do not feel that WWF or other outside agencies normally need assume this responsibility as it is not really efficient use of limited funds. Population inventory and habitat survey are badly needed in the greatly expanding system of sanctuaries and parks in Thailand, and some assistance in planning and actual execution of such activities may be essential. Research assistance may be useful in breeding or managing a few species, such as deer for rural economic development, or sea turtles. Education of persons living near sanctuaries and parks, especially children, is a valuable long-term investment, but it is doubtful if it will modify the immediate poaching and problems attendant upon shifting cultivation, which have largely socioeconomic causes and solutions. Education of high government officials is not such a priority in Thailand because conservation and protection are well supported by the law and the bureaucracy, but education of politicians may be critical because of the potential destruction of species and habitat by rapid technological development.

Nearly 10% of the territory of Thailand, as indicated above, may soon be included in the expanding protected area system. The problem now is how to most effectively maintain and strengthen this area. Socioeconomic action to us seems to be a neglected concern. We will illustrate our concept of the need for action in this area with experiences in two major reserved areas, both of which contain a diversity of endangered species.

Khao Soi Dao Wildlife Sanctuary. This area, which includes over 1,000 km² in southeast Thailand not far from the Kampuchean border, contains elephant, gaur, tiger, wild dog, silvered leaf monkey *(Presbytis cristatus)* and many other species. The very lush rain forests covering its mountains, valleys, and hills contain probably the most dense ar ' extensive population of the pileated gibbon *(Hylobates pileatus* Figs. 4 & 5*)*, making it a top priority for action for this reason alone. Although deforestation has been largely halted, poaching by local farmers continues in

Fig. 3: Map of Thailand showing the location of existing National Parks.

nearly all parts of the sanctuary, and the guards are unable to stop it anywhere except near the three or four stations at the edge of the sanctuary (and usually away from the forest). The forest is not patrolled.

What actions could further conserve the species in this sanctuary since existing protection is insufficient to do the job? Management planners might say that the first priority is more protection, i.e., more jeeps, guns, guard stations, radios and motorcycles. But researchers with several years' experience in Khao Soi Dao have concluded that a project oriented toward more protection capability would probably have little positive effect and might actually have adverse effects. The approximately 30 men stationed there are reasonably well-equipped, but there are too few men to man the existing stations and patrol the forest. It is not likely that their numbers will be increased because the budget is limited for manpower, and an increase cannot be affected by outside financial help. The critical factor may be relations with the local residents, who harvest plant and animal products within the forest. Experience over the years has shown that if strict enforcement is attempted, the local residents resist with a variety of tactics: appeal to local politicians or police to pressure the sanctuary officials, threats on the sanctuary headquarters, and actual shooting at the guards. What is to be done? To advocate that the Royal Forest Department become an occupying army would only worsen an existing insurgency problem in the region. Khao Soi Dao is now nearly a forest island surrounded by several thousand relatively poor farm families (and some not-so-poor rambutan orchards) that cannot be managed or regulated by force. What may be needed is a change in the concept of wildlife sanctuary. Every effort must be made to realize the considerable value of the sanctuary to science, education, and the benefit of the local residents who must make economic sacrifices to preserve it. No such effort is being made now, and we see little hope that local poaching will stop. There is no ethical mandate to stop it.

Fig. 4: Juvenile pileated gibbon (*Hylobates pileatus*) in Khao Soi Dao Wildlife Sanctuary (photo by W. Y. Brockelman).

Fig. 5: Adult male pileated gibbon (*Hylobates pileatus*) in Khao Soi Dao Wildlife Sanctuary (photo by W. Y. Brockelman).

Fig. 6: The stumptail macaque (*Macaca arctoides*), probably the most endangered of Thailand's macaque species (photo by R. A. Mittermeier).

Fig. 7: Forest destruction caused by shifting cultivation to the east of Huay Kha Khaeng Wildlife Sanctuary, Uthaithani Provice. The area was covered with dry evergreen forest until about 200 years ago (photo by A. A. Eudey).

Huai Kha Khaeng Wildlife Sanctuary. This area is more than twice as large as Khao Soi Dao and encompasses monsoon deciduous and evergreen forest in lowland and mountain regions in the Dwana Range in west-central Thailand near Burma. Huai Kha Khaeng and the contiguous sanctuary of Thung Yai to the west total about 4,830 km^2 and constitute one of the largest remaining forested areas in Thailand. In the former the mammal fauna includes elephant, wild water buffalo, tapir (*Tapirus indicus*), serow, and many congeneric species, for example, banteng and gaur, tiger and leopard, Phayre's leaf monkey (*Presbytis phayrei*) and silvered leaf monkey, and five species of macaques, including the stumptail macaque)*Macaca arctoides*, Fig. 6), which appears to be endangered throughout its disjunct distribution in Asia. Only the lar or white-handed gibbon (*Hylobates lar*) is found in the region. Although research or conservation efforts may be based on a species approach (Eudey, for example, has been studying the ecology of sympatric macaques in Huai Kha Khaeng since 1973), the importance of this protected area, with an extremely patchy environment, lies in the complexity of its ecosystem. The area may have been a forest refuge or refugium in the Pleistocene during periods of decreasing temperature and precipitation induced by glacial advances at more northern latitudes.

The region is remote (few Thais in Bangkok have ever visited the province of Uthaithani in which most of the sanctuary is found), yet easily accessible for research (and for poaching). Although the presence of human occupation in the general area and hunting of wildlife can be documented in the archaeological record to about 14,000 years ago, contemporary encroachment by the human population is recent.

Since its declaration in 1972, some effort has been made to employ local residents in the actual running of the sanctuary; a settlement of former hunters even has been incorporated into sanctuary headquarters. Initially Karen hilltribe men, the local people most knowledgeable of the forest and animals, were employed as guides and general assistants, but their numbers have dwindled and no effort is being made to recruit them now. A resettlement scheme for Karen south of the sanctuary may even increase the amount of poaching done by these people. Meo villages occur within the sanctuary. Some of the villages engage in insurgency and some in opium-growing. Throughout the Meo area shifting agriculture is destroying primary forest and wildlife is being threatened by subsistence hunting (Fig. 7 & 8). Increasing communication and cooperation with hilltribe peoples seem essential for strengthening of the sanctuary.

Patrol of the forest against hunting does occur, and this is one sanctuary where, because of its size, an increase in guard stations and acquisition of more sophisticated weapons is necessary. Hunting may be commercially motivated or for sport by people equipped with modern weapons.

Expansion of the boundaries of the sanctuary to the east and south is essential to include habitat critical for bovids. A plywood concession to the east makes the boundary artificial and excludes an area of important salt licks from legal protection. Habitat of wild water buffalo is outside the present boundary in the south. Minor and major irrigation and hydroelectric projects, if executed, will increase the accessibility of the sanctuary to the human population, necessitating more protection. In this context, educa-

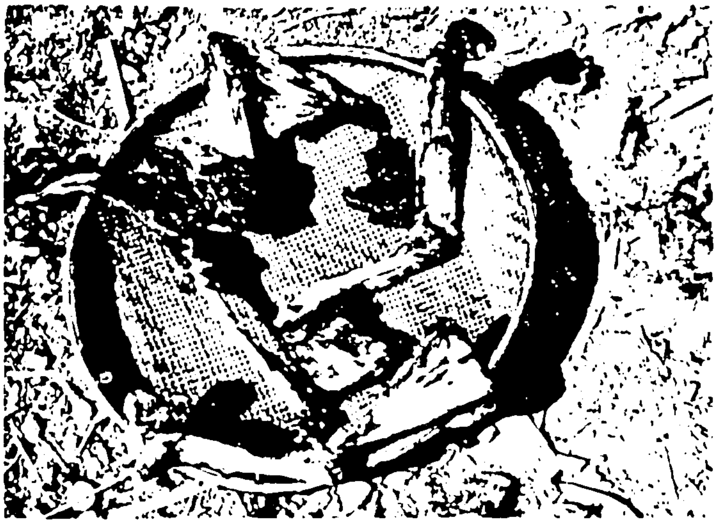

Fig. 8: Signs of subsistence hunting of protected wild animals by Meo hilltribe peoples. In the basket are limb bones of a colobine monkey, probably Phayre's leaf monkey (*Presbytis phayrei*), which has been smoked over a fire, and on the ground is the hair of a white-handed gibbon (*Hylobates lar*) (photo by A. A. Eudey).

tion of politicians as to the consequences for conservation of their decisions about technological development seems critical.

These two examples illustrate that the local conditions that determine an appropriate conservation strategy may vary greatly from place to place. Intimate knowledge of how each system works appears essential. Only persons with local field and cultural experience, including many on our commission, have the knowledge necessary to formulate effective proposals. Thus, we must concern ourselves not merely with deciding on species priorities, but also with helping to formulate and decide on new strategies. All too often strategies are formulated and evaluated on the basis of abstract philosophy or theories currently in vogue.

In Thailand, virtually every visiting consultant and expert in conservation has noted the difficulty of conserving protected areas and recommended, with the best of intentions, increased training, management planning, administration, and equipment for protection. These are, of course, all important. With the best possible management planning, the limiting factors early on should be identified and remedied in the plans, but in practice planners seem to advocate more of the same — guard stations, guns, and other equipment. The needed fundamental changes are seldom recommended except as a very low priority. The scope of conservation management planning, as it has grown largely out of Western experience, is not broad enough to include the needed solutions.

In Thailand, we advocate re-examining the objectives of wildlife conservation and the uses of reserved areas. We feel it is time to address the socioeconomic problems that appear to be worsening and that are limiting progress in conservation.

In conclusion, we advocate that the SSC, while using species and habitats as starting points, broaden the scope of concern to include the identification of locally limiting problems and the most promising and effective strategies to overcome them. In this, the collaboration of other commissions in designing proposals will be of critical importance.

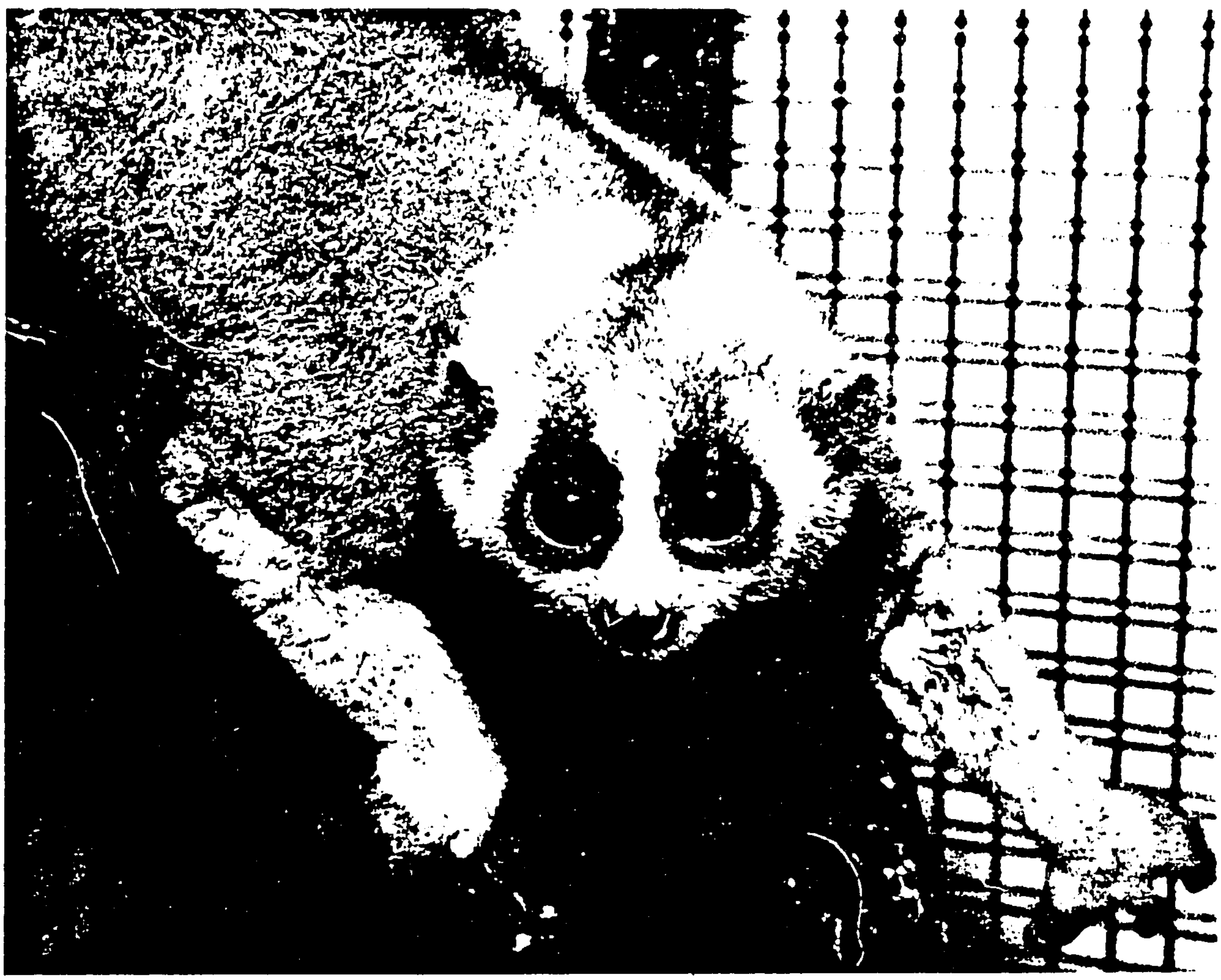

Fig. 9: The slow loris (*Nycticebus coucang*), a nocturnal prosimian found in Thailand and a number of other Southest Asian countries (photo by R. A. Mittermeier).

Burma

Species Conservation Priorities in Burma

John Blower

Introduction

Burma (Fig. 1), with a total area of 676,756 km^2, extends from latitude 10° N in the extreme south, to latitude 28° N on the northern border with Tibet, a total distance of some 2093 km. Between these two extremes there exists an ecological spectrum of almost unique variety, ranging from tropical rainforest and coral reefs in the south to temperate forests of conifers, oaks and rhododendrons in the far north, where snow-capped mountains up to 5792 m mark the eastern extremity of the Himalayas.

High mountain ranges form a continuous barrier along the western border with India and Bangladesh, extending southward parallel with the coast nearly to the Irrawaddy Delta. In the northeast the border with China follows the high crest of the Irrawaddy-Salween divide, then bulges out eastward to enclose the Shan Plateau, a vast area of rugged mountain country bordering with Laos and Thailand. Between these mountain barriers to the west and east lies the fertile, heavily populated basin of the Irrawaddy, with its largest tributary, the Chindwin, joining it from the northwest. Burma's other great river, the Salween, flows south through neighboring Yunnan and then cuts through the Shan Plateau in deep, heavily forested gorges before finally reaching the sea in the Gulf of Martaban. Further south, Tenasserim extends in a long mountainous arm bordering with Thailand down to the Kra Isthmus.

Apart from the northern uplands of Kachin State, the climate of Burma is tropical monsoonal, with a rainy season coinciding with the southwest monsoon from May to October and a generally well marked dry season from November to April. There are, however, important local variations, with mean annual rainfall ranging from as little as 762 mm in parts of the central Dry Zone to over 6350 mm in Tenasserim.

The population is about 33 million with an average density ranging from less than 10 per km^2 in some of the peripheral mountain areas to nearly 350 in the very heavily populated Rangoon Division, and over 116 in the Irrawaddy Delta, giving an overall density of about 46 per km^2, which is well below the average for southeast Asia. The annual population growth rate has been fairly constant in recent years at about 2.2%. Agriculture, including timber production, employs two-thirds of the work force and 76% of the population still lives in rural areas.

The officially quoted figure of 57% overall forest cover in Burma is somewhat out of date. The report of the FAO/UNEP Tropical Forest Resources Assessment Project (FAO/UNEP, 1981), based on analysis of Landsat satellite imagery, estimated about 47% forest cover in 1980, including all types of woody growth such as scrub woodland and bamboo in addition to high forest. The annual rate of deforestation through shifting cultivation and other causes was estimated at around 101,175 hectares per year.

Forests may be broadly divided into four main categories:

1. *Tropical moist forest*, which includes the evergreen dipterocarp rainforest) of the high rainfall areas in Tenasserim, Kachin State, and Upper Chindwin; the semi-evergreen forests of Arakan and parts of North Burma, and the extensive moist deciduous forests, which are of great importance for production of teak and other commercial hardwoods. It also includes the various types of tidal and fresh water swamp forests.
2. *Tropical dry forest;* mixed deciduous forests including *indaing* — characterized by the presence of *Dipterocarpus tuberculatus*, dry teak forest and other types of rather open, stunted woodland found in the drier areas.
3. *Montane sub-tropical forests;* typically including *Quercus, Castanopsis* and pines *(Pinus merkusii* and *P. insularis)* in mountain areas from 915-1524 m, and sometimes higher.
4. *Montane temperate forests;* occurring between 1524 and 3659 m, and characterized by *Quercus, Castanopsis, Schima*, pines *(P. excelsa* and *P. wallichiana)*, and at highest elevations in north Burma, *Tsuga, Abies, Betula* and rhododendrons.

Species Conservation in Burma

Most of Burma lies within the Indochinese Zoogeographic subregion of the Oriental region, with the Arakan and Chin Hills in the Indian sub-region, and the high mountains of the extreme north, with their typically Himalayan species, in the Palearctic region.

Large mammals such as elephant *(Elaphas maximus)*, gaur *(Bos gaurus)*, banteng *(Bos javanicus)*, sambar *(Cervus unicolor)*, barking deer *(Muntiacus muntjak)*, tiger *(Panthera tigris)* and leopard *(P. pardus)* are widely distributed in the less disturbed forested regions of most of Burma apart from the far north. But in the absence of factual data their status is uncertain. Two species of rhinoceros formerly occurred in Burma, of which the Javan rhinoceros *(Rhinoceros sondaicus)* is already extinct and the Sumatran *(Dicerorhinus sumatrensis)* probably so.

Among other larger mammals, the distributions of which are more localized, are hog deer *(Cervus porcinus)*, musk deer *(Moschus moschiferus)*, thamin *(Cervus eldi)* — in the drier areas of central Burma, tufted deer *(Elaphodus cephalophus)* from the northeast border with Yunnan, and two species of mouse deer *(Tragulus napu* and *T. javanicus)* in Tenasserim. There are also three species of goat-antelope; takin *(Budorcas taxicolor)* — which occurs only in the north of Kachin State, serow *(Capricornis sumatraensis)* and goral *(Nemorhaedus goral)*. Tapir *(Tapirus indicus* Fig. 2) were formerly found in mainland Tenasserim ap-

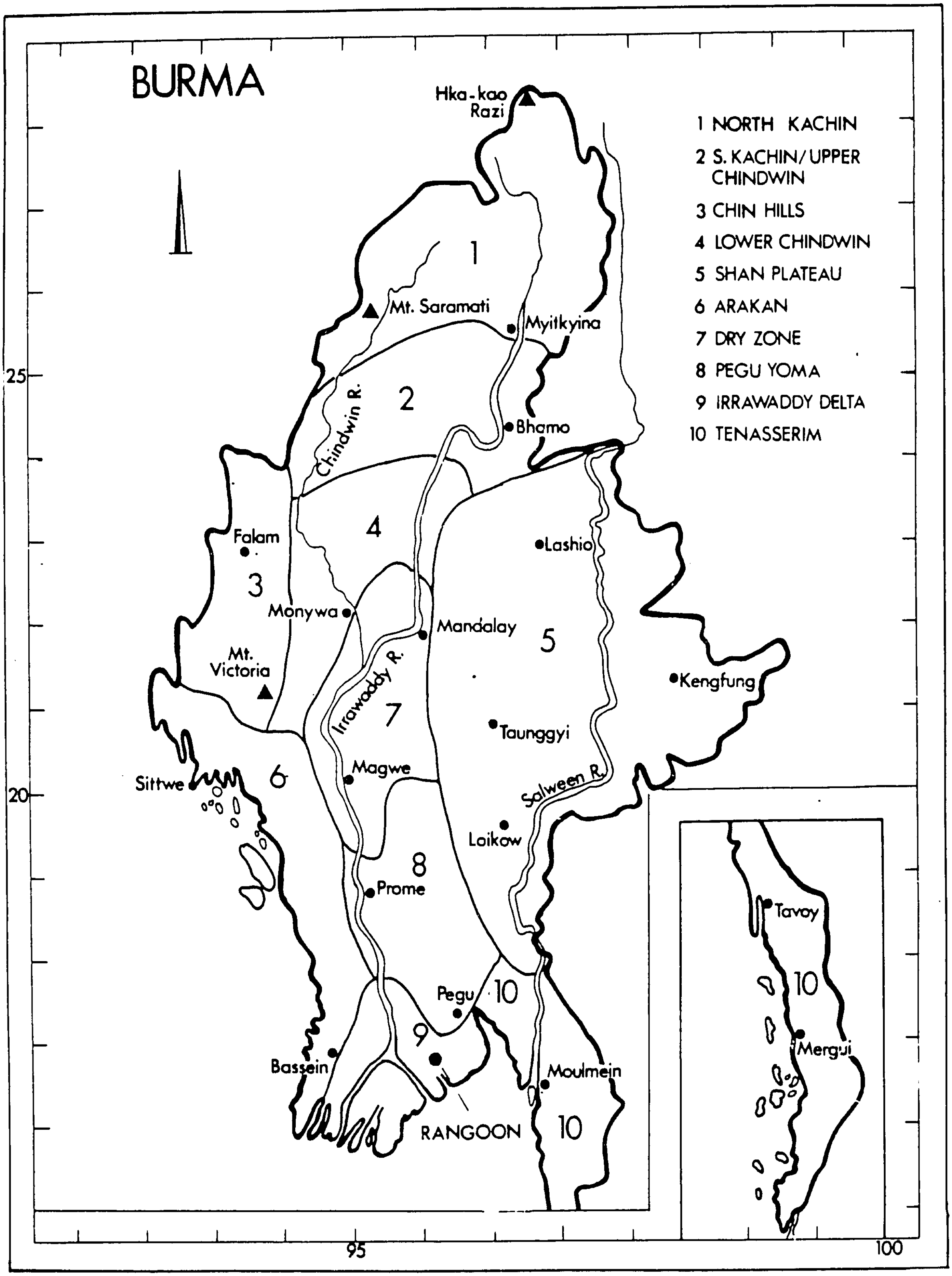

Fig. 1: Map of Burma showing major geographical subdivisions, towns and rivers.

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proximately as far north as latitude 18° N, but whether their present range extends so far north is uncertain.

Carnivores include two species of bear (*Helarctos malayanus*; Fig. 3) and *Selenarctos thibetanus*), clouded leopard (*Neofelis nebulosa*), wild dog (*Cuon alpinus*), Asiatic jackal (*Canis aureus*) and, in northern Kachin State, red panda (*Ailurus fulgens*), and possibly wolf (*Canis lupus*).

Among primates, several species of *Macaca* and *Presbytis* are fairly widely distributed, and there are also two gibbons, the hoolock (*Hylobates hoolock*) of Upper Burma and the white-handed gibbon (*H. lar*) of Tenasserim.

Marine mammals and reptiles occurring in coastal waters and riverine estuaries include the now very rare dugong (*Dugong dugon* Fig. 4), the salt water crocodile (*Crocodilus porosus*) and possibly five species of marine turtle, of which the commonest are the green turtle (*Chelonia mydas*) and probably the olive ridley (*Lepidochelys olivacea*) (although the latter has in the past been confused with the loggerhead (*Caretta caretta*) and the relative status of the two species is unclear).

About one thousand bird species have been recorded from Burma (Smythies, 1953), this relatively high species diversity being due to the fact that the country extends into two zoogeographic regions, each with different bird faunas. The forests of Tenasserim contain many Malesian species, whereas in the central and northern part of the country the bird fauna has Indian and Chinese affinities. A large number of Himalayan species occur in the montane forests of north and west Burma. There are relatively few endemic species (Sayer, 1983).

There is, as yet, little information on the status, distribution and ecology of individual species, though there is no evidence that any major species is seriously endangered, apart from vultures, which have practically disappeared from most of Burma in recent years.

The main threats to bird life are the conversion of wetlands to agriculture, the habitat of waterfowl and waders including the large numbers of migratory species which winter in Burma, hunting and trapping, especially of pheasants and peafowl, and the use of agricultural pesticides such as Endrin, which is a serious threat to scavengers and seed-eaters. The principal conservation needs for birds are the protection of sufficient areas of natural habitat, especially wetlands, and research to obtain data on the status and distribution of individual species, particularly those which are either rare or endemic to Burma.

Wildlife conservation has hitherto been the responsibility of the Forest Department. Apart from the Reserved Forests which total 90,673 km², or approximately 13.5% of the total land area, there are 14 wildlife sanctuaries. However, most are relatively small, their aggregate area being only 4,728 km², or approximately 0.7% of the total land area.

Apart from the inadequate size of existing protected areas, both individually and in aggregate, they also fail to provide representative coverage of several important biota, including the northern temperate forests, the evergreen dipterocarp forests of Tenasserim, and coastal areas including the Irrawaddy Delta and the Mergui Archipelago with its coral reefs.

Under existing legislation, which dates from the pre-World War II colonial era, the fauna in wildlife sanctuaries is protected but the habitat is not, with the result that many areas and species have suffered serious damage. Moreover, in most cases effective protection of wildlife has not been possible due to shortage of Forest Department staff.

Wildlife in Reserved Forests enjoys a certain degree of legal protection and may not be hunted without a special permit. But here again, effective law enforcement is difficult due to staff shortages and the large numbers of firearms in the hands of the military and para-military People's Militia.

Fig. 2: The Malayan tapir (*Tapirus indicus*) an endangered species from Burma (photo by R. A. Mittermeier).

Fig. 3: The sun bear (*Helarctos malayanus*), one of two bear species found in Burma (photo by R. A. Mittermeier).

In 1981, the Government, with assistance from FAO/UNEP introduced a new Nature Conservation and National Parks project with the object of ensuring more effective protection of flora, fauna and natural landscapes, including establishment of national parks and other protected areas. Preliminary surveys of over twenty potential sites have been completed (June, 1983), and several have been identified as suitable for establishing national parks, nature reserves or sanctuaries. Other areas, particularly in northern Burma, still remain to be surveyed.

Species Conservation Action Priorities

The most urgent priorities are the conservation of large mammals, particularly elephants, marine turtles and the saltwater crocodile. In the almost total absence of reliable data on the present status of wildlife populations in Burma it is impossible to give anything other than a very subjective impression of the degree to which individual species may or may not be endangered.

Elephant (Elaphas maximus). The elephant is of major economic importance to Burma for extraction of teak and other hardwoods, which are one of the country's main sources of foreign exchange. There are approximately 5,400 captive elephants in Burma, most of which are employed in the timber industry. However, the annual reproductive rate among timber elephants is only about 5.3 per 100 breeding females, which, allowing for mortality, is insufficient to maintain this population without influx from the wild. Consequently, it is necessary to continue the capture of wild elephants at an average rate of about 120 per year.

Estimates of the wild elephant population in Burma range from 3,000 to 6,000, but observations in the limited areas covered so far by our surveys indicate that the lower figure is probably the more realistic. Mortality in capture operations is officially admitted to be about 20%, and may even be higher. There is also a significant amount of illegal capture and smuggling of elephants to Thailand, and also poaching for ivory (38 animals are known to have been successfully smuggled to Thailand in recent months and a further 11 were intercepted en route and confiscated). Therefore, while it is not yet possible to give any reasonably accurate estimate of actual numbers, it is certain that the overall annual offtake from legal and illegal capture and poaching is appreciable.

In nearly all the areas so far surveyed the elephant population has been found to be appreciably lower than previous official estimates. It is therefore reasonable to assume that the overall population is also considerably lower than the official figure of about 6,000, and that with continuing offtake, known and unknown, numbers are steadily declining.

ACTION REQUIRED:
1. Field research to obtain data on the present status and distribution of wild elephants and to monitor future trends;
2. Based on results of the above, to establish elephant ranges or nature reserves of sufficient size wherein viable populations can be effectively protected;
3. Study of the management of captive elephants, with a view to increasing the birth rate to a level where the population can be self-sustaining;
4. Progressive reduction in numbers of capture permits issued, combined with law enforcement to control poaching, illegal capture and smuggling.

Rhinoceros (Dicerorhinus sumatrensis). This species formerly occurred in Kachin State, Upper Chindwin, Arakan, Mongmit/Mandalay Division, Kayah State and Tenasserim, but there have been no recent confirmed reports of its survival in any of these areas and it may already be extinct.

The only areas where it has been reported to occur during the past 20 years are the Tamanthi Wildlife Sanctuary in Upper Chindwin and Shwe-u-daung Sanctuary on the border between Mongmit and Mandalay Divisions. However, both these areas have been subject to extensive insurgent activity, and it is doubtful that any rhino still survive. Surveys of both areas are planned for the 1983/84 dry season.

ACTION REQUIRED:
1. Surveys of Tamanthi and Shwe-u-daung Wildlife Sanctuaries and any other appropriate areas to determine whether or not any rhinoceros survive;
2. Subject to confirmation of their survival in any area, to plan and implement effective conservation measures without delay (including possible upgrading of the area concerned to National Park or Nature Reserve status).

Thamin (Cervus eldi thamin). The Burmese subspecies of this deer is confined to the drier areas of central Burma, and there have also been unconfirmed reports of its occurrence in Paan Division to the east of the Salween, near the Thai border. Although fully protected by law, thamin are widely hunted, but fortunately appear able to withstand hunting pressure moderately well and

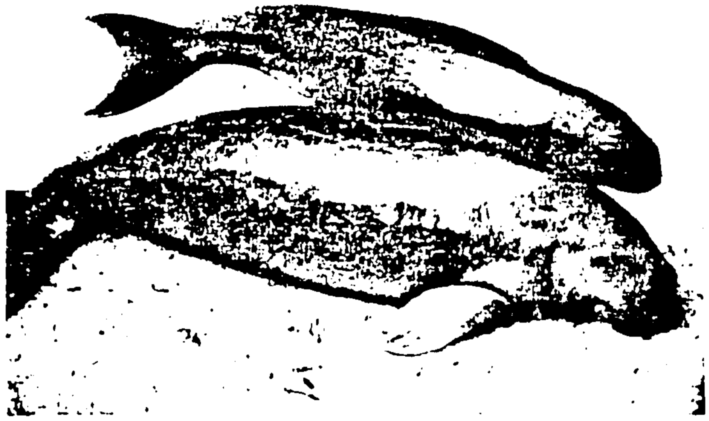

Fig. 4: The dugong (*Dugong dugon*), now very rare in Burman coastal waters (photo by R. A. Mittermeier).

also to adapt to habitat changes. However, their range has been considerably reduced, and although they are spottily distributed throughout much of Shwebo Division and elsewhere in central Burma, the only population which can be regarded as truly viable is in the Kyatthin Wildlife Sanctuary in Shwebo Division. There are believed to be about 2,000 thamin there and a few hundred in the somewhat larger, but much degraded Shwezettaw Wildlife Sanctuary to the west of the Irrawaddy in Minbu Division.

Thamin are vulnerable, but not yet endangered, though conservation measures are needed if they are to survive in the long-term.

ACTION REQUIRED:
1. Enlargement of the Kyatthin Wildlife Sanctuary with realignment of boundaries to exclude villages presently contained within;
2. Upgrade the status of Kyatthin to Nature Reserve with provision of sufficient staff to protect it;
3. Full protection of thamin elsewhere, with severe penalties for illegal hunting; and
4. A research program on thamin ecology.

Wild Cattle (Bos spp.). Gaur *(Bos gaurus)* and banteng *(Bos javanicus)* occur throughout much of Burma in areas where there is still good forest cover and little human disturbance, gaur generally preferring more hilly country than the banteng. Although theoretically protected, both species are heavily hunted and are becoming increasingly scarce. Both are vulnerable, if not endangered.

ACTION PRIORITIES:
1. Establish one or more national parks or nature reserves of adequate size wherein there are viable populations of these species and provide sufficient staff to protect them (the proposed Alaungdaw Kathapa and Pegu Yoma National Parks would be very suitable for this purpose);
2. Enforce the law to stop the killing of these animals for meat, especially by the Army and the People's Militia;
3. Survey to ascertain status and distribution as a basis for further conservation planning.

Tiger (Panthera tigris). Burma is the only country where the tiger occurs that it is not protected by law. When the present law was introduced (1936), tiger were still plentiful in Burma, causing considerable damage to domestic livestock and constituting a serious menace to human life in certain areas. Consequently, they were at that time regarded as "vermin" and were not placed on the protected list.

The situation today is very different. There are a few isolated areas such as the proposed Alaungdaw Kathapa National Park where tiger are still relatively plentiful. But in most areas they are now rare, as has been clearly shown by recent field surveys, which revealed very few signs of tigers. This is probably due both to scarcity of prey species such as the heavily hunted sambar, and also to hunting, trapping and poisoning of the tigers themselves. Tiger skins are readily obtainable in Bangkok where they fetch as much as US $1,000 apiece. Most of these have come from Burma where they have been trapped, shot or poisoned with the highly toxic and widely available agricultural pesticide Endrin.*

Tiger in Burma are not yet seriously endangered, but they will be, as elsewhere in southeast Asia, unless positive steps are taken for their conservation.

ACTION PRIORITIES:

1. Place the tiger on the fully protected list of wildlife, except in cases of proven man-killing, with severe penalties for hunting or possession of skins;
2. Establish national parks or reserves in areas where there are still good populations of tigers and prey species;
3. Conduct an education campaign to convince the public that tigers are a beautiful and increasingly rare species, important in Burmese culture and tradition, and that they will inevitably disappear unless protected.

Saltwater Crocodile (Crocodilus porosus). Formerly widely distributed in estuaries and tidal swamps of Arakan, the Irrawaddy Delta and Tenasserim, crocodiles have been heavily hunted for skins and are now very seldom seen. Another major factor in their decline has been the loss of habitat due to extensive clearing of mangroves for rice cultivation. There are, however, apparently still viable populations in the Irrawaddy Delta where the People's Pearl and Fisheries Corporation (PPFC) collects an average of about 500 hatchlings a year for their crocodile farm in Rangoon. Also, there are still possibly viable populations in less disturbed coastal areas of Arakan and Tenasserim where there are still extensive areas of suitable habitat among the tidal creeks and mangrove swamps.

The PPFC has proposed that Meinmahla Kyun, an estuarine island about 130 km² in area in the Irrawaddy Delta, be declared a sanctuary for this species. The crocodile population is, however, very small with no sign of breeding. Restocking from the crocodile farm will therefore probably be necessary.

ACTION PRIORITIES:

1. Full legal protection for this species, except for the collection of a limited number of hatchlings by PPFC under permit;
2. Heavy penalties for possession of crocodile skins;
3. Establishment of Meinmahla Kyun as a sanctuary for protection of crocodiles with restocking as necessary;
4. Surveys in Arakan and Tenasserim to obtain data on status and distribution, and identify suitable conservation areas.

Marine Turtles. The five species of marine turtles reportedly occurring in Burmese coastal waters are as follows:

— Green turtle *(Chelonia mydas)* — Commonest species on Thamihla Kyun.
— Olive ridley *(Lepidochelys olivacea)* — Fairly common off the Irrawaddy Delta.
— Loggerhead *(Caretta caretta)* — Status uncertain, but reported to be fairly common in the Delta region.
— Hawksbill *(Eretmochelys imbricata)* — Rare.
— Leatherback *(Dermochelys coriacea)* — Very rare.

There are turtle nesting beaches along the coast and on certain offshore islands in Arakan, the Irrawaddy Delta and Tenasserim, of which the most important appear to be Thamihla Kyun (Diamond Island) off the mouth of the Bassein River, Kadonly and Gayedgyi Islands off the mouth of the Bogale River, and Aung Bok in the South Moscos Islands (Tenasserim).

Both Thamihla Kyun and the Moscos Islands are legally established Wildlife Sanctuaries, but nearly all the turtle eggs laid are taken from the former by the PPFC and from the latter by a local contractor with a Forest Dept license. Eggs are also taken from all other known nesting sites.

Past records show that at the beginning of this century 1.5-2 million eggs a year were being harvested from Thamihla Kyun. The average annual offtake today is only about 150,000, a 90% reduction. Many former nesting beaches are no longer visited by any turtles. Apart from egg collection, mature turtles are taken by fishermen, reportedly including PPFC trawlers which catch them in their nets. Hawksbill turtles are killed for their "tortoise shell".

From the enormous reduction in the number of eggs collected from Thamihla Kyun and elsewhere and the fact that many of the formerly well known nesting beaches are now unused, it is clear that turtle populations have declined markedly and that two species, the leatherback and the hawksbill, are endangered while the other three species must be considered seriously threatened. Leatherbacks are so rare that their occurrence should perhaps be considered accidental.

ACTION REQUIRED:

1. Establish Thamihla Kyun and South Moscos as effective wildlife sanctuaries and stop all collection of turtle eggs. South Moscos has been proposed as a future national park and has been approved in principle. Its designation as a park will, however, have to wait introduction of new legislation;
2. Declare Kadonly Kyun a wildlife sanctuary and provide sufficient staff, boats, etc , to protect it and the other two sanctuaries mentioned above. It appears that Kadonly Kyun attracts mainly olive ridley and the other two islands mainly green turtle;
3. Enlist cooperation of PPFC in not trawling in areas immediately seaward of sanctuaries and in releasing any turtles accidentally caught in nets; and
4. Survey by experienced marine biologist to determine the status and distribution of marine turtles in Burmese waters and to recommend further conservation action.

River Terrapin (Batagur baska). This endangered species still occurs in the Irrawaddy Delta and is reported to nest on certain of the offshore islands and sandbanks, including Kadonly Kyun, which has been proposed as a wildlife sanctuary. However, both the terrapin itself and the eggs are taken wherever they are found. The species is now very rare in Burmese waters and without effective conservation measures is likely to become extinct within the foreseeable future.

ACTION REQUIRED:

1. Full protection of both the terrapin and its eggs;
2. Establishment of Kadonly Kyun as a wildlife sanctuary;
3. Survey by a marine biologist to determine status and distribu-

*Note: The Government of Burma has recently prohibited further importation of Endrin and less toxic pesticides are being introduced in its place.

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tion (combined with a marine turtle survey) and to recommend further conservation action, including a possible hatchery on Kadonly Kyun or elsewhere.

Conclusion

Burma is a country of unusual ecological diversity, rich in a wide variety of flora and fauna. But, as elsewhere, the natural environment is increasingly threatened by shifting cultivation, illegal hunting, uncontrolled use of highly toxic pesticides and other harmful influences resulting from steady growth of the human population. Satellite monitoring shows that forest cover, though still greater in proportion to the total land area than in most southeast Asian countries, is diminishing at a steady rate. The Javan rhinoceros has already become extinct here, and other species, including the economically important elephant, marine turtles and saltwater crocodile, are seriously threatened.

The Government, having realized that effective conservation action is urgently needed, has, with UNDP/FAO assistance, initiated a nature conservation program which will include new legislation and establishment of national parks and other protected areas. Several suitable sites have already been identified in addition to the 14 wildlife sanctuaries already in existence.

Provided that viable populations of those species known to be threatened or endangered are effectively protected, together with sufficiently extensive areas of their habitat, their survival should be assured. Otherwise, they will inevitably go the same way as the Javan rhinoceros.

Though much work yet remains to be done, particularly in field research to determine the status and distribution of individual species, the broad basis for an effective nature conservation program now exists. Continued external assistance will be needed for some years, but ultimate responsibility for implementation of this program necessarily rests with the Burmese government.

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Table 1. Burma
Biogeographical Subdivisions Showing Distribution of Protected Areas, Existing and Proposed

Map Ref. No.	*Designation*	*Major rare, vulnerable or endangered species*	*Protected Areas* Existing	*Area (km²)*	*Proposed*	*Area (km²)*
1.	NORTH KACHIN	Takin, musk deer, wolf, red panda, elephant, rhinoceros (?), tiger, several pheasant species	Nil		Nil	
2.	SOUTH KACHIN/ UPPER CHINDWIN	Elephant, gaur, tiger, rhinoceros (?), Sarus crane	TAMANTHI W.S. PIDAUNG W.S.	2150 705	Nil	
3.	CHIN HILLS	Elephant (scarce), gaur, tiger	Nil		NAIMI TAUNG (Mt. Victoria) N.P. KYAUKPANDAUNG N.P.	363 132
4.	LOWER CHINDWIN	Elephant, thamin, gaur, banteng, tiger, wild dog	KYATTHIN W.S.	268	ALAUNGDAW KATHAPA N.P.	1606
5.	SHAN PLATEAU	Elephant, gaur, banteng, tiger, wild dog, Sarus crane	MAYMYO W.S. SHWE-U-DAUNG W.S. TAUNGGYI W.S.	127 207 16	INLE AND MONGPAI N.R.	41
6.	ARAKAN (RHAKINE)	Elephant, gaur, banteng, tiger, wild dog, salt-water crocodile	Nil		Nil	
7.	DRY ZONE	Thamin, gaur, banteng (in foothills), wild dog	SHWEZETTAW W.S. WETHTIGAN W.S. MINWUN TAUNG W.S.	552 5 206	POPA MOUNTAIN PARK	96
8.	PEGU YOMA	Elephant, gaur, banteng, tiger, wild dog	Nil		PEGU YOMA N.P. MOHINGYI N.R. GYOBYU RECREATIONAL AREA	1461 104 34
9.	IRRAWADDY DELTA	Marine turtle, saltwater crocodile, river terrapin, Irrawaddy dolphin (?)	THAMIHLA W.S. (Diamond I.)	1	MEINMAHLA KYUN W.S. KADONLAY KYUN W.S.	130 3
10.	TENASSERIM	Elephant, gaur, banteng, Fea's muntjak, marine turtle, salt-water crocodile, Argus pheasant	KAHILU W.S. KELATHA W.S. MULAYIT W.S. MOSCOS W.S.	161 25 139 49	LAMPI N.P. PAKCHAN N.R.	233 1451

Note: N.P. = National Park. N.R. = Nature Reserve. W.S. = Wildlife Sanctuary.

EXCERPTS FROM:

State of the Environment in Asia and the Pacific. United Nations Economic and Social Commission for Asia and the Pacific. Bangkok, Thailand. 1985. Volume One: Summary, pp.75.

II. Environment and Development

A. Resource Trends The suspended load per km2 of drainage basin, as an indication of soil erosion is 3 to 8 times more in Asia than the world average.

The annual decrease in the operable forest area is about 2 per cent in the region. Forest reserves will be halved from 351 million hectares in 1978 to 181 million hectares in 2000.

The carrying capacity of the grasslands for grazing livestock has already been reached.

The carrying capacity of croplands is under dpregressively increasing stress. Most of the increase in food production in the future is expected to come out of increased yields rather than an extension of the margin of cultivation. Land under cultivation is projected to increase between 4 and 15% durin 1980-2000. Despite increases in land area under cultivation, food reserves decreased from 234 million tons in 1960 to 151 million tons in 1980 (while food prices went up 300%). There was a corresponding decrease in arable area per capita from 0.48 hectare in 1951-1955 to a projected figure of about 0.25 hectare in 2000 (a 50% decline). By subregion, the projected figure in 2000 for South Asia is 0.13 hectare, for South-East Asia 0.20 hectare, and for East Asia 0.08 hectare. (These trends are clearly linked to population growth.)

Access to safe drinking water may become in 2000 even more remote than now.

The per capita fish catch is expected to reach a maximum of about 12.4kg/year in the near future and remain at that level through the year 2000 (and increase of only about 3% per capita) contingent upon the avoidance of over-fishing and protecting the aquatic environment from pollutants.

III. Terrestrial Ecosystems

A. Deforestation Deforestation is probably the most serious environmental debility in the region. Fuelwood collection by rural people for domestic energy needs is probably the most important cause. In many parts of the region this surpasses logging in the intensity and extent of damage caused. The demand for fuelwood exceeds availability. South Asia

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(Afghanistan, Bangladesh, Nepal and Pakistan) has the worst of the fuelwood problem. In India only about 1/4 of the fuelwood needs are met by official removals from forests, and Thailand the figure is about 1/2. The gap between consumption and production is filled by unrecorded removals, resulting in uncontrolled degradation (felling one tree can cause damage to anywhere from 3 to 10 other non-target trees). Insular Southeast Asia has the highest rate of forest degradation from logging, being a major exporter of hardwood. Shifting agriculture is another major contributor to deforestation. India is reported to have the highest incidence of forest degradation through grazing. Fires resulting from human activity are common.

B. Soil erosion and degradation.

Soil erosion is the second major scourge of the terrestrial environment which affects both cultivable and forest lands. 44% of the South Asia soils and 55% of Australasian soils suffers from drought, 59% of the Southeast Asia soils from mineral stress, and 38% of North and Central Asian soil from shallow depth. Thus 82 to 90% of the soil in the region have serious limitations for productivity. Further, in Asia the annual discharge of sediment by rivers is about 14.5 billion tons which is about 70% of the world's total. The most extensive soil erosion due to rain and typhoons occurs in Nepal and the Philippines. South Asia has the highest incidence of erosion by wind, occurring extensively in Pakistan and the arid parts of India.

Soil degradation due to water-logging and salinity arises mainly out of mismanagement sof irrigation systems. Corrective action consists of a programme of subsoil drainage by means of tubewells. Use of the trickle method of irrigation should also be considered.

C. Desertification The countries which suffer most from desertification are Bangladesh, India, Nepal and Pakistan. In Bangladesh there is a backflow of salt water into the river systems. About 12% of India's land, including the arid north-west and the semi-arid region stretching from the Punjab in the north-west to Tamil Nadu in the south. Nepal suffers from desertification mainly in the south-east corner of the country. Pakistan has 50% of its land area classified as arid plateau and mountain, and roughly another 10 million hectares is affected by water-logging and salinity.

D. Species extinction In the course of population growth and economic development, man-induced species extinction has become notably large. Hunting for sport and trophies, collection and hunting for food, pleasure, research and trade are recognized as the main causes of species extinction. However, habitat destruction is now recognized as the most important cause of species extinction. It comes in two forms, direct habitat destruction by removal of the resource (e.g. overexploitation) and indirect habitat destruction (e.g. pollution by chemicals or solid wastes and siltation

During 1960-1980, an estimated 20,000 plant species and more than 1,000 vertebrate species were threatened with extinction. The current number of species in the region is estimated at between 300,000 and one million. The number of species which are likely to become extinct during 1980-2000 may lie between 33,000 and 110,000. The largest number of extinctions are expected in the insect order, the next largest in the plant order and in the third place comes the extinction of mammals, birds and reptiles.

IV. Aquatic Ecosystems

A. Impact of development on aquatic ecosystems The increase in population in the region has caused severe stress on the aquatic resources. Organic and biological pollution in the inland and estuarine waters near the urban centres, industrial and port cities is mainly due to dumping of untreated or partially treated domestic wastes into the nearest water area or into the sea.

The use of pesticides and fertilizers is a significant cause of aquatic pollution in the region.

Red tides (paralytic shellfish poisoning caused by a microorganism) have often occurred in coastal areas of India, the Philippines, Sri Lanka and Thailand. The practice of fishing by using poisons and explosives is another source of pollution and resource degradation of the sea, particularly in coral reefs. Collection of corals and shells for sale or through tourism and recreational activities contributes to coral reef damage. Areas which are already considered over-exploited are: the Gulf of Thailand, the western coast of India, Laguna Bay area in the Philippines. Countries having extensive fresh water fisheries are Bangladesh, China and India.

There are a number of endangered species in the region with high economic importance. Examples include sea turtles, whales, spiny lobsters, crocodiles, the gian clam, precious corals, and slit pencil urchins. Examples of marine national parks established to protect these and other species are located in the Strait of Mannar, Tamil Nadu, and the West Coast of Gujarat in India, and Sombrero island marine park in the Philippines.

C. Aquatic pollution

In Bangladesh, there is extensive silt and sedimentation carried by the river system. Aquatic pollution is mainly due to untreated or partially treated discharge of domestic wastes into the river system. In addition there are localized problems of water being polluted from pulp and paper mill and tannery wastes.

In India, domestic wastes contribute about 90 % of the total pollution, while 7% is contributed by large and medium scale industries and 3% by small-scale industries. The Sabarmati river near Ahmedabad and the Ganga river near Varanasi and Kanpur are the most polluted stretches. The Mahi, the Narmada, the Tapi, the Krishna, the Cauvery, the Pennar, the Godavari and the Subarnarekha are also seriouisly polluted in stretches.

In Pakistan, major rivers (the Kabul, the Rabi, the Leh and the Lyari) are severely polluted when passing through the dense areas of Karachi, Rawalpindi and other cities. The Karachi coastline is the most polluted stretch as a result of domestic and industrial effluents.

In the Philippines, domestic sewage is the main source of pollution followed by industrial and mining sources. In the Pasig River, 70% of the pollution load is contributed by domestic wastes. Twenty eight sugar centrals and ten distilleries are heavy producers of organic pollutants. 24 paper mills cause pollution in the 17 river systems.

In Sri Lanka, Kelani river is severely polluted both from domestic wastes and from effluents from tanneries, tire factories, oil refinery and steelmill.

Severe water pollution is common throughout Thailand, especially in Maeklong, Chao Phraya, Tachin and Pranburi rivers. Waste from sewage, sugar and distillery units, mining activities, synthetic fabric factories etc. have contributed to this pollution. There has been deterioration in the groundwater around Bangkok due to saline intrusion from sea water or from nearby saline aquifers.

In India, over 700 of the 1,700 water pollution-relevant industries have already established treatment plants. Special measures have been initiated in the Philippines to reduce the pollution of the Pasig River and the Laguna Lake and to prevent degradation of mangroves. Sri Lanka and Thailand, in co-operation with ESCAP, have developed Coastal Area Management Plans for the Greater Colombo area and the Gulf of Thailand, respectively. Community waste-water treatment plans have been established for sugar mills in Thailand. Several countries including India, and the Philippines have surveyed and classified the rivers, lakes and marine waters depending upon the best usage, and efforts are mainly centred on retaining that usage. Industry-specific water quality standards have been formulated in most of the countries facing grave pollution of their aquatic environment. Economic instruments such as subsidies, tax concessions, customs duty exemptions etc. have been utilized in India, the Philippines and others to facilitate the installation of pollution abatement devices. Despite vigorous efforts by the countries, the pollution levels in the rivers and water bodies have not been substantially reduced.

V. Atmospheric Ecosystems

A. Air Pollution In the ESCAP region, air pollution is already of serioius dimension in major cities such as Bangkok, Bombay, Karachi, and Manila. In Bangladesh, the level of air pollution is not a serious problem but noise and smoke pollution from heavy vehicles sometimes reach high levels in urban areas. In India, high levels of suspended particulates have been recorded in Delhi, Hzderabad and Kanpur, while sulfur dioxide concentrations show a high figure in Ahmedabad and Bombay. Industrial cities such as Bhilai and Jashedpur are severely polluted due to iron and steel factories. The Philippines and Thailand face the same set of problems caused by growing numbers of automobiles, thermal electric units, and lead smelting, chemical industry and metallurgical industry plants. The dust concentration in some metropolitan cities in these countries is high, and is said to be between 4 and 9 times higher than the international standard level. About have of the carbon dioxide released by fossil fuel combustion remains in the atmosphere. The increase in carbon dioxide anticipated worldwide by 2150 may lead to an increase in global mean temperature of more than 6o C. The impact of such a rise in the temperature could be a melting of the ice-caps, and rising levels of the oceans. Even before this happens, global food production might be affected due to changes in rainfall patterns and desertification of the delicately balanced marginal lands now used for agriculture.

VI Urbanization and the Environment

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Between 1980 and 2000 the region's overall population will increase by about 40%, its rural population by about 25%, and its urban population by about 95%.

The residents of the region suffer particularly gastro-intestinal and respiratory diseases, both related to the environmental conditions and to the heavy demand for shelter.

The large cities in Asia like Bangkok, Bombay, Calcutta, Jakarta, Manila and Singapore, face the traditional environemtnal problems such as lack of sanitation, chronic shortage of services, polluted air and water, lack of open space and recreational areas, traffic congestion, etc. Thus they face the critical and complex environmental problems which adversely affect the carrying capacity of ecosystems to sustatin such giant conurbations at existing levels of growth and consumption. There has been almost a four fold increase in the provision of urban water supply during the last 20 years. The domestic waste disposal in the cities is a major problem because the urban population lacks sewer systems. In 1975, 26% of the population was served by sewer systems.

Though the larger public sector factories have often their own waste water disposal systems, there are many private sector factories with no such facilities. Waste water causes water pollution, obnoxious odors and air pollution, harbors disease vectors such as insects, and contributes to other health hazards.

Bangladesh has elected to address the most crucial of basic needs, access to safe water, and has managed to sink 400,000 rural tube wells, mostly with the assistance of UNICEF.

VII. Human Health

A. Level of development and human health In the Philippines and Thailand, til fifty years ago, gastroentrisis, diarrhea, malaria, diseases of women during pregnancy and confinement, respiratory systems diseases and tuberculosis were the major killers. Now traffic accidents, toxic substances, heart diseases and cancer take the major toll of human lives. It is the manifestation of transformation from a relatively traditional society to more affluent living styles.

B. Environmental pollution and human health Inadequate water supplies for drinking and other uses and inefficient or non-existent sanitation facilities are another aspect of poverty in its relationship to environmental health. In a real sense they could be the determinants of environmental health. Indeed Dr. Halfden Mahler, the Director-General of the WHO, said at the

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United Naitons General Assembly in November 1980, "The number of water taps per thousand persons will become a better indicator of health than the number of hospital beds." What is more, 80% of the diseases in the developing world are directly traceble to unsafe water and poor sanitation.

The diseases caused by lack of water and sanitation can be classified into five categories. These are: a. water-borne diseases such as typhoid, cholera, dysentery, gastro-enteritis, and infectious hepatitis, b. water washed infections of the skin and eyes such as trachoma, scabies, yaws, leprosy, conjunctivitis, and ulcers, c. water-based diseases such as schistosomiasis and the guinea-worm, d. diseases with water-related insect vectors (mosquitoes and blackflies need water for breeding), e. infections that are primarily caused because of defective sanitation such as hook-worm, etc.

At any one time in the world 50% of the people sufferin from these diseases (except river blindness) are found in Asia at any one time. Over 3 million cases of intestinal infections were observed in India in 1981. the Philippines indicated approximately 2.1 million, and Pakistan showed over 1.7 million cases. Lack of proper control over domestic water sources and lack of sewage disposal faciliteis are chief contributing causes.

A WHO estimate in 1984 shows that 40% of the mortality and 60% of the morbidity of the developing countries in the ESCAP region were due to the impact of water-borne diseases.

There is a relationship between the increase in air pollution and the rise in the incidence of respiratory diseases.

C. Toxic substances and human health

WHO has estimated that globally there were 500,000 cases of pesticide poisoning in 1972, of which 9,200 cases proved to be fatal (extrapolation to 1982 gave figures of 9,750,000 cases of poisoning with at least 13,300 deaths).

APPENDIX

Lists of Threatened Animal Taxa

Prepared by the

IUCN Conservation Monitoring Centre

Kew and Cambridge U.K.

March 15, 1985

The lists which follow are presented by country followed in some cases by island or major island group. For each entry the taxon name, common name, and catagory are given.

The catagories are:

E = Endangered
I = Indeterminate Status
R = Rare
V = Vulnerable

Countries are listed by alphabetical order.

15 March 1985

List of Threatened Animal Taxa From CMC

BURMA

Taxon name	Common name	W Cat
Order CICONIIFORMES		
Family Threskiornithidae		
Pseudibis davisoni	White-shouldered Ibis	I
Order ANSERIFORMES		
Family Anatidae		
Cairina scutulata	White-winged Wood Duck	V
Order FALCONIFORMES		
Family Falconidae		
Falco peregrinus	Peregrine Falcon	V
Order GALLIFORMES		
Family Phasianidae		
Lophopharus sclateri	Sclater's Monal	R
Pavo muticus	Green Peafowl	V
Pavo muticus imperator	Green Peafowl	V
Pavo muticus spicifer	Green Peafowl	V
Syrmaticus humiae	Hume's Bar-tailed Pheasant	R
Syrmaticus humiae burmanicus	Hume's Bar-tailed Pheasant	R
Syrmaticus humiae humiae	Hume's Bar-tailed Pheasant	R
Tragopan blythii blythii	Blyth's Tragopan	R
Family A14030		
Tragopan blythii	Blyth's Tragopan	R
Order CHARADRIIFORMES		
Family Scolopacidae		
Tringa guttifer	Nordmann's Greenshank, Spotted Greenshank	
Limnodromus semipalmatus	Asian Dowitcher	R
Order CORACIIFORMES		
Family Bucerotidae		
Rhinoplax vigil	Helmeted Hornbill	I
Order PASSERIFORMES		
Family Pittidae		
Pitta gurneyi	Gurney's Pitta	I
Order LEPIDOPTERA		
Family Papilionidae		
Teinopalpus imperialis	Kaiser-I-Hind, Kaiserhind	R
Family Danaidae		
Tirumala gautama		R
Family Satyridae		
Lethe ramadeva		R
Ypthima dohertyi persimilis		R

Taxon name	Common name	W Cat
Order CARNIVORA		
Family Canidae		
Cuon alpinus	Asiatic Wild Dog, Dhole, Red Dog	V
Family Felidae		
Felis marmorata	Marbled Cat	I
Felis temmincki	The Asiatic Golden Cat, Temminck's Cat	I
Neofelis nebulosa	Clouded Leopard	V
Panthera pardus	Leopard	V
Panthera tigris	Tiger	E
Order PROBOSCIDEA		
Family Elephantidae		
Elèphas maximus	Indian Elephant, Asian Elephant	E
Order SIRENIA		
Family Dugongidae		
Dugong dugon	Dugong	V
Order PERISSODACTYLA		
Family Tapiridae		
Tapirus indicus	Malayan Tapir	E
Family Rhinocerotidae		
Didermocerus sumatrensis	Sumatran Rhinoceros	E
Rhinoceros sondaicus	Javan Rhinoceros	E
Order ARTIODACTYLA		
Family Cervidae		
Moschus moschiferus moschiferus	Himalayan Musk Deer, Siberian Musk Deer	V
Muntiacus feae	Fea's Muntjac	E
Family Bovidae		
Bos gaurus	Gaur, Indian Bison	V
Bos javanicus	Banteng	V
Bubalus bubalis	Water Buffalo, Wild Asiatic Buffalo	V
Order TESTUDINES		
Family Cheloniidae		
Caretta caretta	Loggerhead Turtle, Tortuga de mar, Cares, Tartaruga domar, Uruana, Suruana	V
Eretmochelys imbricata	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira & de Pente	E
Lepidochelys olivacea	Olive Ridley Turtle, Pacific Ridley Turtle, Tortuga verde, Parlama	E

Family Dermochelyidae		
<u>Dermochelys coriacea</u>	Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga	E
Family Emydidae		
<u>Batagur baska</u>	Batagur, River Terrapin, Tuntong, Sungei	E
Family Testudinidae		
<u>Geochelone emys</u>	Burmese Brown Tortoise	K
<u>Geochelone impressa</u>	Impressed Tortoise	K
<u>Geochelone platynota</u>	Burmese Starred Tortoise	K
Order SERPENTES		
Family Boidae		
<u>Python molurus</u>	Indian Python, Burmese Python	V
<u>Python molurus bivittatus</u>	Burmese Python	
Order CROCODYLIA		
Family Crocodylidae		
<u>Crocodylus porosus</u>	Estuarine Crocodile, Salt-water Crocodile	V

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List of Threatened Animal Taxa from CMC

INDONESIA

Taxon name	Common name	W Cat
Order PELECANIFORMES		
Family Fregatidae		
Fregata andrewsi	Christmas Frigate Bird	V
Order CICONIIFORMES		
Family Ciconiidae		
Ciconia episcopus stormi	Storm's Stork	I
Mycteria cinerea	Milky Stork	V
Order ANSERIFORMES		
Family Anatidae		
Cairina scutulata	White-winged Wood Duck	V
Order FALCONIFORMES		
Family Falconidae		
Falco peregrinus	Peregrine Falcon	V
Order GALLIFORMES		
Family Megapodiidae		
Macrocephalon maleo	Maleo	V
Family Phasianidae		
Lophura bulweri	Bulwer's Wattled Pheasant	V
Pavo muticus	Green Peafowl	V
Pavo muticus muticus	Green Peafowl	V
Order CHARADRIIFORMES		
Family Charadriidae		
Vanellus macropterus	Javanese Wattled Lapwing	I
Family Scolopacidae		
Tringa guttifer	Nordmann's Greenshank, Spotted Greenshank	I
Limnodromus semipalmatus	Asian Dowitcher	R
Order CORACIIFORMES		
Family Bucerotidae		
Rhinoplax vigil	Helmeted Hornbill	I
Order PASSERIFORMES		
Family Sturnidae		
Leucopsar rothschildi	Rothschild's Starling	E
Order LEPIDOPTERA		
Family Papilionidae		
Graphium (graphium) stresemanni		R
Atrophaneura (a.) luchti		R
Atrophaneura(losaria palu		K
Troides (troides) prattorum		I
Troides (troides) dohertyi		V
Ornithoptera goliath	Goliath Birdwing Butterfly	R

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Taxon name	Common name	W Cat
Ornithoptera tithonus		K
Ornithoptera rothschildi		V
Ornithoptera chimaera		V
Ornithoptera paradisea		V
Ornithoptera meridionalis		V
Ornithoptera aesacus		I
Ornithoptera croesus		V
Papilio (princeps) jordani		R
Papilio (princeps) neumoegeni		V
Family Danaidae		
Euploea caespes		R
Euploea dentiplaga		R
Euploea eupator		R
Euploea latifasciata		R
Order LEPIDOPTERA (cont.)		
Family Danaidae (cont.)		
Ideopsis klassika		R
Ideopsis oberthurii		R
Parantica kuekenthali		R
Parantica menadensis		R
Parantica philo		R
Parantica wegneri		R
Order MESOGASTROPODA		
Family Cymatidae		
Charonia tritonis	Triton's Trumpet, Giant Triton	R
Order PTERIOIDA		
Family Pteriidae		
Pinctada margaritifera	Black-lipped Pearl Oyster, Banda Shell	
Order VENEROIDA		
Family Tridacnidae		
Hippopus hippopus	Horse's Hoof Clam, Bear Paw Clam, Strawberry Clam	I
Hippopus porcellanus	China Clam	I
Tridacna crocea	Crocus Clam, Saffron-coloured Giant Clam, Boring Clam	K
Tridacna gigas	Giant Clam	V
Tridacna maxima	Small Giant Clam	K
Tridacna squamosa	Scaly Clam, Fluted Clam	I
Order MONOTREMATA		
Family Tachyglossidae		
Zaglossus bruijni	Long-beaked Echidna, Long-nosed Echidna	V
Order MARSUPIALIA		
Family Peramelidae		
Echymipera clara	Clara Bandicoot, White-lipped Bandicoot,	R

Taxon name	Common name	W Cat
Order PRIMATES		
Family Cercopithecidae		
Macaca pagensis	Mentawai Islands Macaque, Bokkoi	I
Presbytis potenziani	Mentawai Islands Langur, Mentawai Leaf Monkey, Joja	I
Simias concolor	Pig-tailed Langur, Pagai Island Langur, Simakobu	E
Family Pongidae		
Hylobates klossi	Kloss's Gibbon, Dwarf Gibbon, Bilou	V
Hylobates moloch	Javan Gibbon, Silvery Gibbon	E
Pongo pygmaeus	Orang-utan	E
Order CARNIVORA		
Family Canidae		
Cuon alpinus	Asiatic Wild Dog, Dhole, Red Dog	V
Family Felidae		
Felis marmorata	Marbled Cat	I
Order CARNIVORA (cont.)		
Family Felidae (cont.)		
Felis planiceps	Flat-headed Cat	I
Panthera pardus	Leopard	V
Panthera tigris	Tiger	E
Order PROBOSCIDEA		
Family Elephantidae		
Elephas maximus	Indian Elephant, Asian Elephant	E
Order SIRENIA		
Family Dugongidae		
Dugong dugon	Dugong	V
Order PERISSODACTYLA		
Family Tapiridae		
Tapirus indicus	Malayan Tapir	E
Family Rhinocerotidae		
Didermocerus sumatrensis	Sumatran Rhinoceros	E
Order ARTIODACTYLA		
Family Suidae		
Babyrousa babyrussa	Babirusa	V
Family Cervidae		
Axis kuhli	Kuhl's Deer	R
Family Bovidae		
Bos javanicus	Banteng	V
Bubalus depressicornis	Lowland Anoa	E
Bubalus quarlesi	Mountain Anoa	E

Taxon name	Common name	W Cat
Order DECAPODA		
Family Coenobitidae		
<u>Birgus latro</u>	Coconut Crab, Robber Crab	R
Order TESTUDINES		
Family Cheloniidae		
<u>Eretmochelys imbricata</u>	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira & de Pente	E
<u>Lepidochelys olivacea</u>	Olive Ridley Turtle, Pacific Ridley Turtle, Tortuga verde, Parlama	E
Family Dermochelyidae		
<u>Dermochelys coriacea</u>	Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga	E
Family Testudinidae		
<u>Geochelone forstenii</u>	Sulawesi (Celebes) Tortoise	R
Order SAURIA		
Family Varanidae		
<u>Varanus komodoensis</u>	Komodo Dragon	R
Order SERPENTES		
Family Boidae		
<u>Python molurus</u>	Indian Python, Burmese Python	V
<u>Python molurus bivittatus</u>	Burmese Python	V
Order CROCODYLIA		
Family Crocodylidae		
<u>Crocodylus novaeguineae novaeguineae</u>	New Guinea Crocodile	V
<u>Crocodylus porosus</u>	Estuarine Crocodile, Salt-water Crocodile	V
<u>Crocodylus siamensis</u>	Siamese Crocodile	E
<u>Tomistoma schlegelii</u>	False Gharial, Malayan Gharial	E

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IRIAN JAYA

Taxon name	Common name	W Cat
Order STRIGIFORMES		
Family Strigidae		
Otus magicus beccarii	Papuan Scops Owl	I
Order LEPIDOPTERA		
Family Papilionidae		
Ornithoptera goliath	Goliath Birdwing Butterfly	R
Ornithoptera tithonus		K
Ornithoptera rothschildi		V
Ornithoptera chimaera		V
Ornithoptera paradisea		V
Ornithoptera meridionalis		V
Family Danaidae		
Euploea albicosta		R
Euploea tripunctata		R
Ideopsis hewitsonii		R
Parantica kirbyi		K
Parantica marcia		R
Parantica weiskei		R
Protoploea apatela		R
Order VENEROIDA		
Family Tridacnidae		
Tridacna derasa	Southern Giant Clam	V
Order MONOTREMATA		
Family Tachyglossidae		
Zaglossus bruijni	Long-beaked Echidna, Long-nosed Echidna	V
Order MARSUPIALIA		
Family Macropodidae		
Dendrolagus dorianus notatus	Doria's Tree-kangaroo	V
Family Phalangeridae		
Phalanger rufoniger	Black-spotted Cuscus	R
Phalanger interpositus	Stein's Cuscus	R
Family Peramelidae		
Echymipera clara	Clara Bandicoot, White-lipped Bandicoot,	R
Order SIRENIA		
Family Dugongidae		
Dugong dugon	Dugong	V
Order DECAPODA		
Family Coenobitidae		
Birgus latro	Coconut Crab, Robber Crab	R

Taxon name	Common name	W Cat
Order TESTUDINES		
Family Carettochelyidae		
Carettochelys insculpta	New Guinea Plateless Turtle, Pitted Shell Turtle, Fly R. Turtle, Pig-nosed	K
Family Dermochelyidae		
Dermochelys coriacea	Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga	E
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus novaeguineae novaeguineae	New Guinea Crocodile	V
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	V

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List of Threatened Animal Taxa from CMC

JAVA

Taxon name	Common name	W Cat
Order CICONIIFORMES		
Family Ciconiidae		
Mycteria cinerea	Milky Stork	V
Order ANSERIFORMES		
Family Anatidae		
Cairina scutulata	White-winged Wood Duck	V
Order FALCONIFORMES		
Family Falconidae		
Falco peregrinus	Peregrine Falcon	V
Order GALLIFORMES		
Family Phasianidae		
Pavo muticus	Green Peafowl	V
Pavo muticus muticus	Green Peafowl	V
Order CHARADRIIFORMES		
Family Charadriidae		
Vanellus macropterus	Javanese Wattled Lapwing	I
Order LEPIDOPTERA		
Family Papilionidae		
Atrophaneura (a.) luchti		R
Family Danaidae		
Euploea gamelia		R
Parantica albata		R
Parantica pseudomelaneus		R
Order VENEROIDA		
Family Tridacnidae		
Tridacna gigas	Giant Clam	V
Order PRIMATES		
Family Pongidae		
Hylobates moloch	Javan Gibbon, Silvery Gibbon	E
Order CARNIVORA		
Family Canidae		
Cuon alpinus	Asiatic Wild Dog, Dhole, Red Dog	V
Family Felidae		
Panthera pardus	Leopard	V
Panthera tigris	Tiger	E
Order SIRENIA		
Family Dugongidae		
Dugong dugon	Dugong	V

Taxon name	Common name	W Cat
Order PERISSODACTYLA		
Family Rhinocerotidae		
Rhinoceros sondaicus	Javan Rhinoceros	E
Order ARTIODACTYLA		
Family Bovidae		
Bos javanicus	Banteng	V
Order TESTUDINES		
Family Cheloniidae		
Caretta caretta	Loggerhead Turtle, Tortuga de mar, Cares, Tartaruga domar, Uruana, Suruana	V
Order TESTUDINES (cont.)		
Family Cheloniidae (cont.)		
Eretmochelys imbricata	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira & de Pente	E
Family Dermochelyidae		
Dermochelys coriacea	Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga	E
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	V

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List of Threatened Animal Taxa from CMC

KALIMANTAN

Taxon name	Common name	W Cat
Order GALLIFORMES		
Family Phasianidae		
Lophura bulweri	Bulwer's Wattled Pheasant	V
Order PRIMATES		
Family Tarsiidae		
Tarsius bancanus borneanus	Bornean Tarsier	I
Family Cercopithecidae		
Nasalis larvatus	Proboscis Monkey, Long-nosed Monkey	V
Family Pongidae		
Pongo pygmaeus	Orang-utan	E
Order CARNIVORA		
Family Felidae		
Felis badia	Bornean Bay Cat, Bornean Marbled Cat	R
Felis planiceps	Flat-headed Cat	I
Neofelis nebulosa	Clouded Leopard	V
Order PROBOSCIDEA		
Family Elephantidae		
Elephas maximus	Indian Elephant, Asian Elephant	E
Order SIRENIA		
Family Dugongidae		
Dugong dugon	Dugong	V
Order PERISSODACTYLA		
Family Rhinocerotidae		
Didermocerus sumatrensis	Sumatran Rhinoceros	E
Order ARTIODACTYLA		
Family Bovidae		
Bos javanicus	Banteng	V
Order TESTUDINES		
Family Emydidae		
Callagur borneoensis	Painted Terrapin, Painted Batagur, Tuntong Laut, Tao Lai, Teen Bet	V
Family Testudinidae		
Geochelone emys	Burmese Brown Tortoise	K

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LESSER SUNDA IS

Taxon name	Common name	W Cat
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	V
Crocodylus siamensis	Siamese Crocodile	E
Tomistoma schlegelii	False Gharial, Malayan Gharial	E
Order LEPIDOPTERA		
Family Papilionidae		
Papilio (princeps) neumoegeni		V
Order TESTUDINES		
Family Cheloniidae		
Lepidochelys olivacea	Olive Ridley Turtle, Pacific Ridley Turtle, Tortuga verde, Parlama	
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	V

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List of Threatened Animal Taxa from CMC

MOLUCCAS

Taxon name	Common name	W Cat
Order CHARADRIIFORMES		
Family Laridae		
Sterna zimmermanni	Chinese Crested Tern	I
Order LEPIDOPTERA		
Family Papilionidae		
Graphium (graphium) stresemanni		R
Troides (troides) prattorum		I
Ornithoptera goliath	Goliath Birdwing Butterfly	R
Ornithoptera aesacus		I
Ornithoptera croesus		V
Order HYMENOPTERA		
Family Megachilidae		
Chalicodoma pluto	Wallace's Giant Bee	K
Order TESTUDINES		
Family Cheloniidae		
Eretmochelys imbricata	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira & de Pente	E
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	V

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List of Threatened Animal Taxa from CMC

SULAWESI

Taxon name	Common name	W Cat
Order CICONIIFORMES		
Family Ardeidae		
Egretta eulophotes	Chinese Egret	V
Order FALCONIFORMES		
Family Falconidae		
Falco peregrinus	Peregrine Falcon	V
Order GALLIFORMES		
Family Megapodiidae		
Macrocephalon maleo	Maleo	
Order LEPIDOPTERA		
Family Papilionidae		
Atrophaneura(losaria palu		K
Troides (troides) dohertyi		V
Papilio (princeps) jordani		R
Family Danaidae		
Euploea configurata		R
Euploea cordelia		R
Euploea eupator		R
Euploea latifasciata		R
Euploea magou		R
Idea tambusisiana	Sulawesi Tree Nymph Butterfly	K
Parantica kuekenthali		R
Parantica menadensis		
Parantica sulewattan		
Parantica toxopei		R
Order VENEROIDA		
Family Tridacnidae		
Tridacna gigas	Giant Clam	V
Order CARNIVORA		
Family Viverridae		
Macrogalidia musschenbroeki	Celebes Giant Palm Civet, Musang, Brown Palm Civet	R
Order SIRENIA		
Family Dugongidae		
Dugong dugon	Dugong	V
Order ARTIODACTYLA		
Family Suidae		
Babyrousa babyrussa	Babirusa	V
Family Bovidae		
Bubalus depressicornis	Lowland Anoa	E
Bubalus quarlesi	Mountain Anoa	E

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Taxon name	Common name	W Cat
Order DECAPODA		
Family Coenobitidae		
Birgus latro	Coconut Crab, Robber Crab	R
Order TESTUDINES		
Family Cheloniidae		
Eretmochelys imbricata	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira & de Pente	E
Order TESTUDINES (cont.)		
Family Dermochelyidae		
Dermochelys coriacea	Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga	E
Family Testudinidae		
Geochelone forstenii	Sulawesi (Celebes) Tortoise	R
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	V
Tomistoma schlegelii	False Gharial, Malayan Gharial	E

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List of Threatened Animal Taxa from CMC

SUMATRA

Taxon name	Common name	W Cat
Order CICONIIFORMES		
Family Ciconiidae		
Ciconia episcopus stormi	Storm's Stork	I
Mycteria cinerea	Milky Stork	V
Order ANSERIFORMES		
Family Anatidae		
Cairina scutulata	White-winged Wood Duck	V
Order FALCONIFORMES		
Family Falconidae		
Falco peregrinus	Peregrine Falcon	V
Order CHARADRIIFORMES		
Family Charadriidae		
Vanellus macropterus	Javanese Wattled Lapwing	I
Order CORACIIFORMES		
Family Bucerotidae		
Rhinoplax vigil	Helmeted Hornbill	I
Order LEPIDOPTERA		
Family Danaidae		
Euploea martinii		R
Parantica albata		R
Parantica tityoides		
Order PRIMATES		
Family Pongidae		
Pongo pygmaeus	Orang-utan	E
Order LAGOMORPHA		
Family Leporidae		
Nesolagus netscheri	Sumatran Short-eared Rabbit	R
Order CARNIVORA		
Family Canidae		
Cuon alpinus	Asiatic Wild Dog, Dhole, Red Dog	V
Family Felidae		
Felis marmorata	Marbled Cat	I
Felis planiceps	Flat-headed Cat	I
Felis temmincki	The Asiatic Golden Cat, Temminck's Cat	I
Neofelis nebulosa	Clouded Leopard	V
Panthera pardus	Leopard	V
Panthera tigris	Tiger	E

Taxon name	Common name	W Cat
Order PROBOSCIDEA		
Family Elephantidae		
Elephas maximus	Indian Elephant, Asian Elephant	E
Order PERISSODACTYLA		
Family Tapiridae		
Tapirus indicus	Malayan Tapir	E
Family Rhinocerotidae		
Didermocerus sumatrensis	Sumatran Rhinoceros	E
Order ARTIODACTYLA		
Family Bovidae		
Capricornis sumatraensis sumatraensis	Sumatran Serow	E
Order OSTEOGLOSSIFORMES		
Family Osteoglossidae		
Scleropages formosus	Asian Bonytongue	V
Order TESTUDINES		
Family Cheloniidae		
Caretta caretta	Loggerhead Turtle, Tortuga de mar, Cares, Tartaruga domar, Uruana, Suruana	V
Eretmochelys imbricata	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira & de Pente	E
Family Dermochelyidae		
Dermochelys coriacea	Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga	E
Family Emydidae		
Batagur baska	Batagur, River Terrapin, Tuntong, Sungei	E
Callagur borneoensis	Painted Terrapin, Painted Batagur, Tuntong Laut, Tao Lai, Teen Bet	V
Family Testudinidae		
Geochelone emys	Burmese Brown Tortoise	K
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	V
Crocodylus siamensis	Siamese Crocodile	E
Tomistoma schlegelii	False Gharial, Malayan Gharial	E

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List of Threatened Animal Taxa from CMC

PHILIPPINES

Taxon name	Common name	W Cat
Order CICONIIFORMES		
Family Ardeidae		
Egretta eulophotes	Chinese Egret	V
Order FALCONIFORMES		
Family Accipitridae		
Pithecophaga jefferyi	Monkey-eating Eagle	E
Family Falconidae		
Falco peregrinus	Peregrine Falcon	V
Order GALLIFORMES		
Family Phasianidae		
Polyplectron emphanum	Palawan Peacock Pheasant	V
Order CHARADRIIFORMES		
Family Scolopacidae		
Tringa guttifer	Nordmann's Greenshank, Spotted Greenshank	I
Limnodromus semipalmatus	Asian Dowitcher	R
Family Laridae		
Sterna zimmermanni	Chinese Crested Tern	I
Order LEPIDOPTERA		
Family Papilionidae		
Graphium (pathysa) idaeoides		R
Graphium (pathysa) megaera		I
Graphium (graphium) sandawanum		V(
Atrophaneura(pachlio schadenbergi		V
Atrophaneura(pachlio atropos		I
Papilio (chilasa) osmana		R
Papilio (chilasa) carolinensis		R
Papilio (princeps) benguetanus		V
Papilio (princeps) chikae		E
Family Danaidae		
Euploea blossomae		R
Euploea tobleri		R
Idea electra		R
Parantica dannatti		R
Parantica davidi		E
Parantica milagros		R
Parantica phyle		R
Parantica schoenigi		R
Order MESOGASTROPODA		
Family Cymatidae		
Charonia tritonis	Triton's Trumpet, Giant Triton	R

Taxon name	Common name	W Cat
Order PTERIOIDA		
Family Pteriidae		
Pinctada margaritifera	Black-lipped Pearl Oyster Banda Shell	I
Order VENEROIDA		
Family Tridacnidae		
Hippopus hippopus	Horse's Hoof Clam, Bear Paw Clam, Strawberry Clam	I
Hippopus porcellanus	China Clam	I
Tridacna crocea	Crocus Clam, Saffron-coloured Giant Clam, Boring Clam	K
Tridacna derasa	Southern Giant Clam	V
Tridacna gigas	Giant Clam	V
Order VENEROIDA (cont.)		
Family Tridacnidae (cont.)		
Tridacna maxima	Small Giant Clam	K
Tridacna squamosa	Scaly Clam, Fluted Clam	I
Order INSECTIVORA		
Family Erinaceidae		
Podogymnura truei	Mindanao Gymnure, Mindanao Moonrat	V
Order PRIMATES		
Family Tarsiidae		
Tarsius syrichta	Philippine Tarsier	E
Order RODENTIA		
Family Muridae		
Batomys granti	Luzon Forest Rat	I
Order SIRENIA		
Family Dugongidae		
Dugong dugon	Dugong	V
Order ARTIODACTYLA		
Family Cervidae		
Axis calamianensis	Calamian Deer	V
Family Bovidae		
Bubalus bubalis	Water Buffalo, Wild Asiatic Buffalo	V
Bubalus mindorensis	Tamaraw	E
Order DECAPODA		
Family Coenobitidae		
Birgus latro	Coconut Crab, Robber Crab	R

Taxon name	Common name	W Cat
Order PERCIFORMES		
Family Gobiidae		
Mistichthys luzonensis	Sinarapan, Tabios	E
Order TESTUDINES		
Family Cheloniidae		
Eretmochelys imbricata	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira & de Pente	E
Lepidochelys olivacea	Olive Ridley Turtle, Pacific Ridley Turtle, Tortuga verde, Parlama	E
Family Dermochelyidae		
Dermochelys coriacea	Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga	E
Order SAURIA		
Family Agamidae		
Hydrosaurus pustulatus	Sail-fin Lizard, Soa-Soa Water Lizard, (Crested Lizard)	V
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus novaeguineae mindorensis	Mindoro, Philippines Crocodile	E
Order CROCODYLIA (cont.)		
Family Crocodylidae (cont.)		
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	

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List of Threatened Animal Taxa from CMC

LEYTE

Taxon name	Common name	W Cat
Order LEPIDOPTERA		
Family Papilionidae		
Graphium (pathysa) idaeoides		R
Papilio (chilasa) osmana		R

LUZON

Taxon name	Common name	W Cat
Order LEPIDOPTERA		
Family Papilionidae		
Graphium (pathysa) idaeoides		R
Atrophaneura(pachlio schadenbergi		V
Papilio (princeps) benguetanus		V
Papilio (princeps) chikae		E

MINDANAO

Taxon name	Common name	W Cat
Order LEPIDOPTERA		
Family Papilionidae		
Graphium (pathysa) idaeoides		R
Graphium (graphium) sandawanum		V
Papilio (chilasa) osmana		R
Papilio (chilasa) carolinensis		R

PALAWAN

Taxon name	Common name	W Cat
Order LEPIDOPTERA		
Family Papilionidae		
Graphium (pathysa) megaera		I
Atrophaneura(pachlio atropos		I

SAMAR

Taxon name	Common name	W Cat
Order LEPIDOPTERA		
Family Papilionidae		
Graphium (pathysa) idaeoides		R

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List of Threatened Animal Taxa From CMC

SRI LANKA

Taxon name	Common name
Order PELECANIFORMES	
Family Fregatidae	
Fregata andrewsi	Christmas Frigate Bird
Order FALCONIFORMES	
Family Falconidae	
Falco peregrinus	Peregrine Falcon
Order CORACIIFORMES	
Family Coraciidae	
Eurystomus orientalis irisi	Ceylon Broad-billed Roller
Order LEPIDOPTERA	
Family Papilionidae	
Atrophaneura(pachlio jophon	
Family Danaidae	
Idea iasonia	
Parantica taprobana	
Order HYMENOPTERA	
Family Formicidae	
Aneuretus simoni	Sri Lankian Relict Ant
Order VENEROIDA	
Family Tridacnidae	
Tridacna maxima	Small Giant Clam
Order CETACEA	
Family Balaenopteridae	
Balaenoptera musculus	Blue Whale, Sulphur-bottom Whale
Order CARNIVORA	
Family Canidae	
Cuon alpinus	Asiatic Wild Dog, Dhole, Red Dog
Family Ursidae	
Melursus ursinus	Sloth Bear
Family Felidae	
Panthera pardus	Leopard
Order PROBOSCIDEA	
Family Elephantidae	
Elephas maximus	Indian Elephant, Asian Elephant

Taxon name	Common name	W Cat
Order SIRENIA		
Family Dugongidae		
Dugong dugon	Dugong	V
Order ARTIODACTYLA		
Family Bovidae		
Bubalus bubalis	Water Buffalo, Wild Asiatic Buffalo	V
Order CYPRINIFORMES		
Family Cyprinidae		
Barbus cumingi	Cuming's Two-Banded Barb, Pothaya	V
Barbus nigrofasciatus	Black Ruby Barb, Bulath Sapeya	V
Barbus pleurotaenia	Side Striped Barb, Hitha Massa	V
Order CYPRINIFORMES (cont.)		
Family Cyprinidae (cont.)		
Barbus titteya	Cherry Barb, Dola Tittaya	V
Labeo fisheri	Green Labeo, Gadaya	E
Rasbora vateriflorís	Vateria Flower Rasbora, Hal Mal Tittaya	V
Family Cobitidae		
Lepidocephalus jonklassi	Spotted Loach	E
Order PERCIFORMES		
Family Gobiidae		
Sicydium halei	Red Tail Goby	V
Family Belontiidae		
Belontia signata	Combtail, Pulutta	R
Malpulutta krestseri	Ornate Paradisefish	V
Family Channidae		
Channa orientalis		R
Order TESTUDINES		
Family Cheloniidae		
Caretta caretta	Loggerhead Turtle, Tortuga de mar, Cares, Tartaruga domar, Uruana, Suruana	V
Eretmochelys imbricata	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira & de Pente	E
Lepidochelys olivacea	Olive Ridley Turtle, Pacific Ridley Turtle, Tortuga verde, Parlama	E
Family Dermochelyidae		
Dermochelys coriacea	Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga	E

Order SERPENTES		
Family Boidae		
Python molurus	Indian Python, Burmese Python	V
Python molurus molurus	Indian Python	V
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus palustris	Mugger, Marsh Crocodile, Broad-snouted Crocodile	V
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	V

15 March 1985 — List of Threatened Animal Taxa From CMC

THAILAND

Taxon name	Common name	W Cat
Order CICONIIFORMES		
Family Ardeidae		
Egretta eulophotes	Chinese Egret	V
Family Threskiornithidae		
Pseudibis davisoni	White-shouldered Ibis	I
Thaumatibis gigantea	Giant Ibis	R
Order ANSERIFORMES		
Family Anatidae		
Cairina scutulata	White-winged Wood Duck	V
Order FALCONIFORMES		
Family Falconidae		
Falco peregrinus	Peregrine Falcon	V
Order GALLIFORMES		
Family Phasianidae		
Pavo muticus	Green Peafowl	V
Pavo muticus imperator	Green Peafowl	V
Pavo muticus muticus	Green Peafowl	V
Syrmaticus humiae	Hume's Bar-tailed Pheasant	R
Syrmaticus humiae burmanicus	Hume's Bar-tailed Pheasant	R
Order CHARADRIIFORMES		
Family Scolopacidae		
Tringa guttifer	Nordmann's Greenshank, Spotted Greenshank	I
Limnodromus semipalmatus	Asian Dowitcher	R
Family Laridae		
Sterna zimmermanni	Chinese Crested Tern	I
Order CORACIIFORMES		
Family Bucerotidae		
Rhinoplax vigil	Helmeted Hornbill	I
Order PASSERIFORMES		
Family Pittidae		
Pitta gurneyi	Gurney's Pitta	I
Family Hirundinidae		
Pseudochelidon sirintarae	White-eyed River Martin	I
Order LEPIDOPTERA		
Family Danaidae		
Tirumala gautama		R

Taxon name	Common name
Order VENEROIDA	
Family Tridacnidae	
Tridacna crocea	Crocus Clam, Saffron-coloured Giant Clam, Boring Clam
Tridacna maxima	Small Giant Clam
Tridacna squamosa	Scaly Clam, Fluted Clam
Order PRIMATES	
Family Pongidae	
Hylobates pileatus	Pileated Gibbon, Crowned Gibbon, Capped Gibbon
Order CARNIVORA	
Family Canidae	
Cuon alpinus	Asiatic Wild Dog, Dhole, Red Dog
Order CARNIVORA (cont.)	
Family Felidae	
Felis marmorata	Marbled Cat
Felis planiceps	Flat-headed Cat
Felis temmincki	The Asiatic Golden Cat, Temminck's Cat
Neofelis nebulosa	Clouded Leopard
Panthera pardus	Leopard
Panthera tigris	Tiger
Order PROBOSCIDEA	
Family Elephantidae	
Elephas maximus	Indian Elephant, Asian Elephant
Order SIRENIA	
Family Dugongidae	
Dugong dugon	Dugong
Order PERISSODACTYLA	
Family Tapiridae	
Tapirus indicus	Malayan Tapir
Family Rhinocerotidae	
Didermocerus sumatrensis	Sumatran Rhinoceros
Rhinoceros sondaicus	Javan Rhinoceros
Order ARTIODACTYLA	
Family Cervidae	
Muntiacus feae	Fea's Muntjac
Cervus eldi siamensis	Thailand Brow-antlered Deer
Family Bovidae	
Bos gaurus	Gaur, Indian Bison
Bos javanicus	Banteng
Bos sauveli	Kouprey
Bubalus bubalis	Water Buffalo, Wild Asiatic Buffalo

Taxon name	Common name	W Cat
Order OSTEOGLOSSIFORMES		
Family Notopteridae		
Notopterus blanci	Featherback	R
Family Osteoglossidae		
Scleropages formosus	Asian Bonytongue	V
Order CYPRINIFORMES		
Family Cyprinidae		
Chela caeruleostigmata		R
Probarbus jullieni	Ikan Temoleh, Ikan Temelian, Pla Esok	I
Order SILURIFORMES		
Family Pangasiidae		
Pangasianodon gigas	Giant Catfish	V
Pangasius sanitwongsei	Catfish	R
Order TESTUDINES		
Family Cheloniidae		
Caretta caretta	Loggerhead Turtle, Tortuga de mar, Cares, Tartaruga domar, Uruana, Suruana	V
Eretmochelys imbricata	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira & de Pente	E
Lepidochelys olivacea	Olive Ridley Turtle, Pacific Ridley Turtle, Tortuga verde, Parlama	E
Family Dermochelyidae		
Dermochelys coriacea	Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga	E
Family Emydidae		
Batagur baska	Batagur, River Terrapin, Tuntong, Sungei	E
Callagur borneoensis	Painted Terrapin, Painted Batagur, Tuntong Laut, Tao Lai, Teen Bet	V
Family Testudinidae		
Geochelone emys	Burmese Brown Tortoise	K
Geochelone impressa	Impressed Tortoise	K
Order SERPENTES		
Family Boidae		
Python molurus	Indian Python, Burmese Python	V
Python molurus bivittatus	Burmese Python	V
Order CROCODYLIA		
Family Crocodylidae		
Crocodylus porosus	Estuarine Crocodile, Salt-water Crocodile	V
Crocodylus siamensis	Siamese Crocodile	E
Tomistoma schlegelii	False Gharial, Malayan Gharial	E

MAMMALS OF BANGLADESH – THEIR STATUS, DISTRIBUTION AND HABITAT

by Sohrab Uddin Sarker and Noor Jahan Sarker

Introduction

After consulting the earlier literature about the mammalian fauna of British India, it has been noted that most of the mammalian fauna have been collected and reported from Assam, Manipur, etc. After the publication of Jerdon's (1873) and Blanford's (1888) works on the mammals of India, Wroughton (1918–21) also surveyed the mammals of the Indian sub-continent.

Ellerman and Morrison–Scott (1961) and Strechy (1963) prepared checklists of Palaeartic and Indian mammals and of Indian wildlife respectively. There has been little reference in the above literature to the mammals of the area that is now Bangladesh. Husain (1974) is the only author who has published a list of mammals found in Bangladesh. He reported more than 90 species of mammals in his book on wildlife of Bangladesh, and mentions 53 species by name.

Bangladesh is very rich in wildlife. A number of works have been published on birds of Pabna, Dhaka but a detailed record of the mammals of Bangladesh is lacking. The authors have here prepared a list of mammals observed in Bangladesh, mentioning their status, distribution and habitat.

LIST OF MAMMALS

Abbreviations used:

Status: C = Common; VC = Very Common; FC = Fairly Common, F = Few; O = Occasional or Rare.

Distribution. W = Wide; Sb = Sundarbans; BB = Bay of Bengal; Ctg = Chittagong; Cht = Chittagong Hill–Tracts; S = Sylhet; T = Tangail; M = Mymensingh; R = Rivers. P = Pabna; U = Uncertain.

Habitat: a = Open country; f = Forest, h = Hilly areas.

CLASS: MAMMALIA

Order	Family	Subfamily	Scientific Name	English Name (Beng. Name)	Status,	Distrib.,	Habitat
Insectivora	Talpidae	Talpinae	*Talpa micrura* Hodgson	Eastern mole	O	U	af
Insectivora	Soricidae		*Suncus murinus* Linnaeus	Whitetailed shrew or House shrew (Chickchiki)	VC	W	a
Insectivora	Soricidae		*S. estruscus* Savi	Savi's Pigmy shrew	O	U	af
Chiroptera	Pteropodidae	Pteropodinae	*Pteropus giganteus* Brunnich	Flying Fox (Badur)	VC	W	af
"	"	"	*Cynopterus sphinx* Vahl	Greater Short - nosed fruit bat	F	Sb	a
Chiroptera	Rhinopomatidae		*Rhinopoma hardwickei* Gray	Lesser rat - tailed bat	F	Sb	af
Chiroptera	Emballonuridae		*Taphozous longimanus* Hardwicke	Longwinged Tomb bat	F	DTS	af
Chiroptera	Megadermatidae		*Megaderma lyra* Geoffroy	False vampire bat	FC	W	af
Chiroptera	Hipposideridae		*Hipposideros bicolor* Temminck	Bicolored leaf nosed bat	FC	Sb	af
"	"		*Coelops frithi* Blyth	Tailless Leaf nosed bat	F	Sb	U
Chiroptera	Vespertilionidae	Vespertilioninae	*Pipistrellus coromandra* Gray	Pipistrelle	FC	Sb	af
"	"	"	*P. mimus* Wroughton	Pygmy pipistrelle	F	Sb	af
"	"	"	*Scotophilus heathi* Horsfield	Greater yellow bat	FC	TSbS	a
"	"	"	*S. kuhlii* Leach	Lesser Yellow bat	O	Sb	a
"	"	"	*S. luteus* Leach	Yellow bat	O	Sb	a
"	"	"	*Tylonycteris pachypus* Temminck	Clubfooted bat	C	W	a
Primates	Lorisidae		*Nycticebus coucang* Boddaert	Slow loris (Lajjaabati Banor)	F	S	f
Primates	Cercopithecidae	Cercopithecinae	*Macaca nemestrina* Linnaeus	Pig - tailed macaque	O	U	U
"	"	"	*Macaca fascicularis* Raffles	Crabeating macaque	O	Sb	F
"	"	"	*M. mulatta* Zimmermann	Rhesus macaque	VC	Wb	af
Primates	Cercopithecidae	Cercopithecinae	*Macaca assamensis* McClelland	Assamese macaque		Sb	
Primates	Cercopithecidae	Colobinae	*Presbytis entellus* Dufresne	Langur (Honuman)	VC		f
"	"	"	*P. pileatus* Blyth	Capped langur	FC	W	f
"	"	"	*P. phayrei* Blyth	Phayre's leaf monkey			
Primates	Pongidae	Hylobatinae	*Hylobates hoolock* Harilan	Hoolock gibbon	FC	SCtg	f
Pholidota	Manidae		*Manis crassicaudata* Gray	Pangolin (Bonrui)	F	Ctg Cht	fh
Carnivora	Canidae		*Canis aureus* Linnaeus	Asiatic jackal (Shial)	VC	W	af
"	"		*Vulpes bengalensis* Shaw	Bengal fox	FC	W	af
"	"		*Cuon alpinus* Pallas	Bed dog, Wild dog Dhole	O	Ctg	fh
Carnivora	Ursidae		*Selenarctos thibetanus* Cuvier	Asiatic black bear	F	Cht S Ctg	fh

Order	Family	Subfamily	Scientific Name	English Name (Beng. Name)	Status,	Distrib.,	Habitat
Carnivora	Ursidae		*Helarctos malayanus* Raffles	Sun bear	FC	Ctg S Cht	fh
Carnivora	Mustelidae	Melinae	*Arctonyx collaris* Cuvier	Hog badger	F	Ctg S Cht	fh
Carnivora	Mustelidae	Lutrinae	*Lutra lutra* Linnaeus	Common otter (Uud)	O	Cht	af
,,	,,	,,	*Aonyx cinerea* Illiger	Small clawed otter	O	Cht	af
Carnivora	Vivveridae	Viverrinae	*Viverra zibetha* Linnaeus	Large civet (Khattash)	FC	W	af
,,	,,	,,	*Viverricula indica* Desmarest	Small civet (Bagdash)	FC	W	af
Carnivora	Vivveridae	Paradoxurinae	*Paradoxurus hermaphroditus* Pallas	Common palm civet	FC	W	af
,,	,,	,,	*Arctictis binturong* Raffles	Bear cat, Toddy cat (Longor)			
,,	,,	Lutrinae	*Lutra perspicillata* Geoffroy	Smooth coated otter	FC	Cht Sb	af
Carnivora	Vivveridae	Paradoxurinae	*Arctogalidia trivirgata* Gray	Small-- toothed civet	C	W	af
Carnivora	Vivveridae	Herpestinae	*Herpestes auropunctatus* Hodgson	Small mongoose (Chota Bajee)	FC	W	af
,,	,,	,,	*H. edwardsi* Geoffroy	Grey mongoose (Baro Bajee)	VC	W	af
,,	,,	,,	*H. urva* Hodgson	Crab-eating mongoose	O	U	f
Carnivora	Hyaenidae		*Hyaena hyaena* Linnaeus	Striped hyaena	O	U	U
Carnivora	Felidae		*Felis chaus* Guldenstaedt	Jungle cat (Jongli Biral)	F	Ctg,S	f
,,	,,		*F. marmorata* Martin	Marbled cat	O		af
,,	,,		*F. temmincki* Vigors & Horsfield	Golden cat (Moufgaora)	FC	W	a
,,	,,		*F. bengalensis* Kerr	Leopard cat	FC	Sb	af
,,	,,		*F. viverrina* Bennett	Fishing cat (Mechobag)	FC	W	af
,,	,,		*Neofelis nebulosa* Griffith	Clouded leopard (Chitta Bagh)	O	U	f
,,	,,		*Panthera pardus* Linnaeus	Leopard (Chittah)	FC	U	f
,,	,,		*P. tigris tigris* Linnaeus	Royal Bengal tiger (Bara Bagh)	FC	Sb	f
Proboscidea	Elephantidae		*Elephas maximus* Linnaeus	Asiatic elephant	FC	Ctg, Cht,SM	f
Perissodactyla	Rhinocerotidae	Rhinocerotinae	*Rhinoceros unicornis* Linnaeus	One horned rhinoceros (Gondar)		EXTINCT	
Artiodactyla	Suidae		*Sus scrofa* Linnaeus	Wild boar (Bunno [illegible]r)	FC	W	af
Artiodactyla	Tragulidae		*[illegible]gulus meminna* Erxleben	S[illegible]tted chevrotain	O	U	U
Artiodactyla	Cervidae	Muntiacinae	*Muntiacus muntjak* Zimmermann	Barking deer	F	Ctg	f

Order	Family	Subfamily	Scientific Name	English Name (Beng. Name)	Status,	Distrib.,	Habitat
Artiodactyla	Cervidae	Cervinae	*Axix axis* Erxleben	Spotted deer (Chital Horin)	VC	Sb	f
..	..	..	*Cervus unicolor* Kerr	Sambar	FC	Cht Ctg	f
..	..	..	*Axis porcinus* Zimmermann	Hog deer	F	Sb	f
..	..	..	*Cervus duvauceli* Cuvier	Swamp deer (Barashingha)	O	Sb	f
Artiodactyla	Bovidae	Bovinae	*Bos gaurus* Smith	Bison (Bongaru)	O	Ctg Cht,SM	f
..	..	..	*Bubalus bubalis* Linnaeus	Water buffalo (Bon Mahish)		EXTINCT	
Artiodactyla	..		*Antilope cervicapra* Linnaeus	Blackbuck	U	U	U
Artiodactyla	..	Caprinae	*Capricornis sumatraensis* Bechstein	Serow	F	Cht Ctg,S	f
Lagomorpha	Ochotonidae		*Ochotona pusilla* Pallas	Trippe pika (Mouse hare)	O	PDM	fa
Lagomorpha	Leporidae		*Lepus peguensis* Blyth	Burmese hare (Khorghosh)	O	U	U
..	..		*Lepus nigricollis* Cuvier	Blacknaped hare	FC	W	af
..	..		*Caprolagus hispidus* Pearson	Hispid hare (Assam rabbit)	F	W	af
Rodentia	Sciuridae		*Beiomys pearsoni* Gray	Hairy footed flying squirrel	O	Cht	f
..	..		*Callosciurus pygerythrus* Geoffroy	Irrawaddy squirrel (Kat Biral)	FC	Cht SM, W	f
..	..		*C. erythraeus* Pallas	Pallas' squirrel			
..	..		*C. flavimanus* Geoffroy	Yellowhanded squirrel	F	Cht	f
..	..		*Petaurista petaurista* Pallas	Common giant flying squirrel		Cht	f
Rodentia	Sciuridae		*Petaurista alborufus* Milne Edwards	Red and white flying squirrel		Cht	f
..	..		*Hylopetes spadiceus* Hill	Burmese pygmy flying squirrel		U	f
Rodentia	Hystricidae		*Atherurus macrourus* Linnaeus	Bushtailed porcupine (Shajaru)	FC	W	f
..	..		*Hystrix hodgsoni* Gray	Crestless porcupine	FC	W	f
Rodentia	Muridae	Murinae	*Chiropodomys gliroides* Blyth	Penciltailed tree mouse	FC	W	af
..	..	..	*Vandeleuria oleracea* Bennett	Longtailed tree mouse (Gachua Indur)	FC	W	af
..	..	..	*Rattus rattus* Linnaeus	Black or house rat	FC	W	a

Order	Family	Subfamily	Scientific Name	English Name (Beng. Name)	Status,	Distrib.,	Habitat
Rodentia	Muridae	Murinae	*R. blandfordi* Thomas	Chestnut rat/Blandford's rat	O		
,,	,,	,,	*R. edwardsi* Thomas	Edward's rat	O		
,,	,,	,,	*R. norvegicus* Berkenhout	Brown rat	VC	W	af
,,	,,	,,	*R. fulviscens* Gray	Short tailed chestnut rat	FC	W	af
,,	,,	,,	*Mus musculus* Linnaeus	House mouse (Langti Idur)	VC	W	a
,,	,,	,,	*M. cervicolor* Hodgson	Fawn coloured mouse	O		
,,	,,	,,	*Bandicota bengalensis* Gray	Lesser bandicoot rat	FC	W	a
,,	,,	,,	*B. indica* Bechstein	Large bandicoot rat	FC	W	af
,,	,,	,,	*Nesokia indica* Gray	Short tailed mole rat	FC	W	U
Cetacea	Balaenopteridae		*Balaenoptera acutorostrata* Lacepede	Little piked whale	O	BB	
,,	,,		*B. musculus* Linnaeus	Great blue or Fin whale	O	BB	
Cetacea	Platanistidae		*Platanista gangetica* Lebeck	Ganges dolphin			
Cetacea	Delphinidae		*Neophocaena phocaenoides* Cuvier	Little black finless porpoise	FC	R	
,,	,,		*Delphinus delphis* Linnaeus	Common dolphin	FC	W,R	
,,	,,		*Stenella malayana* Lesson	Malayan dolphin	F	R	
,,	,,		*Sotalia plumbea* Cuvier	Plumbeous dolphin	F	R	
,,	,,		*Steno bredanensis* Lesson	Rough toothed dolphin	O	R	
,,	,,		*Tursiops truncatus* Montagu	Bottlenosed dolphin	O	R	
,,	,,		*Peponocephala electra* Nishiwaki and Norris	Broadbeaked dolphin	O	R	
,,	,,		*Orcaella brevirostris* Gray	Irrawaddy dolphin	F	R	
,,	,,		*Globicephala macrorhyncha* Gray	Pilot whale	O	BB	

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Protection, Conservation, and Management of Threatened and Endangered Species in Pakistan

Report of the

U.S. Fish and Wildlife Service—National Park Service
Study Mission to Pakistan February 5—16, 1978

PROTECTION, CONSERVATION, AND MANAGEMENT OF THREATENED AND ENDANGERED SPECIES IN PAKISTAN

Report of the U.S. Fish and Wildlife Service-
National Park Service Study Mission to Pakistan
February 5-16, 1978

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International Affairs Staff
U.S. Fish and Wildlife Service

August 15, 1978

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SECTION I

INTRODUCTION

The land now called Pakistan shares the 5000 year history of the India-Pakistan subcontinent. At the present day sites of Harappa in the Punjab and Mohenjodaro in Sind, an Indus Valley civilization flourished in the period between 4000-2500 B.C. with elaborate irrigation systems and large cities of a size and complexity paralleled only in Mesopotamia and Egypt. The seals, painted pottery and figurines found at these sites give ample evidence that these early people recognized the existence of the one-horned rhinoceros, tiger, buffalo, and a variety of other animals. Over the intervening years the vast Indus Valley forests have largely disappeared and with them the numbers and varieties of wildlife contained therein. Similarly, in the extensive expanses of arid land to the east and west of the Indus Valley, scrub vegetation and desert animal species have slowly but effectively been reduced by the actions of man.

Although efforts to protect and manage the forests in Pakistan go back over a hundred years, conservation of animal species is a relatively new practice. Nevertheless, the impetus, once started, has gained increasing strength within the past few years. This is mirrored by the Government of Pakistan's enactment of wildlife legislation, creation of the National Council for the Conservation of Wildlife, establishment of wildlife sanctuaries and national parks, and the development of a national conservation strategy.

The U.S. Fish and Wildlife Service has been formally involved with international wildlife matters since 1900 and as the perceived ecological arm of the federal government has been called upon more and more frequently to provide leadership, expertise and assistance in environmentally oriented international matters--particularly those which relate to the conservation of wild fauna and flora.

The U.S. National Park Service has played a unique and significant role in the global conservation of ecosystems, wild flora and fauna and cultural heritage. Requests for advice and assistance have resulted in the implementation of the national park concept in over 100 nations with over 1400 natural areas in which wild flora and fauna habitat is protected.

Through the authority of the U.S. Endangered Species Act of 1973 (Public Law 93-205), the Fish and Wildlife Service obtained the use of excess foreign currencies to assist foreign nations in carrying out conservation programs aimed at

The U.S. team members were impressed and heartened by the professional caliber and interest of the Pakistani officials who had arranged a detailed and challenging itinerary (see Appendix II). Both federal and provincial personnel have a genuine concern in endangered species conservation and it was possible for U.S. and Pakistani representatives to pursue discussions of both general and specific issues of mutual interest. The team had an opportunity to meet several Pakistani candidates seeking training in wildlife conservation outside the country and was struck by the caliber and desire of these personnel for such training. A listing of the contacts made by the study mission appears as Appendix III of this report.

The Government of Pakistan is to be commended for its far-sighted approach to wildlife conservation and its concern for endangered species. Pakistan has acceded to The Convention on International Trade in Endangered Species of Wild Fauna and Flora. It has established its priorities and programs for funding with excess foreign currencies and the Fish and Wildlife Service and National Park Service intend to act in the role of advisors, monitoring the progress of projects and assisting in project modification when necessary.

All proposals and, indeed, all communications with the Government of Pakistan concerning wildlife conservation is coordinated through the International Union for the Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund (WWF) in Morges Switzerland. These organizations are the main international agencies concerned with conservation of nature and wildlife worldwide.

Additional information on the Excess Foreign Currency Program in Pakistan may be obtained from:

Chief, International Affairs Staff
U.S. Fish and Wildlife Service
Department of the Interior
Washington, D. C. 20240
Telephone: 202/343-5188

Chief, International Park Affairs
U.S. National Park Service
Department of the Interior
Washington, D. C. 20240
Telephone: 202/523-5260

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SECTION II

SUMMARY

With a land area of over 300,000 square miles, Pakistan forms a bridge between the Middle East and the Orient. It contains a wide range of habitats from sea level to 25,000 feet above with some of the world's hottest low areas and highest cold areas. Because of this range of topography and climate, Pakistan originally had a rich and varied flora and fauna. Destruction of natural habitats and overhunting over a long period of time has led to the decline of most of the fauna and a general deterioration of the flora. Several species of animals are threatened with extinction. The U.S. Fish and Wildlife Service lists 23 species (12 mammal, 2 bird and 9 reptile).

Efforts at wildlife conservation and nature protection in Pakistan go back over a hundred years when early rulers first created game preserves to insure viable populations of game species for hunting. However, enlightened management programs didn't come into effect until the past two decades. Enactment of wildlife legislation, establishment of parks and reserves, and creation of organizations to administer wildlife policies have done much to slow the destruction of Pakistan's invaluable living natural resources. However, the officials responsible for wildlife protection and management in Pakistan feel a real need for improving their effectiveness and expanding their influence. The plight of their endangered species is critical and it is felt that many more species than listed are in trouble.

After visiting several sites in Pakistan, holding discussions with numerous Pakistan officials and workers in the wildlife field, and reviewing the proposals developed under the Pakistan Wildlife Conservation Strategy, the U.S. Study Mission recommends that actions be implemented at the earliest convenience to establish programs in Pakistan dealing with:

1. Wildlife Education and Training.
2. Surveys of endangered wildlife and habitats.
3. Restoration and management of species and their habitats.

The U.S. Team encourages the use of excess Rupees available for this program to transport qualified Pakistan officials associated with the program to beneficial meetings and conferences for the purposes of broadening Pakistan contacts within the conservation community and exposing Pakistan officials to the interests and operations of governmental and nongovernmental organizations in the United States and elsewhere.

The Team also encourages increased communication between Pakistan officials at the federal and provincial level and the U.S. Fish and Wildlife Service/National Park Service to improve transfer of information of benefit to Pakistan's wildlife, resources and to prevent misunderstandings such as the training misconceptions which have occurred in the past (see Section IV for further discussion). Cooperation between all the Pakistan agencies at the federal and provincial level is extremely critical in furthering the objectives of wildlife conservation. Increased use of nongovernmental organizations in Pakistan is stressed. These organizations have much to offer and are being underutilized by government officials at present.

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SECTION III

PHYSICAL ENVIRONMENT OF PAKISTAN

Area and Geography

About 45 million years ago the subcontinent of what is now known as India, Pakistan, Nepal and Bangladesh collided with the landmass known as Eurasia. The continued movement of these large landmasses compressed and distorted the earth's crust at their junction. The most notable result of this displacement is the Himalayan Mountain system which forms the northern boundary of the present countries of Pakistan and India.

Runoff from the snowcapped ranges of the eastern extremity of the Himalayas formed major river systems flowing generally south and west for over a thousand miles through the land now known as Pakistan into the Arabian Sea. One of the first human civilizations on earth became established in these river valleys over 4000 years ago.

The present Republic of Pakistan covers an area of about 310,400 square miles (about the size of Washington, Oregon and California combined). Roughly rhomboidal in shape, Pakistan forms a bridge between the Middle East and the Orient. It borders Iran and Afghanistan on the west, China on the north, the disputed State of Jammu and Kashmir on the northwest, and India on the east. To the south it faces the Arabian Sea.

Pakistan can be divided into four major geographic regions with both plains and mountains. Elevations range from sea level on the Arabian Sea to over 25,000 feet above sea level in the far north. Part of this latter area is subject to earthquakes and is one of the earth's main seismic zones. The mountain ranges in the north are generally oriented northwest while a series of lesser ranges in both, extent and elevation, extend generally southwest-northeast throughout the northwest and western sides of the country. The flat Indus Plain dominates the eastern and southeastern portion of the country.

1. Indus Valley and basin - The Indus River and its four main tributaries - the Jhelum, Chenab, Ravi and Sutlej drain over one-half of the country's land area with an annual flow of up to 65 million acre feet, more than four times the annual flow of the entire Colorado River system in the United States. Annual monsoonal river flooding added

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rich alluvial soil to this area and gave rise to extensive tracts of tropical scrub, forest areas and riverine swamps. The river provided an early route for human settlement and the original vegetative cover has largely been cut away for agricultural purposes. A modern system of irrigation was initiated in 1860 to make cultivation possible in areas that otherwise could not be made productive because of lack of rainfall. Within the last decade, two of the world's largest earth filled dams and water storage reservoirs have been constructed. This system eventually gave rise to a dense network of irrigation canals making it one of the most extensive in the world.

2. Cholistan-Thar Desert- generally a barren, sandy waste, interspersed with rocky hills and dry valleys and occasional patches of shrub and sparse grass. This area lies mainly in India but extends northwest to the southern Indus Valley of West Punjab and Sind Provinces in Pakistan where it covers about 32,000 square miles.

3. Baluchistan Plateau - a broad, arid, table land in western Pakistan covering about 135,000 square miles. It extends from the Indus Valley into Iran. Vast sandy expanses are broken by rugged and barren hills and low mountains, most of them devoid of trees except for occasional *Acacia*, *Zizyphus* and, at higher elevations, *Juniperus*. Most of the region is from 1,000 to 3,000 feet above sea level and encircled by mountains. Drainage is internal with runoff and short rivers entering into shallow lakes in the plateau or disappearing in the sandy desert.

4. Northern Highlands - the rugged mountainous region of North Pakistan along the borders with Afghanistan at the Wakhan Corridor and the State of Jammu and Kashmir contain the towering alpine peaks and snowcapped ranges of the Himalayas, Karakorams, Hindukush and other ranges and include the world's second highest mountain (K-2) and a dozen others more than 25,000 feet high. The narrow, steep valleys are largely treeless, covered with barren scree and *Artemisia*. At higher elevations, where melt water from the snow provides moisture, alpine scrub and meadows exist.

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The southern parts of these mountains, in the districts of Hazara, Swat and Dir, receive the benefits of the summer monsoon and vegetation tends to be lush. Most of Pakistan's 8000 square miles of forests, characterized by oaks and conifers, occur in this region. However, the underlying soils in this region are quite fertile and many people have settled in the hills, cut the trees and converted the slopes into terraced fields. Almost every level piece of ground and every alluvial fan at the mouths of streams are irrigated and cultivated while domestic stock may be grazed to the upper elevational limits of vegetation.

Climate

Except in the northern mountains, annual rainfall in Pakistan averages less than 20 inches. The desert areas sometimes go for years without rain while the annual summer monsoon in July-September may bring 40-60 inches of annual precipitation to the northern mountains. Farther north, beyond the effects of the monsoons, precipitation drops to less than 20 inches. Yearly rainfall varies from six inches in Karachi, 15 in Peshawar, 18 in Lahore, to about 30 in Islamabad. Most rains occur during the summer monsoon although the Punjab and Northwest Frontier have a moderate rainy season as well. Precipitation in the desert areas such as the Baluchistan Plateau is scanty, often occuring as snow and seldom exceeding 10 inches or less.

Seasonal temperatures vary widely throughout the country with hot summers ranging from 90-120 degrees F and little nighttime relief. Karachi has a brief cool season, but Lahore, Islamabad, and Peshawar have a distinct winter season with daytime tempertatures of 60 degree F. or less, cold nights, and, in Islamabad and Peshawar frequent morning frosts. There are definite seasons in the north with altitudinal differences in climate.

Vegetation and Ecological Zones

Altitude, climate and latitude serve to affect the type of vegetation and its associated fauna. Pakistan contains some of the world's hottest low areas, highest cold areas and many areas in between within a relatively small locality. In the dry soil, low rainfall Himalayas, tough, wiry grasses and scrub trees subsist. Alpine flowers and climbing ivy invade mountain meadows at 9,000 feet and above along with large stands of fir trees. Long-leaved pine, oak, chestnut and walnut characterize the 3000 to 5000 feet slopes. While much of the plains areas, as on the Baluchistan Plateau, is so dry, it is devoid of vegetation. However, date palms and mangroves line the banks of the Indus. Only about 2.5 percent of Pakistan's land surface is forest covered and most of that occurs in the northern mountains.

Pakistan contains equivalents of many of the world's climatic and vegetational or ecological zones which can be differentiated by characteristic species of plants and animals. These zones do not form continuous units but occur as a mosaic of areas of similar ecological constitution. A large part of Pakistan has been so heavily degraded by the effects of man's activities that many natural systems and communities can no longer be related to any distinct ecological entity.

The following description of Pakistan's ecological zones is taken from Roberts (1977) and is itself a modification of a number of other groupings.

1. Permanent Snowfields and Cold Desert - the northernmost and highest elevation regions where vegetation, when present, is extremely xerophytic. It comprises about six percent (18,580 square miles of the total land of the country. Plants include species of <u>Salix</u>, <u>Juniperus</u>, <u>Mertensia</u>, and <u>Potentilla</u>. The periphery of this zone is used by herds of domestic goats and sheep for summer grazing and is shared with several wild species of animals.

2. Alpine Zone - characterized by meadows, subalpine scrub and birch forests, and dry steppic forests. The terrain is generally steep and rocky but includes large level areas, with occasional small lakes. This zone is subject to long winters and short growing seasons restricting the vegetation to low-growing plants.

   The meadows support may annual grasses of the genus <u>Poa</u> and include forb species of <u>Draba</u>, <u>Polygonum</u>, <u>Saxifraga</u>, and <u>Euphorbia</u>.

   The scrub and forest areas of the zone, though widespread, are confined to narrow sites in ravines and slopes of the higher mountains. Characteristic plants include species of <u>Betula</u>, <u>Rhododendron</u>, <u>Juniperus</u>, with grasses of <u>Sorbus</u>, <u>Alopecurus</u>, and <u>Poa</u> and forbs of <u>Primula</u>, <u>Ranunculaceae</u> and <u>Anemone</u>.

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The steppic forests occur at lower elevations usually in ravines and valleys. Woody species are common. Density is light and species of Juniperus, Berberis, Pistacia, Pinus, Artemesia and Ephedra vary according to locality. Much of these forests occur at sites in western and central Pakistan.

3. Montane Temperate Forest - a rather narrow zone restricted to the inner ranges of the Himalayas, it can be broken down into three distinct sub-divisions which comprise about 5.5 percent (17,122 square miles) of the total land area. The climate is generally sub-humid with 20-50 inches of precipitation. Much of the land is mountainous and rocky with patchy soil cover. Overgrazing of domestic livestock is a real problem and the woody vegetation is generally under pressure by the local inhabitants for use as fuel. Wildlife habitat has suffered accordingly.

   Over half this zone is made up of dry temperature coniferous forest and is found in the more sheltered lower slopes. It contains tree species of Picea, Pinus and Cedrus, with understories of Indigofera, Sambucus, Sorbaria, and Plectranthus.

   Lower down in elevation and receiving higher rainfall during the monsoon season is mixed deciduous and conferous forest characterized by tree species of Quercus, Acer, Populus, Taxus, and Pinus. The understory usually contains species of Fragaria, Viola and Impatiens as well as shrubs such as Berberis, Lonicera, Viburnum, and Skimmia.

   The third segment of this zone is generally confined to a fairly narrow band between about 3000 feet and 6500 feet elevation. Pinus, Quercus, Berberis, Clematis, Carissa, Cotoneaster and clumps of grasses such as Apluda, Themeda, and Aristida typify this environment.

4. Tropical Deciduous Forest Zone - though highly restricted to a narrow area bordering the north-east boundary of Pakistan and the disputed territory of Jammu and Kashmir, this zone is extremely interesting. It lies in the Pale-arctic Zoogeographic Region, yet contains bird and mammal elements from the Oriental Region.

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Some deciduous tree species common to the Indo-Malayan Region also occur here. Spring and early summer are usually hot with little rainfall and the ridge tops tend to be quite arid, although they do support a dry sclerophyllus forest association. The monsoonal rains in late summer result in relatively high total precipitation (up to 37 inches in a year) and deciduous species, typical of tropical forests grow in ravines, especially those that are shaded.

The terrain is largely mountainous with agriculture confined to small level or terraced mountain slopes. Natural woody vegetation is composed of species of Acacia, Bauhinia, Cassia, Ficus, Shorea, Salmalia, Sterculia, Punica, Lannea, Dodonea, Woodfordia, Carissa, Adhatoda, and Zizyphus.

5. Arid Subtropical Zone - over one-third of Pakistan's land area (111,483 square miles) can be classified under this category. It includes rocky hill country and plateaus from sea level to about 3000 feet elevation. Precipitation is generally less than 20 inches per year but varies according to the effects of the monsoons. Where rainfall is relatively moderate creating humid summers but dry winters, the vegetation is near subtropical and contains species of Euphorbia, Zizyphus, Acacia, Commiphora, Nannorrhops, Capparis, Caragana, and Haloxylon.

   In areas less influenced by the monsoonal rains the climate tends to be more Mediterranean with hot, dry summer months and some winter showers and regular frosts. Here, species of Acacia, Olea, Tecommella, Dodonea, Monotheca, Eryngium Adhatoda, and Withania are much degraded from heavy over-grazing.

   A still drier area, where the monsoons show no influence and which has cold winters and only occasional winter and spring showers (4 to 12 inches annually) is characterized by Reptonia buxifolia, Haloxylon ammodendron, Pistacia interregima, Olea cuspidata, Nannorrhops ritchieana, Bromus molle, Bromus tectorum and other Bromus species. Vegetation tends to be degraded in this area also

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6. Tropical Thorn Forest Zone - The largest single category, this zone covers nearly forty percent of Pakistan's land surface (120,592 square miles). Extensive areas of this zone are covered by semi-desert and desert sand dunes such as the Thal Desert in Punjab and Northwest Frontier Provinces (6600 square miles), Cholistan and Thar Desert in Punjab and Sind (32,000 square miles) and the Chagai Desert in Baluchistan Province (21,000 square miles). Precipitation is light (annual average from two to four inches) and vegetation is sparse. When rainfall does occur, runoff is quick and flash floods in the flat valleys are prevalent. The ground beyond these water courses is often pebble covered. Hardy desert species of Haloxylon persist on the sand dunes while species of Calligonum, Alhagi, Acacia, Prosopis, Pennisetum, Leptadaenia, Capparis, Tamarix and Eragrostis appear wherever sufficient moisture can be obtained. Many desert woody species are important sources of fuel to local communities and desert nomads. The more succulent and palatable species receive continual overuse from nomadic grazing.

The remainder of this zone is known as the Indus Plains and, as its name implies, is located along the path of the Indus River, the mouths of its major tributaries and along the coast of the Arabian Sea. Because of the deep soil associated with this part of the zone, most of the original forest cover has been removed and cleared for agriculture. Occasional patches of forest continue to persist but in a highly degraded condition due to the assaults of charcoal makers and grazing by domestic livestock. Low sand hills interspersed with highly saline flats are a distinctive feature in these otherwise level plains. Precipitation is rather low (4 to 12 inches per year) throughout most of this area with higher amounts occurring along the Arabian coast. Agriculture is supported by an elaborate system of irrigation canals. Where not destroyed, natural vegetation consists of species of Prosopis, Tamarix, Capparis, Salvadora, Suaeda and Chenopodium.

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Within the Indus Plains region are several local and usually limited areas of significantly different make-up. Even though the Indus River system is largely controlled by dams and barrages it is still subject to summer flooding especially in its lower reaches. This annual inundation has given rise to localized swamps and wet areas most of which dry up by April or May but some of which are permanent. Aquatic species of *Saccharum*, *Phragmites*, *Tamarix*, *Typha*, *Arundo*, *Paspalum* and *Erianthus* are typical of these areas.

In the immediate vicinity of the Indus and its tributaries up to the base of the foothills in the north are riverine strips of *Tamarix*, *Saccharum*, *Populus* and *Acacia*.

At the mouth of the Indus and in several bays along the Mekran Coast, mangroves mark the littoral or inter-tidal areas. Besides the mangroves (*Rhizophora conjugata*) vegetation in these areas is likely to be comprised of species of *Avicennia*, *Ceriops* and *Salsola*.

Land Use and Anthropogenic Effects

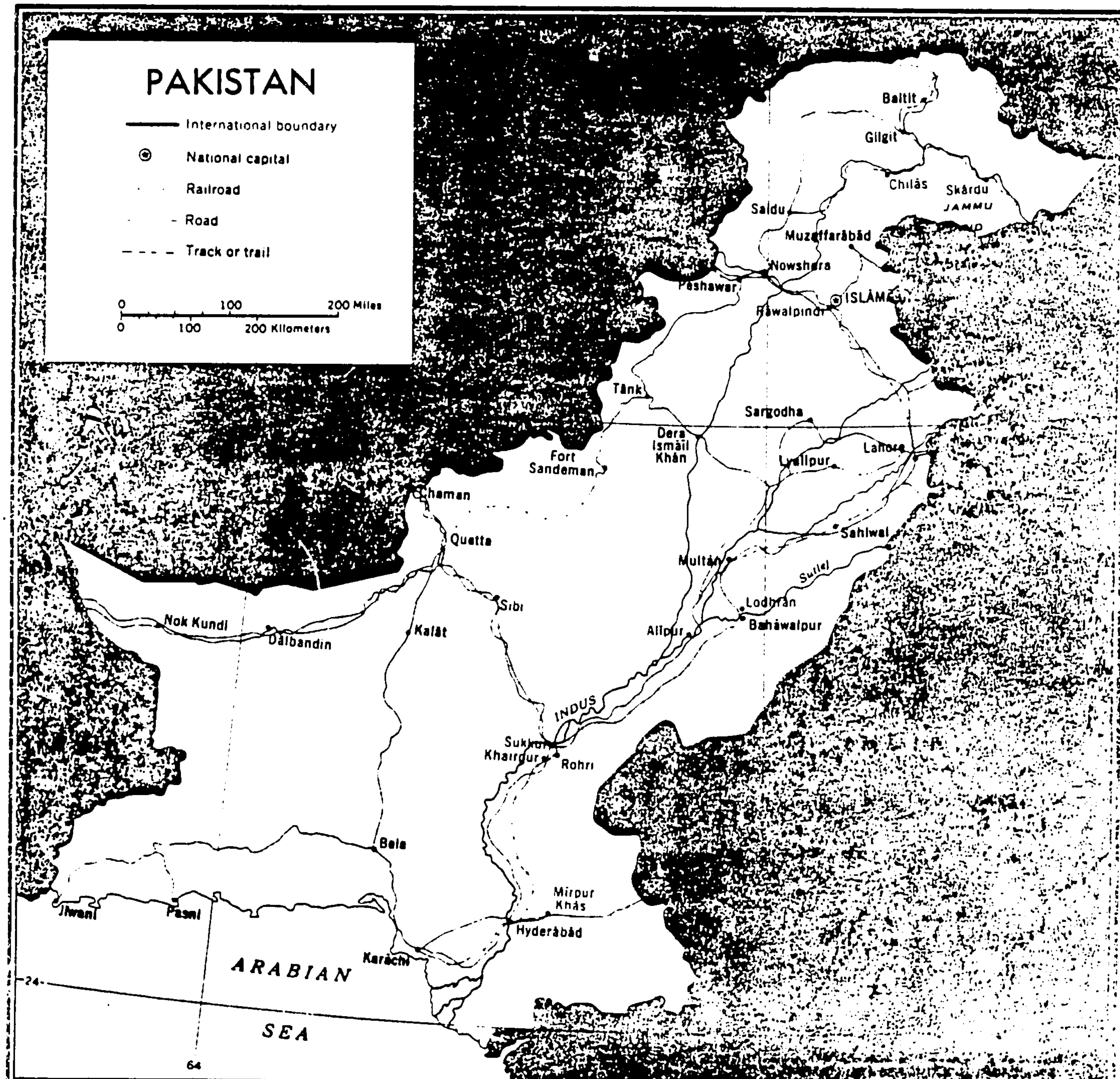
The earliest known inhabitants of the present Republic of Pakistan date back 6000 years. Remains of small villages and a simple agrarian culture have been discovered in what are now parts of Baluchistan and Waziristan. However, the 700 mile long Indus River Valley, with its five major tributaries, bounded by the Himalayas and Hindu Kush mountains to the north and west, the Thar Desert to the east and the Arabian Sea to the south provided the conditions suitable for the establishment of civilization on a major scale. This Indus Valley Civilization is known to have flourished in the period between 4000-2500 B.C. Elaborate irrigation systems, fine buildings of baked bricks and well planned streets are characteristic of the two major cities of Harappa and Mohenjodaro and the more than 30 lesser towns and villages scattered in the Indus Valley.

Human occupation and its effects in the Indus Valley has been constant ever since although a host of different peoples and cultures have come and gone. The annual inundations of the Indus River system combined with a favorable climate gave rise to a rich forest growth covering the land mass wherever the waters reached. Even in the more arid and high elevation regions, scrub and grass vegetation found conditions satisfactory for growth. With the advent of human civilization, the riverine forests were cleared and the land was converted to agricultural practices. Where rainfall would not sustain crops, irrigation was introduced which allowed still more land to be cleared. An extensive modern irrigation system was initiated in 1860 and has since grown into the largest network in the world involving over 37,500 miles of canals which serve about 25 million acres.

Tarbela Dam, the world's largest earth and rock-filled dam and three times greater in volume than Egypt's Aswan Dam, is 60 miles northwest of Islamabad and was completed in 1974 to control the Indus River. Designed to increase irrigation for agricultural land by some 1.4 million acres and to provide recreational opportunities along a reservoir stretching 50 miles up the Indus Valley, the dam has had, since its completion, a series of emergency and structural malfunctions resulting in loss of irrigation water. Until Tarbela Dam was finished, Mangla Dam, halfway between Rawalpindi and Lahore, ranked as the world's largest earth-filled dam.

As in many countries the demise of the natural flora and its associated faunal species is due to the expansion of the human population with its over-exploitation of natural resources. Pakistan is no different in this respect. With an annual population growth rate of 2.6-3.5 percent, the present population is estimated at about 65 million people with the most rapid increase occurring in urban areas. Density averages about 210 people per square mile, being greater around Karachi and in the agricultural Indus Valley of the Punjab and less in the barren uplands of Baluchistan.

Over 80 percent of the population is rural and is engaged in agriculture and the country's economy is predominantly agricultural accounting for almost 45 percent of the national income. Governmental projects have entailed active land reclamation to produce foodgrain and cotton on large areas of land previously too arid for such practices and the intensification of agro techniques to make the nation self-sufficient in food grain.



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SECTION IV

STATUS OF WILDLIFE MANAGEMENT AND CONSERVATION IN PAKISTAN

Legislation

The first written legislation that directly benefited wildlife were rules and regulations formulated in Sind under the Forest Act in 1887 and later compiled under the name of Bombay Forest Manual. These rules, while enacted for protecting the forests, served to protect animal species as well since the forests were fenced to control domestic grazing and fire control was practiced. Hunting in these forests, though not widely practiced, was not legally controlled.

Rules issued under the Forest Act in 1927 and containing passages dealing with the control of hunting, grazing, cultivation, lumbering and other activities, served to extend the degree of protection for wildlife and habitat. This control, however, only applied to areas declared Reserved or Protected Forests which formed only a small proportion of the country's habitat.

The primary national legislation consists of the 1959 Wildlife Protection Ordinance and the 1960 Wildlife Protection Rules issued under that Ordinance which prohibits the killing of some species of birds, reptiles and mammals and lists others as game animals which may only be hunted on license. The Ordinance also has provisions for the declaration of Game Sanctuaries and Game Reserves but does not protect these areas from habitat destruction.

The Wildlife Protection Ordinance and the Forest Act apply only to the settled areas of Pakistan (broadly speaking, the flood plains of the Kabul and Indus Rivers and all the land to the east of them) and neither are applicable to the Special Areas (a collection of semi-autonomous States, separately administered territories, and tribal areas, in none of which, other than ex-British Baluchistan and probably Gilgit and Baltistan, are any written conservation laws known to have been applied).

Other legislation controlling the export of live wild animals and wild animal products has been enacted under the Import and Export Control Act.

A total ban was imposed on the export of skins of leopard, snow leopard, caracal, fishing cat, marbled cat, clouded leopard, palm civet, mongoose, smooth otter, mugger crocodile, gharial, monitor lizard and python in 1968.

Except for some areas such as the Gilgit Agency, wildlife in Pakistan is under the jurisdiction of the provinces. Further, regions such as Khyber, Kurram and Waziristan in the western part of the country are known as Special Areas, and are guided by tribal laws in most matters. Sind Province has its own Wildlife Ordinance (1972) as do Baluchistan and Punjab Provinces (1974). These latter ordnances govern hunting, protection of habitat (establishment of game sanctuaries and parks), import and export of wild animals or their parts, and protection of species threatened with extinction.

Status of Wildlife and Endangered Species:

Because of its range of topography and climate Pakistan originally had a rich and varied fauna, showing affinites to those of the Palearctic, Oriental, and Ethiopian Regions as well as to that of the Indochinese Sub-region. Destruction of natural habitats and over-hunting, both legal and illegal, for sport, food, and furs over a long period of time has led to the decline of most of the fauna. The lion, tiger, great one-horned rhinoceros and swamp deer have already been extirpated; the cheetah, Indian wild ass and Kashmir stag may have joined these vanished species. Almost all species of large mammals and many kinds of birds, are threatened with extinction.

Lists of animals threatened with extinction throughout their range are maintained by various national and international agencies. The U.S. Fish and Wildlife Service, under the authority of the U.S. Endangered Species Act of 1973, maintains one such list which includes 23 species occurring in Pakistan (12 mammals, 2 birds and 9 reptiles see Appendix I).

Other species not necessarily listed by the Service because of their more secure status in other parts of their range, are nevertheless rare to uncommon and threatened in Pakistan. In some cases, as for the musk deer, goitered gazelle, Eurasian otter, lynx, caracal, Baluchistan black bear, mugger crocodile and gharial, populations or individuals are scarce and often so localized in distribution that little is known about them. Active conservation programs cannot be instituted until surveys are made to find out where animals still exist and in what numbers. Little is known of the Indus River dolphin also, although a visible population has been reported from the Indus near Sukkur.

The Marco Polo sheep is one of Pakistan's most spectacular animals and in recent years has become one of the rarest. It is now confined to about thirty square miles around the Kilik and Khunjerab Passes of Northern Hunza as a sporadic visitor. Heavily hunted in recent years in Pakistan the sheep spends most of its time in the Sinkiang Province of the People's Republic of China where it is protected. As protection is strengthened in the Khunjerab National Park, established in 1975, this species may once again regain its numbers in Pakistan.

Bharal or blue sheep are distributed equally as locally in the upper Ghujerab and Shimshal Valleys of Hunza at great elevations. Due to the strategic importance of this frontier region little information is available on this species' status.

Hog deer has a wide range across India through Assam to Burma and Thailand but is quite local in distribution. It was once plentiful throughout the Pakistan riverine forests of Punjab and Sind but now only survives in small and scattered populations in reed beds and thickets in the Indus River forest reserves of Sind. Flooding, shrinking of the natural habitat and over-hunting has placed the status of this species in an extremely vulnerable position.

Blackbuck were once numerous in the deserts of eastern Pakistan. In 1969 it was estimated that fewer than 200 animals remained. By the mid 1970's the status of this species seemed to be even more precarious with no permanent population and the presence in Pakistan due to regular vagrants from India. Ten animals were brought from a flourishing population earlier introduced in Texas, U.S.A. and released into an enclosure in the Lal Suhanra National Park in 1970 through a World Wildlife Fund project to augment dwindling numbers in their native habitat. By the mid 1970's this population had increased to 22 animals.

The nilgai is endemic to the Indian subcontient and is widespread in all areas where there is not tropical forest or higher rainfall. Although reputed to have been plentiful in Gujrat and Jhelum districts of the Punjab at the turn of the century there is practically no permanent resident population in Pakistan today.

Brown bear, generally restricted to high montane meadows and areas above the tree zone in extreme northern Pakistan, has always been sparsely distributed. Recent reports, however, indicate the species may have suffered a drastic decline.

Of the five species of sea turtle reported to occur in the territorial waters of Pakistan, the hawksbill and leatherback are listed by the Fish and Wildlife Service as endangered. The others are also imperiled and will soon be listed as threatened or endangered. Green and olive ridley turtles nest between July and November on several beaches along the approximately 550 miles of Pakistan coastline but mainly at Sandspit and Hawkes Bay beaches near Karachi. Although Pakistan officially protects all turtles and their eggs under the Sind Wildlife Protection Ordinance of 1972, exporters of turtle products have continually worked to have this changed. In addition, cottage construction is threatening the nesting sites and stray dogs have also been responsible for nest destruction.

Of the 158 or so mammal, 900 bird, and numerous reptile and amphibian species known to occur in Pakistan, information is often sketchy or incomplete for making accurate pronouncements on their status. Several species of animals are still widespread and sometimes locally abundant. But whereas recently as [illegible] years ago large numbers of gazelle, wild ass, wild goats and sheep could be observed, and individual herds contained numbers of over a hundred, many of these same animals are no longer seen or their groupings are comprised of only a few animals.

The Indian gazelle is a highly adaptable animal and has an extensive range in the arid and sub-arid regions of Pakistan. Its preference for open, level terrain has made it extremely vulnerable to shooting from vehicles, however, and it has been considerably reduced in the desert regions all along the eastern Pakistan border.

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Wild boar is another highly adaptable species and can survive in a variety of habitats but is more commonly found in the thick riverine forests of the Indus basin. With no serious predators it has become a serious agricultural pest. Massive government extermination campaigns using poisoned bait have failed to seriously reduce its numbers.

Of the three subspecies of urial sheep in Pakistan, the Afghan urial is the most common. The Shapu or Ladak urial is listed by the Fish and Wildlife Service as endangered and according to knowledgeable biologists studying this creature, fewer than 1000 still exist in Pakistan. These are located along the Indus and Shyok Rivers between Skardu and the cease fire line with India. Urial are hunted persistently by the local peoples, they are preyed upon by a number of carnivores and suffer from competition with domestic grazing flocks.

Another group of ungulates, the wild goats, including the markhor and Siberian ibex, have a wide distribution in the hill and mountain areas of the country. But they too have suffered from unrestricted shooting by the military and local human population. Goats occur all across the Baluchistan ranges south of Quetta and in western Sind. Kirther National Park provides a safe refuge for a large population of about 1500 animals in the latter area. The markhor hasn't fared as well and fewer than 3000 may still exist in the northern regions of Pakistan. The taxonomy of this species is relatively confused at present although the U.S. Fish and Wildlife Service recognizes three separate subspecies and lists them all as endangered. The Siberian ibex is still found at high altitudes, above 10,000 feet in the northern mountains but its status is by no means secure.

The large carnivores of Pakistan, like the large carnivores in most other countries, have become rare due to the activities of humans. While many species have reduced ranges and specific habitats, the striped hyaena and the wolf still maintain extensive ranges over vast areas of the country.

However, their status is relatively obscure because of their nocturnal or secretive habits. Based on reliable estimates they are not common, although, probably in no danger of extinction.

Although many investigators have systematically recorded the numbers and variety of bird life in Pakistan, little has been done to determine the status of various birds outside the game species and likewise little management is carried out. The Fish and Wildlife Service lists only two bird species as endangered, the great Indian bustard and the western tragopan pheasant. Many of the other four species of pheasants are in trouble but without accurate, documented evidence their status remains obscure. The houbara bustard, once abundant in the Cholistan deserts where it annually over-wintered, has been nearly decimated from over hunting. Much of this overhunting is done by well-equipped and organized falconry parties from other countries. This activity has also resulted in a drain on the resident and migratory birds of prey, especially the falcons, which are sold for falconry purposes.

Other game birds such as the snowcock, snow. see see, chukar, grey and black partridges, peafowl, sandgrouse and quail, while once abundant, have all suffered reductions. Thirty six species of waterfowl use the Indus River as a major flyway and wintering grounds. Habitat alteration and overhunting have had their effect on these populations also.

Throughout the long period of human occupation in Pakistan, most of the activity has centered around the Indus River basin. Development pressures and habitat alteration have not been nearly so great in the mountainous country to the west. Not surprising then is the fact that most of the county's wildlife can still survive in these mountains particularly in two outstanding areas. The first, represented by the western part of the Quetta Division, Kalat and Mekran in Baluchistan, is the southwest of the country, and the second is in the extreme north (Baltistan, Gilgit, Chitral, Upper Dir, Swat, and Hazara).

Attempts to ascertain the status of wildlife species in Pakistan have been sporadic and generally unrelated. Mr. Tom Roberts, a long time resident of Pakistan has made a special contribution to the

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accumulation of knowledge. Through his interest and studies he has called international attention to the country's wildlife. His Mammals of Pakistan published in 1977 will serve as an outstanding basis of biological information for the country's mammals for years to come.

The World Wildlife Fund Pakistan, established through the efforts of Mr. Christopher Savage, has supported several brief studies by Dr. Zahed Mirza. Savage has been instrumental in collecting information on the country's wildfowl and wetlands and was untiring in promoting the aims and objectives of wetland conservation through his relationship with the International Wildfowl Research Bureau (IWRB).

The Government of Pakistan requested the World Wildlife Fund (WWF) to assist in examining the current status of wildlife in the country with particular reference to those species of animals and their habitats in need of special attention. WWF sent two expeditions to Pakistan in 1966 and 1967. Their reports detailed information on many species and made a series of recommendations for a program of conservation.

As a result of another recommendation by the WWF team, the Government of Pakistan appointed a Wildlife Enquiry Committee in November 1968 to carry out status surveys and to obtain better control of hunting and other forms of wildlife exploitation.

About the same time a wildlife consultant from the Food and Agriculture Organization of the United Nations (FAO) spent three months in Pakistan compiling information on wildlife and its protection. His recommendations appeared in the 1969 FAO Report No. 17. The same consultant, Mr. I.R. Grimwood, returned to Pakistan from February 1970 to July 1971 to act as Wildlife Conservation and Management Advisor, working with the Wildlife Enquiry Committee, conducting wildlife management surveys teaching wildlife management at the Forestry College, Peshawar, and conducting in-Service training in wildlife management for Forest Service personnel.

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The Baluchistan Forest Department initiated a broad wildlife survey in 1969 and the Punjab Forest Department estimated urial numbers in the Salt Range. The Wildlife and Forest Department of Sind censued wild goat, and, in collaboration with the IUCN, prepared a management plan for Kirthar National Park. Northwest Frontier has recently completed a rough, indirect wildlife survey in the province. Brief surveys of waterfowl, western tragopan and other species have been conducted by various visiting foreign investigators.

There have been only two intensive studies on large mammals: one on the wild pig around Lyallpur in 1963-1964 by Dr. Richard Taber, and the second includes extensive surveys with detailed studies of several species of wild sheep and goat by Dr. George Schaller and others from 1970-1975.

Wildlife management and training

Wildlife in Pakistan is under the jurisdiction of the provinces except for some areas such as the Gilgit Agency, which are administered by the central government. Prior to 1967 a separate Game Department, with appropriate provincial counterparts, administered the Wildlife Protection Ordinance in those parts of Pakistan to which that Ordinance applies. The functions and staff of the Game Department were absorbed into the Forest Department and the staff was reallocated so that now each Divisional Forest Officer has a Deputy Inspector (wildlife) and a variable number of Game Wardens (rangers) and Game Watchers under his command. Broadly speaking, the Forest Department uses its other staff to enforce the Wildlife Protection Ordinance and Rules under the Forest Act in Reserved and Protected Forests and Deputy Inspectors (wildlife), Game Wardens and Game Watchers to enforce the Wildlife Protection Ordinance elsewhere.

The Wildlife Enquiry Committee set up in 1968 to formulate recommendations for a national conservation program, agreed upon the necessity of a comprehensive approach including scientific management of wildlife through introduction of regular management plans, administrative organization training, education and research.

In 1974, the National Council for Conservation of Wildlife was established to formulate appropriate policies to fulfill the Wildlife Enquiry Committee's recommendations and to act as liaison with international agencies and the provincial governments to promote the conservation of wildlife. Creation of Wildlife Management Boards to act as advisors to the local governments has helped in this effort in the provinces. More effective and more comprehensive wildlife legislation has been introduced and implemented in all the provinces.

In the last few years the quality as well as the quantity of wildlife management in Pakistan has improved. Some of the provinces such as Sind have had more interested or more progressive officials and have historically practiced sound wildlife management. Others, such as Azad Kashmir, are only recently taking effective measures for the preservation of wildlife.

The provincial forestry (wildlife) departments vary widely in both staffing and structure with Punjab and Sind being generally considered the best. In some of the provinces (Punjab and Northwest Frontier as examples) the Wildlife Department is still a branch of the Forestry Department while in Sind, wildlife has equal ranking with forests.

All officers joining the Forest Department receive their training at the Forest Institute Peshawar. The Institute has no formal wildlife management training program but from 1968 onward courses in wildlife management form part of the Forest Management and Economics syllabus for both graduate and diploma students. They are taught by a forestry graduate of the Institute. Refresher courses are also offered.

The Fish and Wildlife Service/National Park Service team visited the school and met with appropriate officials. These officials showed a definite interest in broadening the curriculum to include specialities such as wildlife, range, and park management, as well as forestry. They also felt it was important to develop their wildlife management program to academic quality so that the University would honor a degree in the subject. The facilities at Peshawar could easily be converted to include other environmental diciplines to form an Institute of Natural Resources but would require academically qualified staff. The Forest Institute officials envision a two-year course in wildlife management (including park and range management) consisting of class and field projects through four semesters. The semesters run about six months with a two-week break between. Students are expected to spend much of their time in field on actual work exercises.

Forest schools exist at Ghoragai and Bahawalpur to train medium grade Forest Department staff from the north and south of Punjab respectively. Conservation practices are included in the syllabus of both establishments.

Unfortunately, Forest Department students were usually ignorant of the wildlife of their country. The provincial forest departments lacked trained field biologists and little intensive wildlife research was initiated. Incentive to enforce wildlife protection laws was lacking even though, except in tribal areas, the staff was available. Only Sind and Northwest Frontier provinces had made a sustained effort to halt illegal shooting by appointing wardens and by prosecuting offenders.

Training in wildlife management and conservation is recognized by the National Council for Conservation of Wildlife as being a national priority. Wildlife research is at a level which was reached in North America over 40 years ago and in East Africa 20 years ago. Local universities are not ecologically oriented in their teaching and research and thus do not provide trained personnel for government organizations, such as the Zoological Survey of Pakistan, and the provincial forest departments. Moreover, wildlife officials in Pakistan work almost in an intellectual vacum, either unaware of published information or unable to obtain it.

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Under the National Wildlife Strategy the National Council for Conservation of Wildlife has listed wildlife education and training as the main priority. Introduction of graduate, post graduate and short term in-service training at the Pakistan Forest Institute through international experts and the training of their national counterparts is seen as a means of accomplishing these goals.

During the U.S. Fish and Wildlife Service/National Park Service study mission to Pakistan, the team spent a great deal of time interviewing wildlife personnel desirous of training in the United States. National and provincial officials had obvisously gone to extensive lengths over the past few years to select a core group of individuals for specialized training in the U.S. and the provincial offices went to considerable trouble to bring their candidates in from remote areas to meet with the team. Unfortunately, the training prospectus had been initiated by the Food and Agriculture Organization of the United Nations and the International Association of Fish and Wildlife Agencies in the United States without the benefit of support from the Fish and Wildlife Service or the National Park Service. The team agreed on the high priority established for training but was unprepared to make immediate decisions relative to selection of candidates for training.

It is highly disturbing that this misunderstanding occurred and emphasizes the need for increased communication between Pakistan officials at the federal and provincial level and the U.S. Fish and Wildlife Service/National Park Service.

Future negotiations under the Excess Foreign Currency Program should explore the establishment of a training program with ultimate expansion to an educational program. For example, training courses could be initiated both in the U.S. and in Pakistan. Selected individuals could also be brought to the U.S. for actual advanced university training. In-country training at Peshawar Forest Institute would probably be the most efficient in terms of expense and number of individuals reached. This approach might be effective until a U.S. training program could be established and a permanent or long-term staff could be located in Peshawar.

Parks and Reserves

Land areas set aside specifically for protecting wildlife is not a new concept in Pakistan. The early rulers or Mirs often declared certain areas as preserves expressly for this purpose so they would have a sufficient supply of game animals for hunting.

The first forest reserves set up under the British period in the mid 1800's, more often than not, circumscribed the same areas previously set aside by the Mirs. Under the British forest system, habitat was protected and to some degree, wildlife itself.

Outside the Indus basin, wildlife has maintained itself due to the remoteness and inaccessibility of the terrain. Here and there, especially in the northern, mountainous, tribal areas, local chieftains with a passion for hunting, often recognized the value of putting certain areas off limits to hunting to allow animal populations to build up.

Thus, coming into the present century, there existed a number of areas scattered around the country which served to protect wildlife. Except for the reserved or protected forests, few received more than a minimum amount of management and many were unknown.

The passage of the Wildlife Protection Ordinance in 1959 and issuance of the Wildlife Protection Rules in 1960 authorized the establishment of sanctuaries and reserves for game. Wildlife was formally recognized as an important natural heritage.

Following the World Wildlife Fund expeditions in 1966 and 1967, recommendations were made to the Government of Pakistan for the establishment of parks and reserves. The Wildlife Enquiry Committee, appointed in 1968 had additional functions which included the selection of suitable areas to be set aside as national parks or reserves and making recommendations concerning legislative, administrative and other measures to set up and maintain them.

It was well recognized that in order to conserve its wildlife, Pakistan needed an extensive network of well maintained reserves and that this network should include samples of all the various habitats and their associated fauna, including predators such as wolves and leopards.

The Wildlife Enquiry Committee completed its work in October 1970 and recommended the establishment of 46 wildlife sanctuaries - "devoted to preservation of flora and fauna in its natural state. Entrance and activities to be controlled by permit", 22 national parks - "All forestry practices, collection of grass, firewood, building materials, etc., are prohibited"; and, 5 Game Reserves - "hunting is controlled by a special permit system".

The first national park, Lal Suhanra, was formally declared in the Bahawalpur District of Punjab in 1972. The park consists of irrigated forest plantation (20974 acres), Desert Branch Pond (4780 acres) and Cholistan Desert (51726 acres) for a total of 77480 acres. The park was established to: protect existing wildlife and vegetation; reintroduce extirpated species; rehabilitate wildlife habitat; create educational/research facilities, facilities for local and foreign tourists, and recreational facilities for the local population. Blackbuck, Indian gazelle, hog deer, peafowl and nilgai have been reintroduced to date.

Representatives of the U.S. Fish and Wildlife Service/National Park Service study team visited the park and discussed future directions and needs. Lack of trained personnel was an expressed need. In addition, the dissemination of public information about the park and the improvement of public interest among local people and potential tourists is necessary. Environmental education is also required in order to build an appreciation for and acquire cooperation in the park's protection.

Kirthar National Park achieved its status in 1973. Established in the Dadu District of Sind, this 466,000-acre reserve provides protection for a fine herd of ibex about 60 miles north of Karachi. Other large game species such as Indian gazelle and urial sheep have increased their populations within the park. FWS/NPS team representatives visited this area also. A management plan has been drawn up for the park with the assistance of the International Union for Conservation of Nature and Natural Resources (IUCN). However, fiscal restraints and other priorities have largely precluded full implementation of the plan. The staff consists of a Divisional Forest Officer and Game Warden with two Game Inspectors each with three assistants (rangers) and a total of 63 Game Watchers. Some fine new facilities have been constructed including a headquarters and dormitory building and five individual family quarters.

Khunjerab in northern Hunza, Gilgit Agency, became the third national park in 1975. This area has been successful in providing protection for Marco Polo's sheep, blue sheep, snow leopard, snowcock, snow partridge and other high mountain species.

A fourth national park has been recently declared in Swat, Northwest Frontier to preserve ibex, markhor, snow leopard and the monal pheasant. Other areas have been proposed for Azad Kashmir(Machiara National Park), Shigar in Balistan Northern Area, and a federal area in Margalla Hills near Islamabad(which has a proposed management plan already).

National parks in Pakistan have apparently been established primarily for wildlife not necessarily for their historic or senic features and their administration is handled by the provincial wildlife departments.

In addition to the four designated national parks, the Government of Pakistan lists 65 wildlife sanctuaries (Punjab - 16 areas covering 8,406,498 acres; Sind - 12 areas covering 415,518 acres; Northwest Frontier - 14 areas covering 47,868 acres; Baluchistan - 4 areas covering 83,200 acres; Azad Kashmir - 9 areas covering 119,837 acres; and Northern Area - 10 sites covering 666,240 acres) comprizing 15,217 square miles. In addition, 44 other areas have been designated Game Reserves and these govern an additional 4407 square miles of terrain (Punjab - 9 areas covering 161,678 acres; Sind - 8 areas covering 420,274 acres; Northwest Frontier - 7 areas covering 48,260 acres; Baluchistan - 16 areas covering 1,808,766 acres; and, Northern Areas - 4 sites covering 381,440 acres).

Most of the areas were created to provide some sort of habitat protection for animal species commonly referred to as game (huntable species for sport or meat). Providing protection for these species also affords a measure of security for many less known plant and smaller animal species. Thus, the Government of Pakistan has created a parks and reserve system governing about seven percent of the country's land mass.

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There presently exists a certain amount of confusion over nomenclature for the parks and reserves. Each nation affixes a name to its natural area to be preserved based on the purpose, function and style of management to be served by that area. However, the resultant term may have different meanings in different parts of the world which has led to confusion in understanding what types of protected area a country really has. Attempts have been made for many years to achieve international agreement on classification of protected areas in defined and limited categories and on affixing some sort of standardized terminology to these categories. In 1969, at the General Assembly session of the IUCN in New Delhi, a definition of "national park" was adapted. Yet even this agreement has limitations and many nations continue to have problems meeting the prescribed requirements to utilize such a term.

However, more important than terminology and classification is purpose and function. Pakistan is concerned with its resources in a national context and has used descriptive terms to fit its needs. Sound planning and management are essential to effective land conservation and in assessing its future needs the Government of Pakistan should take an inventory of what should be preserved and assess their economic, social and biological value. Those areas in most urgent need of protection because of their biotic value should take precedence over those most easily set aside because they are of little interest or value. Since these protected areas are no less important than other uses of the land such as agriculture, water supply, energy, human settlements and other major development activities planning for them should be an integral part of the national planning process.

SECTION V

INSTITUTIONAL STATUS OF WILDLIFE MANAGEMENT AND NATURE PROTECTION IN PAKISTAN

A variety of governmental and nongovernmental agencies and organizations are involved with wildlife conservation in various capacities in Pakistan. The U.S. Study Mission noticed, on several occasions, apparent tensions between various groups. This can probably be attributed to the zealous nature and seriousness with which most of the Pakistan officials hold the subject. However, it is extremely important that all agencies and organizations work closely together in an integrated fashion so that the wildlife problems in Pakistan can be met.

Government Agencies

A. Ministry of Food and Agriculture

Overall responsibility for wildlife protection in Pakistan is assigned to this Ministry headquarterd in the capital Islamabad. Within the Ministry the wildlife functions are handled in the Forestry Department under the Agriculture Division through the Inspector General of Forests who is also the Joint Secretary, Ministry of Food and Agriculture. The Inspector General is assisted by a Deputy Conservator of Forests (Parks and Wildlife) who acts as an advisor on wildlife but who has no direct administrative or executive control of subordinate game staff. As the actual management of wildlife is handled by the provincial governments, the staff at the federal level is very small. However, major wildlife policies and actions must be coordinated through the federal staff.

1. National Council for the Conservation of Wildlife

In 1974 the Council was established replacing the Wildlife Enquiry Committee which was dissolved in 1971. The new organization is intended to provide overall coordination of central and provincial government effort in the implementation of any conservation program. They have become a state member of the International Union for Conservation of Nature and Natural Resources (IUCN) and, in collaboration with the Pakistan Forest Institute, World Wildlife Fund (WWF) - Pakistan, Sind and Punjab Wildlife Management Boards and the Conservator of Forests in Peshawar, have prepared a Wildlife Conservation Stragety for implementation under

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the IUCN/WWF - Pakistan Conservation Coin Collection Scheme. The Fish and Wildlife Service/National Park Service Study Mission met with various representatives of the National Council and received copies of the list of projects developed under the above mentioned Conservation Strategy. Many of these proposals are being considered for funding and are further discussed in section VI.

Some wildlife officials in Pakistan are dissatisfied with the role of the National Council and its progress to date. It has been proposed by the Pakistan authorities to reconstitute the Council with the Secretaries of the Provincial Forestry Departments becoming the principal functionaries and the position of chairman being rotated between them, the first chairmanship to be held by Sind because of its active role in the past.

2. Forestry Department

Within the provinces the local Forest Departments have a supplemental wildlife function. Implementation of the various laws was discussed in section IV. The legal status of wildlife differs widely and the effectiveness of management of the resources likewise differs widely depending on the interest and abilities of the pertinent personnel involved.

There are five Chief Conservators of Forests located at Peshawar, Lahore, Multan, Hyderabad and Quetta. Each has a Subdivisional Forest Officer (wildlife) who advises him and his Division Forest Officers on wildlife matters but who cannot exercise administrative or executive control of subordinate game staff. Each Divisional Forest Officer has a Deputy Inspector (wildlife) and a variable number of Game watchers under his command.

In addition some provinces have Wildlife Management Boards (Sind and Punjab) to assist in carrying out programs for wildlife (their function is described later on in this report). Others (Northwest Frontier and Northern Areas) have created Wildlife Wings under the administrative control of the Conservator of Forests while Azad Kashmir has a separate Wildlife Department.

3. Wildlife Management Boards

These groups were created to act as advisors to the local provincial governments on wildlife matters. They are usually made up of governmental and nongovernmental representatives who are knowledgeable or concerned with wildlife conservation.

Sind has a well established Board based in Karachi which is probably the most progressive organization on wildlife in Pakistan. It is a governmental member of IUCN and has already completed some projects in cooperation with the IUCN/WWF. These include preparation of management plans for Kirthar National Park and wetland sanctuaries in the province. They also have a number of other proposals involving conservation of turtles, Indus dolphin and waterfowl to be implemented.

Punjab has a Board which is beginning to show a greater interest in the development of wildlife conservation and has implemented a number of projects involving training, development of reserves and captive breeding of pheasants, partridges and crocodiles.

4. <u>Marine Fisheries Department</u>

A federal research and action agency, this organization was established to promote the development of inland and marine fisheries and fish industries in the country. Based in Karachi, its main functions include oceanographic, biological and technical research, surveys and collection of data, and training of personnel. It also organizes fisheries development projects, advises the provincial governments and private enterprises in development of fisheries, and seeks to implement the recommendations of the Indo-pacific Fisheries Council of the United Nations Food and Agriculture Organization. It is strongest in fisheries technology.

Members of the FWS/NPS team met with the Director of this organization and his staff receiving a brief orientation and visiting the museums and library.

The Government of Sind has a Fisheries Department in Karachi and representatives had an opportunity to talk with members of the U.S. study team also. Some work has been done on green sea turtles in Karachi.

5. <u>Captive Breeding Units</u>

Located in Punjab, north of Islamabad on the road to Murre, the Ghora Gali Pheasantry is situated in moutainous, pine-covered habitat which receives snow during the winter months. It contains a small dormi-

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tory for forestry students and has a number of pens for holding birds. During the visit of the U.S. Study Mission, the pens contained one pair of Cheer pheasants plus twenty pairs of ring-necked pheasants, the latter received from Korea. Plans are to raise four species of native pheasants here for restocking in the wild - Cheer, western tragopan, monal and the Kalij. The Cheer is considered extinct and the tragopan (listed as endangered by the U.S. Fish and Wildlive Service) as almost extinct in Pakistan. The monal and Kalij are still considered to be common but declining. The ring-necked is to be used for stocking habitat where the native species are not supposed to be found.

Another small game bird propagation facility exists in the Punjab south of Lahore where francolins and peafowl are being raised. Additional propagation projects are being carried out in the Northwest Frontier and Azad Kashmir.

Although some personnel involved with these game bird operations have attended a six-week course in breeding pheasants at the Poultry Research Institute, Karachi organized by the National Council for Conservation of Wildlife and one man from Azad Kashmir had received training at an English pheasantry, the U.S. Study Team felt that all captive breeding projects would benefit from a cooperative propagation and release program for endangered upland species as well as additional training and techniques. This might be coordinated by the federal government. The program, however, would have to be well publicized and the released birds would have to receive complete protection (in action as well as by law).

B. Pakistan Forest Institute

Located at Peshawar University, Northwest Frontier, this institution falls under the jurisdiction of the central government. Its main role is to train officers joining the Forest Department and to carry out research in forest products and silviculture. The Director General oversees four Divisions: 1) Forest Research (Silviculture, genetics, forest mensuration and management, range management, watershed management and wildlife management, 2) Forest Products Research, 3) Biological Sciences Research (forest entomology, forest chemistry, forest botany, and medicinal plants), and 4) Forest Education.

As was mentioned in an earlier section of this report, the Institute has no formal wildlife management training program but some courses in wildlife are taught. A real need for both classroom and field training exists and Pakistan officials are highly interested in upgrading the caliber of the Institute cadre. They also want to create a wildlife degree program recognized by the University.

Some wildlife research such as population dynamics of markhor in Chitral Gol, effect of domestic grazing in Chitral Gol, waterfowl studies in Haleji Lake and forage production in Hazara have been conducted by Institute personnel. The Institute is a governmental member of the International Union of Conservation for Nature and Natural Resources.

C. <u>Indus Flyway Committee</u>

Pakistan is a signatory of the 1972 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar, Iran Convention). Ratifying this agreement obligated the Government of Pakistan, which is a State member of IUCN, to safeguard the wetlands along Flyway No. 4 known as the Indus Flyway. While all the provinces have a joint responsibility, Sind, with the major populations of wintering waterfowl, has taken the lead in wetland conservation.

Established in January 1978 its goals are to collect information about wildfowl from different sources, monitor hunting pressure, and supervise research programs and other activities relating to waterfowl conservation. A Secretariat to carry out these goals will be established in Karachi at the office of the Sind Wildlife Management Board. The Secretariat will act in a consultative capacity for research and management of migratory waterfowl and will maintain liaison and coordinate with international organizations.

The Committee currently consists of the Martial Law Administrators of the four provinces, the Secretary Forestry and Wildlife Department of each province, Administrator World Wildlife Fund - Pakistan, Director General of the Forest Institute, and one member from each Wildlife Management Board.

D. <u>Zoological Survey Department</u>

This agency was created in 1948 and is headquartered in Karachi. It is affiliated with the Marine Biological Research Lab and collects information about systematic and geographical zoology, conducts faunal surveys, and studies habits, habitation and family relationships of different species. The U.S. Study Team visited this agency which has facilities including a transport, launch, a few research [illegible] and a museum, but is relatively poorly funded. The chief interest of officials there, and where the greatest expertise lies, is in taxonomy of large mammals, marine organisms and insects. But the organization is charged with researching all the wildlife and there is some pressure to upgrade the entire operation, especially in regards to survey and population estimation programs.

E. Pakistan Science Foundation

This federal agency is located in Islamabad and functions as the national research and information center for science much like the Smithsonian Institution in the United States. It encourages scientific research through grants and fellowships but is poorly funded.

Nongovernmental Agencies

A host of nongovernmental organizations serve vital functions in the effort to manage and conserve wildlife in Pakistan. The following is a list compiled from many sources and is not necessarily complete.

A. Universities

1. Quaid-i-Azam-Islamabad. This university has strong interests in rhesus monkeys and has a variety of projects on behavior, reproductive physiology, and parameters of this species underway through the Department of Biological Sciences. The U.S. Study Mission team met with many of the staff and toured the facilities. The University's orientation is more on pure science rather than management-related but the potential for wildlife management concerns exists especially in regards to the work on rhesus monkeys and certain lizard species (particularly agamids).

2. Peshawar - mentioned earlier under the discussion of the Forest Institute. Many of the faculty from the University share joint teaching responsibilities with the Institute.

3. Karachi - contains a Marine Resources Department (which is federally funded) with several faculty of high quality. The U.S. Study Mission had an opportunity to visit this organization and were impressed with the efficiency and caliber of the work being done. Most deals with marine research and has no applicability to terrestrial wildlife management. But if programs with marine fisheries are contemplated, this university is obviously the main Pakistan contact.

4. University of Agriculture, Lyallpur, Punjab - Established in 1961 around the Punjab Agricultural College and Research Institute, the university was designed to serve the educational needs of the country in agricultural sciences and is primarily a teaching and research institution. Its physical accommodations include lecture theatres, research labs, staff offices and department and central libraries.

   The Department of Zoology was created in 1962 and covers ichthyology, ornithology, mammalogy and ecology. It has four research labs and a museum.

B. Museums

Little is known of the various museums in Pakistan. A natural history museum exits in Lahore with smaller facilities at the Zoological Survey Department in Karachi, the Marine Fisheries Department in Karachi and at the University of Agriculture, Lyallpur.

C. Zoos

Facilities exist at Lahore and Karachi but little is known of the quality or orientation of the former establishment. Members of the U.S. Study Team visited the Karachi Zoological Park and found it interesting and well laid out. The Directors of both institutions have good reputations and long years of experience. The Director of the Karachi Zoo is very active and vigorous in promoting interests of wildlife management and quite knowledgeable of Pakistani wildlife.

D. International Agencies

Several international agencies which have world-wide wildlife conservation interests at heart have chapters or affiliations in Pakistan.

1. Pakistan Wildlife Appeal - financed by the Fauna Preservation Society (main headquarters are in Great Britian).

2. United Nations Development Programme in Pakistan

3. World Pheasant Association (Pakistan) - an affiliate of W.P.A. (England) which promotes pheasant research and management projects in Pakistan. There is presently an ongoing pro-

ject on the ecology and management requirements of endangered pheasants, expecially the western tragopan in Azad Kashmir under Dr. Sheldon Severinghaus. There are an additional number of proposals including park development and educational projects.

5. World Wildlife Fund (Pakistan) - affiliated with WWF in Morges, Switzerland, the Pakistan representative is located in Lahore. This organization is a nongovernment member of IUCN and promotes wildlife related projects in Pakistan. A number of projects have already been carried out under their auspices such as the creation of the Khanewal Wildlife Centre and more are proposed including an ecological study of the Indus dolphin, conservation of waterfowl habitats in Sind and nature conservation policy development in Pakistan.

6. Asia Foundation - Private, nonprofit philanthropic organization based in San Francisco with offices throughout Asia including one in Islamabad. It supports Asian education, social, economic and cultural development through sponsorship of local programs, observation and study tours for Asian nationals, conferences and seminars and research. The office in Islamabad administers a program for Pakistan.

7. Rare Animal Relief Effort, Inc. - Nonprofit, volunteer organization devoted to endangered wildlife. In cooperation with New York Zoological Society and WWF - Pakistan provided 2500 posters in Urdu and English for distribution in northern Pakistan promoting protection of snow leopard in 1977.

E. <u>Other</u>

Other Pakistan organizations such as the Pakistan Forestry Association and the Wildlife Conservation Society of Pakistan (Karachi) are made up of concerned Pakistanis interested in furthering the development of sound wildlife conservation principles and protecting Pakistan's rich faunal and floral heritage.

Paragon Publisher - Muhammadi House, Chudrigar Road, Karachi publishes the monthly magazine "Outdoorman", a layman's journal on hunting and conservation. Primarily concerned with Pakistan, but including articles on conservation projects internationally, this magazine was started in 1971. It appears to have been discontinued recently, however.

The National Instructional Technology Unit in the Ministry of Education, Islamabad, is a governmental advisor on all matters pertaining to the development of instructional techniques and oversees the implementation of these programs throughout the country.

Private and foreign organizations with interest in conducting wildlife conservation research or management projects vary according to the funds available and the interest of the participants. Both the National Science Foundation (N.S.F.) and the Smithsonian Institution in the United States have coordinated projects in Pakistan using excess foreign currency (Public Law 83-480) funds in the past. N.S.F. is presently sponsoring a three-year behavior study of the rhesus monkey in Northwest Frontier being conducted by Dr. Alison Richard, Yale University (U.S.) Dr. Richard Taber at the University of Washington (U.S.) has proposed several variations of projects through the Smithsonian on the hog deer and associated fauna including wild boar in Sind.

The International Foundation for Game and Wildlife Conservation based in Paris, France has three proposals pending on protection of markhor, regeneration of wildlife habitat in the Margalla Hills Sanctuary and the reintroduction of Cheer pheasant into the Margalla Hills Sanctuary.

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SECTION VI

RECOMMENDATIONS OF THE STUDY MISSION

At the first meeting between the officials from Pakistan and the United States, the U.S. Study Mission was presented with a list of proposed projects taken from the Pakistan Wildlife Conservation Strategy. This program was developed by the National Council for the Conservation of Wildlife in collaboration with the Pakistan Forest Institute, World Wildlife Fund - Pakistan, Sind and Punjab Wildlife Management Boards and the Conservator of Forests in Peshawar.

The Study Mission also received a list of proposed projects from the wildlife officials in Sind during the meetings in Karachi. Some of these were developed in conjunction with the IUCN/WWF.

Other project proposals for wildlife work in Pakistan generated by non-Pakistani agencies and organizations have been reviewed and considered for their relationship to the major Endangered Species Act program goals.

The project priorties listed by the National Council include:

1. Wildlife education and training

2. Surveys of threatened wildlife and habitats

3. Restoration and management of species and their habitats.

The U.S. Study Team considers these conservation priorities as rational and fitting and recommends that actions be taken to assist the appropriate Pakistan officials in carrying out specific project proposals.

<u>Wildlife Education and Training</u>

As the expressed number one priority of all Pakistan personnel met during the U.S. visit, the Study Mission recommends that plans be implemented at the earliest convenience to establish a program of wildlife education and training.

Project No. 1 in the Pakistan Conservation stragegy-Foreign training in wildlife management and conservation, Project No. 2-Education and research in wildlife management, and Project No. 3-Public education in environmental conservation have detailed proposals which could meet this recommendation. There are many possibilities that should be explored in implementing this recommendation. For example, initially, short training programs could be established in Pakistan with selected individuals being brought to the U.S. for advanced education or training in areas of similar habitat to that in Pakistan. In-country training could be carried out at the Forest Institute, Peshawar. U.S. personnel from FWS/NPS or universities could be detailed to Peshawar for periods up to six months (the duration of a normal school term) to offer specialized courses in population survey, habitat management, biostatistics, mammalogy, law enforcement, ornithology, and other related park and wildlife management techniques.

Another aspect of this training is to assist in enriching the backgrounds of the current cadre of Pakistan wildlife professors, instructors and educators. Fellowships could be established at U.S. universities for faculty members at Peshawar, Quaid-i-Azam, Lyallpur and Karachi Universities.

Programs for the general public are essential in establishing cooperation for implementing wildlife management programs in Pakistan. They should be designed to provide a basic environmental awareness to the population, emphasizing wildlife protection and explaining the importance of national parks and other protected areas to wildlife and wildlife habitat. Chitral has formed conservation committees in villages. Sind and Punjab are establishing visitor centers with audio-visual aids. Many more activities such as these should be encouraged and implemented. Production of attractive booklets with provisions to reach illiterate villagers on endangered species with a number of colored pictures, brief descriptions, problems and value could be produced. The production of the snow leopard poster is an example of this.

Each provincial wildlife office should have a small reference library on available literature as well as standard texts.

Organizing an international workshop on endangered species and park management in Pakistan would serve a variety of purposes by bringing in a group of international experts, stimulating action, establishing cooperation and liaison, and educating the general public as well as the wildlife personnel in governmental agencies.

Surveys of Threatened Wildlife and Habitats

Project No. 4-Survey of Threatened Wildlife and Their Habitats, by the National Council, lists 15 specific species and mentions several other groups of animals. Nine of the listed species also appear on the U.S. list of Endangered Species and the others are legitimate for research.

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The U.S. Study Mission recommends that action be taken to implement projects aimed at determining the status of threatened and endangered species in Pakistan with the initial emphasis on those species in the most critical situations.

Several opportunities present themselves immediately and could be carried out in conjunction with other priority projects. For example, Haleji Dhand Lake east of Karachi is a wetlands of international importance and is recognized for its value to wildlife especially aquatic birds. The lake and supporting canals and marshes provide suitable to excellent habitat for mugger crocodile. A survey of the lake as crocodile habitat could be easily developed. Surveys of gharial in the proposed Indus River dolphin reserve and Nara Canal reserve with management recommendations could be developed relatively quickly.

Other survey projects on sea turtles, (especially the green), and with other reptiles, amphibians and birds could be included in a coordinated program associated with the proposed wild boar-hog deer-associated fauna project in Sind. Internationally important species such as the Marco Polo sheep and houbara bustard could be surveyed per the proposal by the National Council. Any surveys should include biostatistical techniques.

Restoration of Species/Habitats and Management

A good share of the project proposals listed by the National Council fall under this category. Projects 5-15 cover reintroduction of species, restoration of habitat, anti-poaching campaigns, and management of wildlife.

The U.S. Study Mission recommends that action be taken to implement management projects for Pakistan's endangered wildlife. The projects concerning reintroduction of blackbuck and wild ass into Kirthar National Park could probably be accomplished rather quickly.

In addition to and complementing the proposals listed by the National Council the U.S. Study Team notes that for Project No. 6 - Restoration of crocodiles, construction of crocodile breeding facilities is being done in Punjab and there is a need for advice and breeding stock. This could be responded to quickly and could assist in the development of a more general program for all crocodilians in Pakistan.

Projects 8-12 dealing with antipoaching campaigns indicate [illegible] active program of law enforcement. Next to destruction of habitat, poaching and other wanton killing of animals has been the main cause for the extinction and precarious status of many species. While the Pakistan proposals cite a real need for equipment to more effectively deal with poachers, the U.S. Study Mission recommends that projects be instituted for a broader approach to law enforcement.

Pakistan has acceded to the Convention on International Trade in Endangered Species of Wild Fauna and Flora and projects to assist in implementing the terms of this Convention are needed such as training enforcement people to be stationed at the major port of Karachi perhaps Islamabad or Lahore, to inspect wildlife products going into and out of the country.

Project 12 - Restoration of pheasants shows a high interest in this group of birds. The western tragopan is a U.S. listed endangered species and projects to ascertain this bird's status and protect its habitat should be considered a reasonably high priority. Other species of pheasants especially the Cheer should also receive attention.

The U.S. Study Mission encourages the use of excess Rupees available for this program to transport qualified Pakistan officials associated with the program to beneficial international meetings and conferences for the purposes of broadening Pakistan contacts within the world conservation community and exposing Pakistan officials to the interests and operations of governmental and nongovernmental organizations in the United States and elsewhere.

Appendix I

Endangered and Threatened Wildlife

(List Maintained by U.S. Fish and Wildlife Service-July 1977)

Pakistan	Convention on Trade of T&E Species
Asiatic cheetah (Acinonyx jubatus)	Appendix I
Asian wild ass (Equus hemionus)	Appendix I
~~Gaur (Bos gaurus~~) Goral (Naemorhedus goral)	Appendix I
Leopard (Panthera pardus)	Appendix I
Snow leopard (Panthera uncia)	Appendix I
Entellus langur (Presbytis entellus)	Appendix I
Chiltan markhor (Capra falconeri	Appendix I
chiltanensis)	Appendix I
Straight-horned markhor (Capra falconeri jerdoni)	Appendix I
Kashmir stag (Cervus elaphus hanglu)	Appendix I
Shapu (Ovis vignei)	Appendix I
~~Dugong (Dugong dugon~~) Kabul Markher (Capra falconeri megaceros)	Appendix I
Western Tragopan (Tragopan melanocephalus)	Appendix I
Great Indian bustard (Choriotis nigriceps)	Appendix II
Gharial (Gavialis gangeticus)	Appendix I
Mugger crocodile (Crocodylus palustris palustris)	Appendix I
Desert monitor (Varanus griseus)	Appendix I
Yellow monitor (Varanus flavescens)	Appendix I
Indian flap-shell tortoise (Lissemys punctata punctata)	Appendix I
Indian soft shell turtle (Trionyx gangeticus)	Appendix I
Spotted pond turtle (Geoclemmys hamiltonii)	Appendix I
Hawksbill sea turtle (Eretmochelys imbricata)	Appendix II
Leatherback sea turtle (Dermochelys coriacea)	Appendix I
Loggerhead sea turtle (Caretta caretta)	Appendix I
Green sea turtle (Chelonia mydas)	Appendix I
Olive Ridley sea turtle (Lepidochelys olivacea)	Appendix I

Appendix II

Itinerary of U.S. Study Mission in Pakistan

February 5-14, 1978

Feb. 5	Islamabad	- U.S. Embassy discussions
Feb. 6	Islamabad	- Asia Foundation discussions - Ministry of Food and Agriculture, meeting with National Council for Conservation of Wildlife, university and governmental officials involved in wildlife conservation.
Feb. 7	Islamabad	- Meeting with training nominees of Northern Provincial Governments (Punjab, Northwest Frontier, Azad Kashmir and Northern Areas) - Quaid-i-Azam University, tour of facilities and discussions with officials in Dept. of Biological Sciences - Site visit to proposed Margalla Hill National Park area
Feb. 8	Ghora Gali Pheasantry	- Travel to, tour facilities and return to Islamabad
Feb. 9	Peshawar	- Travel to, tour Forest Institute and Peshawar University facilities, discussions with officials and faculty, leave for Karachi and Lal Suhanra National Park
Feb. 10		- Part of Team visits Helji Dhand wetland near Karachi, Sind; remainder visits Lal Suhanra National Park
Feb. 11		- Part of Team visits Karachi Zoological Park, Marine Fisheries Department, Zoological Survey of Pakistan and field sites at Sandspit, [illegible]'s Bay and a sacred crocodile temple near Karachi.

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		The remainder of the Team toured Lal Suhanra National Park.
Feb. 12		A representative of the team traveled to Kirthar National Park, another carried out administrative duties in Karachi with talks at the U.S. Consulate. The remainder of the team traveled to Karachi from Lal Suhanra National Park.
Feb. 13	Sind -	Wildlife Management Bureau offices meeting with training nominees from Sind, Secretary to the Government of Sind, Wildlife and Forest Dept. and other wildlife officials and workers in Sind. Afternoon was spent visiting Marine Resources Department at University of Karachi
Feb. 14	-	Most of team departed for U.S. One team member traveled to Lahore, visited with officials of Punjab province.
Feb. 15	-	Team member held meetings and discussions with Punjab officials, visited game bird propagation facilities south of Lahore.
Feb. 16	-	Final team member departs Pakistan

Appendix III

List of Contacts Made by Study Mission

(listed alphabetically)

Afzal, Mr. Mohammad-	Division Forestry Officer, Northern Areas, Gilgit. Forest Institute graduate. B.Sc. B.A. (forestry). Training applicant.
Ahmad, Mr. Ashiq-	Peshawar. Training applicant.
Ahmad, Mr. M. Farooq-	Director, Zoological Survey Department, Karachi
Aleem, Mr. Abdul-	Wildlife Management specialist teaching at Forest Institute Peshawar
Arslan, Dr. M.-	Professor and Chairman, Department of Biological Sciences Quaid-i-Azam University, Islamabad
Ashraf, Mr. Muhammad-	Conservator of Forests, Bahawalpur
Baloch, Mr. Hassan Ali-	Conservator of Forests, Range Management Circle, M.R. Kayani Road, Karachi. Also Deputy Provincial Chief Game Warden Sind. Training applicant.
Conder, Mr. Peter-	Waterfowl and Wetlands Consultant from Great Britain on assignment to investigate Sind wetlands from International Wildfowl Research Bureau sponsored by IUCN/WWF. Karachi.
Durani, Muttar-	Asia Foundation, Islamabad
Hendrickson, Mr. Richard-	Asia Foundation Representative, Islamabad
[illegible]ir-	Peshawar. Training applicant.
Hussain, Mr. Syed Iqmara-	Peshawar. Training applicant.

Igsal, Dr. Q. J. Aved-	Assistant Professor, Department of Biology, Quaid-i-Azam University, Islamabad.
Jalali, Ms. Samina-	Lecturer, Department of Biology, Quaid-i-Azam University, Islamabad.
Jaleel, Mr. S. A.-	Director, Marine Fisheries Department, Karachi.
Junejo-Schlegel, Dr. Brigitte-	Game Warden, Sind; Member Sind Wildlife Management Board, Junejo House, Sanghar, Sind.
Kermani, Mr. W. A.-	Secretary, Sind Wildlife Management Board; M. R. Kayani Road; Karachi.
Khan, Mr. Ashraj Ahmad-	Deputy Conservator of Wildlife, Punjab, Lahore.
Khan, Mr. Muhammed Khan-	Deputy Conservator of Wildlife, Sind, Karachi.
Khan, Mr. M. Yunus-	Deputy Director, Fisheries Department, Sind, Karachi.
Khattak, Mr. Abdul Malik-	Inspector General of Forests, Ministry of Food and Agriculture (Agriculture Division) Rm 325, Pakistan Secretariat, Islamabad.
Khattak, Dr. Ghaus Mohammad-	Director General, Pakistan Forest Institute, Peshawar
Khilji, Mr. Abdul Lateef-	Karachi, Training applicant.
Masood, Mr. Raja Mohammad-	Assistant Administrator, Lal Suhanra National Park, Bahawalpur.
Masud, Mr. Rana Mohammad-	Deputy Conservator (wildlife), National Council for Conservation of Wildlife, 4-G, Street No. 51, F-6/4, Islamabad.
Masud, Mr. Rava-	Islamabad. Training applicant.
Memon, Mr. Mohammad Yusuf-	Range Forest Officer, Mirpurmothelo District, Sukkur, Sind. Training applicant.

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Mohiuddin, Mr. S. Q.-	Deputy Director, Marine Fisheries Department, Fish Harbour, West Warf, Karachi.
Mukhtar, Major Hamid-	Administrator, Lal Suhanra National Park, Bahawalpur.
Mumdaz, Mr. Mohammad-	Peshawar. Training applicant.
Naizi, Mr. Abdul Aziz Khan-	Assistant Game Warden (Development), Punjab
Qazi, Mr. Ishtag Ahmad-	Deputy Inspector General, Department Inspection General of Forests, Ministry of Food and Agriculture, Islamabad.
Qazi, Dr. M. H.-	Professor Biology, Quaid-i-Azam University, Islamabad.
Quirashy, Dr. A. A.-	Director, Karachi Zoo, Karachi.
Rizvi, Dr. M. H.-	Medical Superintendent, Spencer Eye Hospital, Karachi Municipal Corporation, Karachi. Member Sind Wildlife Management Board.
Roberts, Mr. Tom J.-	FAO Consultant with Vertebrate Pest Control Centre. P.O. Box 3311, Malir City Post Office, Karachi 23. Member WWF-Pakistan.
Shirazi, Mr. Kalimullah-	Assistant Secretary (wildlife), National Council for Conservation of Wildlife, 4-G, Street No. 51 F-6/4, Islamabad.
Trippett, Mr. Frank L.-	Science Officer, U.S. Embassy, Islamabad.
Uddin, Mr. M. Khalil-	Curator, Marine Fisheries Department Museum, Karachi.
Yunus, Mr. Mohammad-	Division Forest Officer, Apod, Kashmir. Training applicant.
Zaku, Mr. Salah-ud-Din-	Assistant Game Warden, Punjab, Lahore. Training applicant.

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Appendix V

Specific Names of Animals Used in the Text

Mammals

Baluchistan black bear (*Selenarctos thibetanus*)
Bharal (blue sheep) (*Pseudois nayaur*)
Blackbuck (*Antilope cervicapra*)
Brown bear (*Ursus arctos*)
Caracal (*Felis caracal*)
*Cheetah (*Acinonyx jubatus*)
°Clouded leopard (*Pathera nebulosis*)
Eurasian otter (*Lutra lutra*)
Fishing cat (*Felis viverrina*)
Goitered gazelle (*Gazella subgutterosa*)
+Great one-horned rhinoceros (*Rhinoceros unicornis*)
Hog deer (*Axis porcinus*)
Ibex (*Capra ibex*)
Indian Gazelle (Chinkara) (*Gazella gazella*)
*Indian wild ass (*Equus hemionus*)
Indus River dolphin (*Platanista gangetica*)
*Kashmir stag (*Cervus elaphus hanglu*)
*Leopard (*Panthera pardus*)
+Lion (*Panthera leo*)
Lynx (*Felis lynx*)
°Marbled cat (*Felis marmorata*)
Marco Polo sheep (*Ovis ammon polii*)
*Markhor (*Capra falconeri*)
Mongoose (*Herpestes sp*)
Musk deer (*Moschus moschiferus*)
Nilgai (*Boselaphus tragocamelus*)
Palm civet (*Paguma larvata*)
Rhesus monkey (*Macaca mulatta*)
*Shapu (*Ovis vignei*)
Siberian ibex (*Capra ibex*)
Smooth otter (*Lutra perspicillata*)
*Snow leopard (*Panthera uncia*)
Striped hyaena (*Hyaena hyaena*)
Swamp deer (*Cervus duvauceli*)
+Tiger (*Panthera tigris*)
Urial (Afghan urial) (*Ovis orientalis*)
Wild boar (*Sus srofa*)
Wild goat (*Capra hircus*)
Wold (*Canis lupus*)

Birds

Black partridge (Francolin) (*Francolinus francolinus*)
[illegible] pheasant (*Catreus wallichi*)

Chukar partridge (*Alectoris graeca*)
*Great Indian bustard (*Choriotis nigriceps*)
Grey partridge (*Francolinus pondicerianus*)
Houbara bustard (*Chlamydotis undulata*)
Kalij pheasant (*Lophura leucomelana*)
Monal pheasant (*Lophophorus impejanus*)
Peafowl (*Pavo cristatus*)
Quail (*Coturnix coturnix*)
Ring-necked pheasant (*Phasianus colchicus*)
Sandgrouse (*Pterocles* sp.)
See see partridge (*Ammoperdix griseogularis*)
Snowcock (*Tetraogallus himalayensis*)
Snow partridge (*Lerwa lerwa*)
*Western tragopan (*Tragopan melanocephalus*)

Reptiles

*Gharial (*Gavialis gangeticus*)
Green sea turtle (*Chelonia mydas*)
*Hawksbill sea turtle (*Eretomochelys imbricata*)
*Leatherback sea turtle (*Dermochelys coriacea*)
*Monitor lizard (*Varanus* sp.)
*Mugger crocodile (*Crocodylus palustris*)
*Olive Ridley sea turtle (*Lepidochelys olivacea*)

Key

*Listed endangered by U.S. Fish and Wildlife Service
+Extirpated from Pakistan
°Not native to Pakistan

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THE DATABASE OF THE IUCN CONSERVATION MONITORING CENTRE

by D.C.Mackinder

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c/o The Herbarium,
Royal Botanic Gardens,
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United Kingdom.

December, 1982.

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ABSTRACT

The IUCN Conservation Monitoring Centre's database is split into four main units united by a common geographical and taxonomic skeleton. The four units deal with threatened animals, threatened plants, protected areas and wildlife trade. The purpose of the database is to produce various outputs synthesising data relevant to any given conservation problem from all four units of the database. Information is stored in the computer in two main forms; in data files, which hold data in a rigid format, and text files which permit a more flexible format allowing for the variability of biological data. Data files are used to store summary information such as data on distribution and conservation status as well as holding pointers to the text files which expand on the coded information. Geographical data is stored using codes which may be translated into political or bio-geographical area names as required. Taxonomic information is held in a tree structure which permits any number of taxonomic levels and enables any taxon to be defined in a number of different ways - thus catering for taxonomic differences of opinion.

INTRODUCTION

IUCN (the International Union for Conservation of Nature and Natural Resources, set up the IUCN Conservation Monitoring Centre (CMC) in 1981. CMC is composed of four units, the Threatened Plants Unit, the Species Conservation Monitoring Unit, the Protected Areas Data Unit and the Wildlife Trade Monitoring Unit. The Centre has the task of providing information on the status of conservation worldwide to IUCN, the World Wildlife Fund, and to the Global Environment Monitoring System run by the United Nations Environment Programme, as well as to the wider conservation movement. This information is provided in the form Red Data Books consisting of data sheets on threatened plants and animals, Protected Areas Directories consisting of data sheets on national parks and protected areas, scientific articles, special reports and other tabulations of conservation information; such information is essential to the success of the conservation movement. IUCN's conservation objectives are succinctly stated in the World Conservation Stategy (IUCN, 1980) and have played a large role in shaping the CMC database.

A major factor behind the structure of the CMC database is that it must remain flexible so that it can match the changing needs of conservation. The detailed structure of the data files reflects the compromise between the data that CMC would ideally like to have and that which it is practical to collect, code and use at the present. Thus, for others whose interests overlap those of CMC, in certain areas the CMC database will undoubtedly not go far enough or will over-simplify, especially since the computer side of the database is still fairly new. However, it should be remembered that this database is continually developing by becoming more comprehensive and covering a broader scope, so these problems should decrease. The current structure of the data files is not seen as permanent or as a constraint to the expansion of the database, indeed the number of different pieces of information and the amount of detail coded is continually increasing.

DATA STORAGE METHODS

Data is stored in two main ways, in summary form in data processing files and as text in word processing files. Storing data in summary form imposes restrictions on exactly what data is stored since not all pieces of information may be easily and efficiently coded in a DP environment. Storing data in this form, however, allows one to exploit the power of computers firstly to extract all information relevant to any given problem and secondly to sort it into any desired order for presentation; this is (in computing jargon) data processing or DP. To avoid the problems of forcing inherently variable biological information into a DP format, information is also stored in word processing (WP) documents which allow a complete coverage of the more complex details relating to any given piece of information. However, as a result of this freedom it is much more difficult to programme a computer to extract and rearrange the information stored in text files;

(2) The taxonomic skeleton

Scientists use the system of binomial latin names so they may refer unambiguously to the taxa with which they are concerned. It is therefore vital that those names are spelt correctly and it is virtually essential that a database using taxonomic names have some method of ensuring that all database outputs use the correct taxonomic names. Thus CMC has built up various files containing the majority of taxonomic names that CMC requires. These files have other important advantages besides allowing taxon names to be checked. Computers are able to store numbers much more compactly than characters; for example, assuming that it takes 8 binary bits to store one character, a binary number between 0 and 65535 may be stored in the same amount of space as two characters. Thus code numbers for each name may be stored instead of the actual names, thereby saving a considerable amount of space especially when there are many records in the database for the same taxon, as is the case in the trade database files. Lookup files allow this coding to be done automatically whilst simultaneously checking the spelling of the names being coded. If numerical codes are stored instead of taxonomic names the spelling of a name may be changed throughout the database by making one alteration to the name lookup file, rather than by searching for every occurance of that name in the database. The methods CMC has used to construct these taxonomic lookup files have varied for the plant and animal sections due to the different taxonomic problems involved.

The Threatened Plants Unit (TPU) uses three taxonomic levels above species - genus, family and divisions. In cooperation with the staff at the Royal Botanic Gardens at Kew, the TPU have created data files containing all generic and family names accepted by the Herbarium at Kew. All families within a given division are given consecutive numbers, enabling genus, family and division information to be coded by a family number and a genus number. At present specific and sub-specific names are not coded in the TPU files since each name would not occur many times and therefore the space saving does not offset the extra work needed to create and maintain the lookup table files; these names are simply stored as characters.

For animals (especially invertebrates) however, many more taxonomic levels are needed. Thus any one taxon must be coded as belonging to several taxa at higher taxonomic levels. One solution is to devise a taxon number composed of several consecutive sets of digits each of which describe succesively lower taxa. The number could start with one digit describing the kingdom, two digits for the phylum within the kingdom and so on. The ISIS (International Species Inventory System) described by Seal and Makey (1974) is such a system. An advantage is that taxonomic sorting is very easy, as is the process of determining the taxonomic name for any given code. The problem is that making taxonomic changes is difficult since, for example, to move a genus between families the code numbers for the genus and all its sub-members must be altered in both the lookup tables and in the database itself. In the case of a large database this may result in altering many files. The cause of this problem is that two separate pieces of information are being coded in the same number; the taxon's taxonomic position and the taxon's individual identity. These two things are separate since the biological information relating to a taxon (its individual identity) does not necessarily change if its taxonomic position is changed. A solution is to use arbitrary unique numbers to hold the individual identity of the taxa and then make a file detailing the taxonomic relationships. These may be handled very flexibly by using a tree-like structure, if the simple assumption is made that any taxon may only be a sub-member of one other taxon. Thus every taxon has a pointer to the next higher taxon in the taxonomic tree, except for synonyms which have a pointer to the acceptable name for the taxon.

Such a "taxa-tree" may be contructed by making a file which, for every taxon holds its name and number, the number of the taxon of which it is a sub-member (or synonym), a code for the taxonomic level (e.g. species, genus etc) and a taxonomic sorting code (Fig. 1). There is no requirement that all the sub-members of any taxon be at the same information consists of two links, one to the protected areas files and one to the ELC database. At present the links simply say whether more relevant information is available in the legal or protected area files for the current taxon in any given area.

To date, some 2400 taxa have been entered representing all mammals, reptiles and amphibians covered by the Red Data Books (e.g. Thornback & Jenkins, 1982; Groombridge, 1982), or on the CITES appendices or which have been covered by other CMC reports; the majority of molluscs and fish currently under consideration for the forthcoming Invertebrates and Fish Red Data Books have also been entered. Work has recently begun on coding data for birds. The initial aim is to enter records for all animal taxa of conservation concern.

(5) Protected areas

The protected areas section of the database holds summary data on some 4500 national parks and protected areas and is described more fully by Harrison (in press). This information allows an assesment of the extent to which the different bio-geographic provinces of the world are covered by protected areas (e.g. Harrison et al, 1982) so that recommendations about extensions to the world system of protected areas may be made. Programmes exist which can select protected areas on the basis of any of the different pieces of information coded and then display details about the areas matching the selection criteria. The UN List of National Parks and Protected Areas (IUCN, 1982a) has been produced from this section of the database, as have the tabulations for the recent IUCN Directory of Neotropical Protected Areas (IUCN, 1982b). Another data file contains information on current and projected staffing levels in the parks systems of different countries and is being used to compare staffing levels and make recommendations about future staffing levels and training schemes.

(6) Wildlife trade

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is designed to control trade in threatened species of animals and plants by requiring both importing and exporting states to issue permits for trade in such species. All Parties to the convention are required to submit, to the CITES secretariat, annual reports detailing permits issued for trade in CITES listed species. Data from these reports forms the basis of the wildlife trade section of the database and is analysed for CITES by the Wildlife Trade Monitoring Unit.

In the case of trade between Parties to the convention there should be two records of that trade in the CITES data files, one from the importing and one from the exporting country. Analysis programmes have been written which allow the exports reported by a country to be compared with imports other countries have reported recieving from the exporting country. Similar analyses for a countries· imports are also possible. Reports may also be produced for non-Party states or Party states which have not reported. This data enables an assesment of the volumes and trends in international trade in threatened species to be made, and also permits an analysis of the effectiveness of the convention either for different taxonomic groups or for different regions of the world.

FUTURE DIRECTIONS

(1) Conservation projects database

To achieve maximum conservation gain from restricted funds, conservation organisations must plan their projects to maximise project overlap and minimise duplication of effort. Therefore, information on conservation projects which have been identified as necessary, and those which are in progress is necessary. Such information also enables gaps in current conservation effort to be identified and possibly remedied. Therefore, CMC is starting to create a database containing information on conservation projects; the

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Genetic Diversity and Genetic Vulnerability—An Appraisal[1]

WILLIAM L. BROWN[2]

During the past decade questions relating to biological diversity, genetic vulnerability, narrowing of the gene base of important cultivars and the loss of germplasm of both economic and noneconomic species have received increasing attention. Numerous studies, conferences, and symposia on these general subjects have spawned a flood of reports, proceedings, and scientific papers (Timothy and Goodman, 1979; Nat. Acad. Sci., 1972; Nat. Acad. Sci., 1978; U.S. Dept. of State, 1981). Many of these questions relate to the world's food supply, the future of which could depend upon the conservation and greater utilization of the reservoir of crop plant diversity (Biol. Diversity, 1980).

The Green Revolution has been criticized for its replacement of indigenous crop plants with high-yielding varieties that are alleged to be less dependable than those varieties they have replaced when grown under less than ideal conditions.

It has been suggested that the acquisition of seed companies by large, multinational corporations may result in a reduction in the number of varieties available to growers and in a possible monopoly of plant genetic resources (DeCrosta, 1980).

Without minimizing the importance of protecting noneconomic species and the environments in which they occur, I shall limit this discussion to questions of diversity and vulnerability as they relate to cultivated plants. Although no attempt will be made to treat specific crops in detail, my comments are in reference to major seed propagated field crops grown in the United States. It is mainly this group of cultivars about which there is much confusion today relative to the degree to which serious erosion is occurring in the gene base. There are conflicting viewpoints as to the amount of germplasm being lost and the biological and economic implications of that loss. There is also controversy over the alleged hazards associated with the widespread use of uniform cultivars.

For these reasons, an appraisal of the current situation relative to genetic diversity and genetic vulnerability of important economic crops seems appropriate. I hope to identify the more important needs still to be filled if the unused germplasm resources of cultivated plants are to receive the attention they fully deserve. I shall comment on those factors that lead to uniformity in modern high-yield varieties, and also consider the merits and disadvantages of uniformity. Finally, I shall describe my understanding of ways in which the modern seed industry relates to many of these matters.

RELATIONSHIP OF DIVERSITY AND VULNERABILITY

Much of the recent interest in genetic diversity developed as a result of the experience in the United States with southern corn leaf blight in 1969–1970. A

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new or previously undetected race of *Helminthosporium maydis* was first observed in Florida from where it moved rapidly northward, reaching the Cornbelt in 1970 (Tatum, 1971). It has been estimated that nationally corn production was reduced by as much as 15% because of this disease. The problem arose because of the cytoplasmic uniformity of a large proportion of the maize being grown at that time, and, for the first time, breeders came to realize that disease susceptibility is not determined solely by nuclear genes.

Genetic diversity is usually thought of as the amount of genetic variability among individuals of a variety, population or species. It is commonly believed that genetic vulnerability results from a reduction in genetic variability. For example, those varieties with a larger amount of genetic variability are thought to be less susceptible to the hazards of disease, insects, and other stresses than those with a small amount of genetic variability. It is this kind of thinking that leads to the assertion that modern agriculture, using uniform varieties and hybrids reduces genetic diversity of our crop plants and causes them to be more susceptible to biological stresses. Such varieties are also said to be more narrowly adapted than varieties of greater genetic variability.

It is now clear that genetic diversity per se provides no insurance against genetic vulnerability. If it did, the American chestnut, *Castanea dentata*, would still be among the dominant species of the deciduous forests of eastern North America. No one familiar with *Castanea dentata* would question the breadth of genetic variability within the species, yet it was decimated by a single pathogen in approximately two decades, as a result of its uniform susceptibility to the chestnut blight fungus, *Endothia parasitica*.

Similarly, the highly variable American elm, *Ulmus americana*, has been shown to be highly susceptible to Dutch Elm disease fungus as that organism moved westward from the Atlantic coast.

In 1916 and in 1935 wheat rust spread throughout the Great Plains, destroying hundreds of thousands of acres and numerous varieties of bread wheat, despite the fact that the amount of genetic diversity found among the varieties of wheat in use at the time was considerable.

In the early 1950s *Puccinia polysora*, a tropical rust fungus, spread across east Africa on highly variable hosts—the open pollinated maize varieties of the area. Yields were reduced significantly, and maize culture was in jeopardy until resistant genotypes were introduced from the Caribbean and Mexico. The local landraces of maize grown in east Africa at that time were extremely variable, yet they were all found to be uniformly susceptible to tropical rust.

The point with respect to disease and insect resistance is that genetic diversity alone is an inadequate defense unless that diversity includes genetic resistance to the organisms in question. What is important is diversity in those alleles that code for susceptibility or resistance to the pathogen or insect causing the problem.

This is not to say that the breeder should not increase the genetic diversity of those cultivars upon which we depend for our food, feed, and fiber. Neither should we allow landraces, old varieties, and primitive types, replaced by newly-introduced varieties, to become lost. To the extent it is possible to do so, all such sources of germplasm should be preserved for possible future use in breeding.

What are the circumstances that cause the breeder to be interested in increasing the gene base of our major crops? It is usually the presence of unusual biological or environmental stresses which result in noticeable yield reduction or crop failure. And to understand why problems of genetic diversity arise in cultivated species, some knowledge of how plant breeders operate is essential.

If the breeder is working with a species that has already undergone a considerable amount of selection and breeding research, the primary breeding materials are usually the elite varieties in current use. The usual practice is to intermate the best varieties available and select for superior genotypes within the progeny of such matings. It follows, then, that the continual use of the best varieties as breeding materials tends to concentrate in the breeding pool genes from limited elite sources. Thus, the repeated use of the best varieties for purposes of generating new varieties, lines and so forth tends to reduce the genetic variation within the breeding population.

The simplest way to alleviate this condition is to introduce into the breeding pool germplasm from unrelated sources. In simplest terms, the breeder is interested in introducing useful alleles which are different from those present in the populations in use. With present methodology there are no completely satisfactory ways of identifying new alleles of most of the genes which make up the species. However, since the breeding programs of most crops utilize only a small percentage of the total germplasm available, it is reasonable to assume that the elite breeding materials in use do not include all the desirable alleles present in the species. So, to increase genetic diversity, one has only to introduce new sources of germplasm which are not closely related to those in use.

For most crops there are vast stores of germplasm available in numerous gene banks, most of which consist of landraces, primitive varieties, etc. Many are from foreign sources which are not closely related to elite varieties in commercial use.

In the United States alone, there are more than 400,000 accessions of germplasm included in the National Plant Germplasm System. The USDA Small Grains Collection contains about 90,000 accessions of wheat, oats, barley, rye and rice. About 13,000 individual collections of maize are stored and maintained at the CIMMYT Seed Bank in Mexico. The accessions stored in the United States and most of those abroad are available to any bona fide plant scientist. Consequently, the breeder has access to a wealth of material if he wishes to increase the genetic diversity in the breeding populations with which he is working.

Under these circumstances, why then are we concerned about the erosion of the gene base in crop plants, and why is the genetic diversity of those crops less than desired? If breeders are not making full use of the germplasm available to them, why is this so?

The answer to the first question is that only limited use is being made of the vast germplasm sources available. The reasons for the limited use are somewhat more complicated; yet, there seem to be two primary reasons. First, although a vast amount of material is available, little is known about the major characteristics and potential usefulness of the individual accessions making up that store of materials. In other words, little of the material residing in the germplasm banks has been evaluated. In the absence of this knowledge, the breeder has no way of knowing which few among several hundred accessions will most likely provide the particular trait or traits needed in a breeding program. Since a systematic screening of accessions to locate the traits needed would require the full time of the breeder, he reluctantly chooses other sources in lieu of the accessions of the germplasm banks.

The second reason for the limited use of materials from the gene banks is more difficult to justify and has to do with the nature of unimproved germplasm. As was pointed out earlier, most gene bank accessions consist of landraces and unimproved varieties. Such sources contain many undesirable traits which cannot be tolerated in modern cultivars. To eliminate such traits while retaining the few desirable genes that may be present in unimproved varieties is a formidable breeding task that requires much time and unlimited patience. It is not an activity from which rapid progress can be expected. Since the breeder is interested in efficiency, he is reluctant to spend time using germplasm that will require years to successfully incorporate into adapted genotypes.

This points up one of the most critical needs in germplasm resource management, that of evaluation. For reasons mentioned above, the bulk of germplasm resources now found in gene banks around the world will not be used until its potential value as breeding material has been determined. Until this is accomplished, it makes little sense to expand the present collecting activity beyond that required to salvage materials threatened with extinction. Within the United States, the National Plant Germplasm System should expand and concentrate its efforts on evaluation until those accessions now in storage are adequately screened and documented. Until this is done, and a catalogue of the evaluated germplasm made available, one of the most important sources of increased genetic diversity within cultivated plants will, in effect, continue to be unavailable to the breeder.

PROGRESS IN EXPANDING THE GENETIC BASE OF MAJOR CROPS

In 1972 a report was issued by the National Academy of Sciences on the genetic vulnerability of major crops. The report summarized the results of a study of a committee which, under the aegis of the National Research Council, had investigated the extent to which major U.S. crops were genetically vulnerable to epidemics and other biological stresses. The conclusion reached was that the genetic base of several important crops was sufficiently narrow to justify concern. A number of recommendations were made for increasing genetic diversity and, hopefully, reducing genetic vulnerability.

Ten years have elapsed since the publication of the NAS report. A recent survey by Duvick (1981) permits at least a partial comparison of the situation today with that of a decade ago. Duvick's survey included 87 breeding programs, 56 of which were public and 31 private. The crops surveyed included maize, sorghum, wheat, soybeans and cotton.

Without going into detail, the survey showed that the concentration of a few leading cultivars on U.S. farms, although still high, is less today than in 1970; that new cultivars in advance trials are numerous; that the average life of commercial varieties is 6–10 yr and growing shorter; that more diverse germplasm is present in current breeding pools than in those of former years. Still, superior new varieties tend to come from elite sources of germplasm with a relatively narrow genetic base.

With respect to maize, the survey indicated that more than 450 commercial hybrids were being offered the U.S. farmer in 1981. In addition, very large numbers of pre-commercial and experimental hybrids were in advance trials and in the final stages of testing.

In general, this survey suggests that considerable progress has been made in the past 10 yr in increasing the amount of genetic diversity available to U.S. agriculture. While these are encouraging signs, they provide no reason for a relaxation of efforts to continue to add to the gene base of our major crop species.

GENETIC DIVERSITY AND MODERN AGRICULTURE

The possible impact that plant breeding, plant variety protection legislation, and an expanding seed industry has on genetic diversity continues to receive much attention.

A number of authors (Wilkes and Wilkes, 1972; Paddock, 1970; Harris, 1972) have suggested that the replacement of genetically-variable, indigenous varieties with high-yielding, uniform cultivars entails considerable risk to those nations and farmers who have come under the influence of the Green Revolution.

Programs that introduce new, high-yielding varieties into areas where traditional agriculture depends upon the use of indigenous landraces have been criticized mainly on two counts. It is suggested that the introduction of new, high-yielding varieties into such areas results in the disappearance of the indigenous varieties and a resultant loss of potentially useful germplasm. It is also said that, while genetically uniform modern varieties produce high yields when combined with accompanying modern inputs such as fertilizers and chemical pesticides, they fail to perform as well as indigenous varieties under adverse environments and, therefore, lack the stability of performance required to provide a dependable, if minimal, food supply to the subsistence farmer.

The first criticism is a perfectly valid one with which no responsible biologist should disagree. If newly introduced varieties are accepted by farmers they will, indeed, result in a decline in use, and possibly ultimate disappearance of local landraces unless the latter are salvaged. However, there are no a priori reasons why this should happen. The old landraces of crop species are valuable resources which should not be allowed to disappear. It is the responsibility of governments, genetic resource organizations, and plant breeders, both public and private, to salvage germplasm before it is lost and to assure its introduction into appropriate germplasm banks. If this is done, and done properly, the introduction and adoption of new varieties will not result in the loss of older ones. Moreover, it does not seem right that the farmer should be deprived of the use of better performing crop varieties simply because, by chance, he happens to reside in an area of the world rich in plant genetic diversity.

The conclusion that the introduction of high-yielding, uniform cultivars necessarily results in a wipe-out of indigenous varieties fails to recognize the intelligence and sound judgment that is characteristic of most farmers. I have yet to encounter a farmer, either in the developed or developing world, who has ever completely replaced his traditional crop varieties with newly-introduced ones before having had some experience with the new introductions. This is true regardless of the claims made for the new varieties. Farmers, generally, are anxious to try new strains of plants, but initially will do so only in a small way and in comparison with the varieties with which they are familiar. It is only after he has demonstrated to his own satisfaction over a period of years that the new introductions are superior that the farmer will switch varieties completely. If a substitution of varieties is made, it will likely benefit the farmer and is justified. But fortunately, his conservative and sound approach to switching varieties provides some insurance against the sudden loss of indigenous germplasm and provides some lead time in which to salvage replaced varieties before they disappear.

The second criticism leveled at the introduction of high-yield varieties into areas of primitive agriculture is much more controversial. Statements similar to the following frequently appear in the literature: "Given ideal conditions, and large amounts of fertilizers and chemicals, green revolution seeds will respond well and provide high yields. However, if any required inputs do not arrive on time, or are absent altogether, farmers may experience extensive crop failure" (Mooney, 1979).

The validity of such assertions, usually made in the absence of any supporting data, need to be seriously questioned. It is true, of course, that any variety, be it primitive or modern, will perform better under favorable conditions than under unfavorable ones. But it is also true that high-yield varieties tend to outperform primitive varieties under all conditions, even though yield levels of both categories of varieties will be lower when grown under unfavorable conditions.

The critical point here has to do with relative yield stability of genetically-uniform and genetically-variable varieties. This is a question of variety × year and variety × location interactions, commonly employed statistical measures of the stability of genotypes when exposed to fluctuating environments.

Some of the best information on the relative stability of genetically uniform and genetically variable genotypes comes from experiments with maize (Eberhart and Russell, 1969). For many years following the development of hybrid maize, the hybrids used were double crosses. This type of hybrid involved 4 inbred lines as grandparents and 2 single crosses as parents (a single cross being the progeny of a mating of 2 inbred lines). The doublecross hybrid, therefore, was a population exhibiting considerable genetic variation. As further breeding produced more vigorous and higher-yielding inbred lines it was shown in the 1960s that it was practical to produce singlecross hybrids for commercial use. It had long been known that the best single crosses were higher yielding than the best double crosses but because of the genetic uniformity of single crosses, it was believed that they would lack the stability and consistent performance over years and environments that was characteristic of good double crosses. To obtain answers to this question, a number of experiments were carried out comparing variety-by-year and variety-by-location interactions in single and double crosses (Eberhart and Russell, 1969). The resulting data showed clearly that, on the average, estimates of variety-by-year and variety-by-location interactions were larger among single crosses than double crosses. Yet, it was also shown that, despite the averages, the variety-by-year and variety-by-location interactions in the best single crosses were no higher than in the best double crosses. This suggested that the performance of the best highly uniform, high-yielding single crosses might be expected to be as stable and consistent as the best double crosses. Experience has borne this out, and today the single cross is the predominant type of hybrid in use in the United States.

There are no genetic reasons why the best genetically-uniform varieties of wheat and rice and other self-fertilized species should be less stable and less consistent in performance than uniform single-crosses of maize. If those who continue to refer to the erratic performance of high-yield, uniform varieties expect to be taken seriously, they should at least provide data from which they draw their conclusions. In the absence of such data one should continue to view with skepticsm those references to the high risks associated with the use of uniform cultivars.

Before leaving the matter of genetic uniformity it is appropriate to consider the reasons for the dominance of uniform cultivars in the developed world. While it is often assumed that the breeder is responsible for the uniformity of varieties, there are, in fact, many other forces in agriculture which encourage uniformity. Some degree of uniformity is essential for the satisfactory utilization of mechanical harvesting equipment and certain processing equipment used in the food industry. Farmers tend to associate uniformity with "good breeding" and seem to prefer it to variability that is apparent in the field. Prescribed levels of uniformity are necessary to meet the requirements of seed certifying agencies.

In parts of Europe the requirements of "inscription" are such as to eliminate effectively variability in the varieties approved for sale. Thus, although the breeder develops genetically-uniform varieties, he does so primarily because of pressures from users and agencies which either control or influence the introduction of new cultivars. If the decision was left to the breeder he would prefer to have the option of complete flexibility with respect to genetic uniformity. The breeder also recognizes that genetic vulnerability can be reduced through inter-varietal as well as intra-varietal variability. Availability of several varieties or hybrids of different genetic backgrounds but adapted to similar ecological zones probably provide more protection against damage from pests than one quite variable variety. The breeder often uses this option to counter the requirement of intra-varietal uniformity and to protect the user.

THE SEED INDUSTRY AND GENETIC DIVERSITY

The following examples are fairly typical of statements purporting to associate a decline in genetic diversity with practices within the seed industry:

"For commercial reasons, transnational corporations are concentrating on fewer varieties of seeds which they can market worldwide, thus eroding the genetic diversity of plants" (Hurtado, 1982).

"By controlling seed companies, multinational corporations have the potential to control the food producing resources of this country . . . . Multinational corporations, many of which are chemical companies, could then develop varieties that are coated with fungicides and depend on the companies' own fertilizers for good yields. They could also tie up the market and raise the price of seeds to many times what they usually sell for" (DeCrosta, 1980).

Statements such as these cause concern, not only amongst laymen but also among biologists. It is sometimes difficult to know what the facts are relative to such statements unless one has detailed knowledge of the observations in question.

The rapid movement of large chemical, pharmaceutical, and energy companies

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into the seed industry has happened and seemingly is continuing. It is too early to know the effects of this change in ownership in the seed industry. One might logically assume, however, that the recent acquisitions would eventually result in greater competition in the industry. The increased competition, if it occurs, would be because of the development and release of more and better varieties. Such an occurrence would increase genetic diversity as opposed to reducing it.

The fear that large corporations may concentrate on fewer varieties and market them worldwide, thereby eroding genetic diversity, makes little sense biologically. While there is some flexibility in the longitudinal adaptation of plants, most species are quite sensitive to photoperiodic and temperature changes associated with latitudinal differences. These factors place severe constraints on the movement of cultivars to environments which differ from those under which they were developed. Also, many diseases and insects are location-specific which, when breeding for resistance, requires selection to take place in the area in which the variety is to be used. These requirements, in addition to the varietal preferences of the user, place severe restraints on the degree to which varieties can be successfully used worldwide.

Those groups that are concerned about the impact of multinational companies on genetic diversity seem also to fear the effects of plant variety protection legislation. No doubt some of the fear must result from a failure to distinguish between American legislation and that of the Common Market countries of Western Europe where a system of "national lists" has been developed which prohibits the use of varieties not included in the lists. The Plant Variety Protection Act of the United States is quite different in nature and effect. It was developed to discourage the pirating of varieties and to preserve the rights to the variety by the developer of the variety. Its use is voluntary, and it has no effect whatsoever on the marketing or use of new varieties. Protected varieties are available for use in research. Moreover, they may be multiplied by farmers for their own use or for sale to neighboring farmers.

It is yet too early to know the extent to which this legislation provides protection to the breeder. There seems little doubt, however, that it has resulted in additional breeding and the introduction of a larger number of varieties, particularly varieties of self-fertilized species. In this way the legislation tends to increase rather than decrease genetic diversity.

SUMMARY

1. Plant germplasm is among the most essential of the world's natural resources. Its conservation merits far greater attention than it is now receiving.

2. Total genetic diversity does not provide insurance against genetic vulnerability. To be of use to the breeder, sources of genetic diversity must include useful alleles not present in elite populations that carry resistance to pests and other stresses that adversely affect productivity and quality.

3. Breeding programs of the most important crops include only a small percentage of the total germplasm available within each crop. The major reason for this limited use of the stores of germplasm found in gene banks is the lack of evaluation data on such material. Until a gene bank's accessions are evaluated and documented they will continue to be of limited value to the breeder.

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4. The results of a recent survey indicate that the genetic base of several important crops has increased during the past decade.

5. Several criticisms of the Green Revolution (used in the broadest sense) are considered. Introductions of new, improved cultivars do tend to replace indigenous varieties containing potentially useful germplasm. Expanded efforts are needed to rescue such varieties before extinction.

Research does not support the contention that modern, genetically-uniform cultivars are necessarily less stable and less dependable than genetically-variable cultivars.

6. With respect to the impacts of a changing seed industry on genetic diversity, it is suggested that these changes will not result in a concentration of fewer varieties used worldwide. The movement of pharmaceutical and chemical companies into the seed industry has occurred too recently to permit an evaluation of the effects of such moves. It will likely result in greater competition which, in turn, will stimulate more breeding and the introduction of a greater number of varieties than have been available in the past.

Plant variety protection legislation in the United States has also served to stimulate additional breeding in self-fertilized species and has resulted in an increase in the amount of genetic diversity available to the farmer.

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GERMPLASM RESOURCES OF PLANTS: THEIR PRESERVATION AND USE

♦3730

G. F. Sprague

Department of Agronomy, University of Illinois, Champaign-Urbana, Illinois 61801

Germplasm resources of a particular crop species may be divided into three groups. The first group consists of all individuals within a genus or broader cluster within which sexual compatability exists, including wild or weedy representatives. The second group is a subset of the first and includes all individuals in the working collections of the breeders. Plant breeding operations are largely limited to this group. The third group is even more restricted and includes the improved cultivars in commercial use and their potential replacements. An effective system of germplasm management must provide for gene flow from group one to groups two and three. Each group offers its own unique challenges: identification, maintenance, and evaluation. It is this genetic diversity, in its entirety, which is basic to all plant breeding improvements.

This report presents a brief resume of the US and international effort devoted to germplasm collection and preservation, the current status of this effort, some of the problems requiring further attention, and, finally, some of the benefits that have been derived from use of exotic germplasm.

Early History

In the hunting and gathering period of man's development a large number of plant species were used for food on either a regular or occasional basis. As man progressed toward a more stable agriculture many of these species decreased in relative importance. Various listings of the currently most

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(IBP) provided much of the impetus for an expanded international effort. In 1967 a technical conference was held in which the methodologies of plant exploration and genetic conservation were examined and goals and strategies developed. A summary of genetic resources was published in 1973 (9, 10). The necessity for germplasm collection and preservation was also emphasized at the United Nations Conference on the Human Environment held at Stockholm in 1972. These and other activities developed a broader public awareness of the problem.

IBPGR Activities

The Consultative Group on International Agricultural Research (CGIAR) established the International Board of Plant Genetic Resources (IBPGR) in November 1973. The basic function of IBPGR as defined by the Consultative Group is "to promote an international network of genetic resource activities to further the collection, conservation, documentation, evaluation and utilization of plant germplasm and thereby contribute to raising the standard of living and welfare of people throughout the world."

Collection activities of the past have often been in response to a particular need rather than an attempt to assemble an adequate and representative sample of the diversity available within a given species or group of species. With the establishment of IBPGR, several new activities and policies have been initiated. Among these was the establishment of a worldwide network of institutions, organizations, and programs concerned with all aspects of germplasm resources. Where necessary, new institutions or centers have been established and close cooperative ties fostered among the new and the previously existing centers. As an aid to furthering this cooperative effort, internationally staffed advisory committees of experts have been appointed for each of the major crops or group of crops. They have been asked to evaluate the adequacy and current status of existing collections and to identify areas or regions where additional collection activity is necessary to achieve adequate representation. Where collection activities have been mounted, the effort, where possible, has been cooperative, with the collected material being shared among replicate storage centers.

IBPGR, with the help and advice of FAO and other agencies, has established priorities for collection activities based on an assessment of the existing collections, the rapidity of genetic erosion within a region, the financial resources available, and other pertinent factors. Details of these activities are presented in the annual reports (2–4).

Technical meetings on crop genetic resources have been sponsored and special training schools developed for potential plant explorers or collectors. Guidance and financial support for the development of computerized information storage and retrieval systems suited to the needs of the several genetic stock centers and to all users of genetic resources have also been

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provided. IBPGR has contributed immeasurably to the modernization and integration of all aspects of germplasm collection, preservation, and use.

Since 1976 IBPGR has sponsored plant collection activities in over 20 countries or areas. The crops of interest have included all of the major cereals, the pulses, grasses, forage legumes, groundnuts, vegetables, potatoes, cassava, and sweet potatoes. The IBPGR-sponsored collections were specifically designed to salvage materials in areas where genetic erosion was proceeding most rapidly. The centers currently involved in the international network concerned with collection, conservation, and documentation are illustrated in Figure 1 (4). Center locations and responsibilities for a few of the crop species are described in Table 1.

In cooperation with FAO, IBPGR is preparing a compilation of stocks of various species currently held in storage at research or governmental centers throughout the world. Copies of certain listings have been supplied to me in advance of a more general distribution. These listings are too extensive for detailed presentation here. A consolidation has been attempted in Table 2 which provides some indication of the numbers of items and the countries in which they are stored.

Figure 1 Location of National Agencies and International Centers cooperating with IBPGR in 1977–1978 in various aspects of germplasm collection, conservation, and documentation (from IBPGR annual report for 1977).

Table 1 A partial listing of national and international centers responsible for germplasm collections of crop plants[a]

Crop	Genus and species	Location
Rice	*Oryza sativa indica*	IRRI Los Banos, Philippines
	O. sativa javanica	IRRI Los Banos, Philippines
	O. sativa japonica	National Institute of Agricultural Science, Japan
	Mediterranean forms, temperate and intermediate from USA	National Seed Storage Laboratory, Fort Collins,
	Wild species	IRRI, Los Banos, Philippines
	African forms	IITA, Nigeria
Wheat	Culivated species	N. T. Vavilov Institute of Plant Industry (VIR) USSR, CNR Germplasm Laboratory, NSSL, Bari, Italy, Fort Collins (Each institute's collection duplicated at one of the others.)
	Wild species of *Triticum* and *Aegilops*	Plant Germplasm Institute, University of Kyoto, Japan (Duplicated in one of the above institutes.)
Maize	New World material	NSSL, Fort Collins
	Asiatic material	NIAS, Japan
	European material	VIR, USSR and another center to be designated
Sorghum	Cultivated and wild	NSSL, Fort Collins
Millets	Cultivated and wild	
	Pennisitum spp.	NSSL, Fort Collins
		Canadian Gene Bank, Ottawa
	Eleusine	ICRASAT, Hyderabad, India
	Panicum miliaceum	ICRASAT, Hyderabad, India
	Setaria italica	ICRASAT, Hyderabad, India
	Minor Indian millets	Indian Council for Agriculture Research New Delhi, India
	Eragrostis spp.	Plant Genetics Resource Center, Addis Ababa, Ethiopia
Legumes	New World	
Phaseolus	All species, but special emphasis on *P. vulgaris*, *P. coccineus*, *P. lunatus*, and *P. acutifolius*	CIAT, Cali, Colombia
Pigeon pea	*Cajanus cajan*	ICRASAT, Hyderabad, India
Groundnut	*Arachis hypogaea*	ICRASAT, Hyderabad, India
Chickpea	*Cicer arietinum*	ICRASAT, Hyderabad, India
Cowpea	*Vigna sinensis*	IITA, Ibadan, Nigeria
Vegetables	Southeast Asian species	Institute of Plant Breeding, Los Banos, Philippines

[a]Taken in part from 1977 annual report of the International Board of Plant Genetics Resources (3).

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Please refer to our discussion on 24 July 1985 at the Office of the National Environment Board, I would like to provide the draff proposals of potential study for your information. You may please review whether these proposals are practical and their possibility of getting fund or at least their priority for USAID point of view. Any comments and suggestions from you regarding this matter would be greatly appreciated.

Sincerely yours,

(Arthorn Suphapodox)

Deputy Secretary General

Project: Thailand - Conservation of Freshwater Wetlands in Peninsular Thailand

PART 1. OVERVIEW

1.1 Function: Support for the survey, classification and planning of management of wetlands.

1.2 Sector: Ecosystem conservation - Planning and Management.

1.3 Implementing Agency: National Environment Board of Thailand in collaboration with Royal Irrigation Department, Fisheries Department the Royal Forest Department and Kasetsart University.

1.4 Commencement: January 1986. Duration: Two years (1986-1987)

1.5 Government Input: US $ 36,000

1.6 Aid Needed: US $ 75,000

1.7 Abstract

Thailand has a number of important freshwater wetlands. Though little is known of the resources of these ecosystems, most wetland areas have come under intensive uses which may not be compatible with the capability of the ecosystems to sustain the uses.

It is imperative that the freshwater wetlands be surveyed and their resources inventorised so as to provide a sound ecological basis for the classification for management purposes. One area would then be selected for detailed assessment of their conservation needs with a view to developing management plans for national use, (eg. the use in agriculture, fisheries etc.)

Envisaged to last two years, the first year would be devoted to the general survey and inventory work and the second to conservation assessment and preparation of management plans for the selected areas. Government agencies concerned would handle the work aid is needed to support foreign experts to organize the work and the publication of reports and management plans.

PART 2. DESCRIPTION

2.1 Immediate Objectives

(1) Mapping of freshwater wetlands in Peninsular Thailand.

(2) Classification of the freshwater wetlands.

(3) Identification of plant and animal species reported to be endemic, rare and endangered.

(4) Determination of their status of conservation and identification causes of threat.

(5) Detailed assessment of conservation problems of two selected areas with a view to developing management plans.

2.2 Development Objectives

(1) This project would contribute to a national strategy for the sustainable utilization of the natural resources of Thailand through the provision of means to ensure the wise use of freshwater wetlands.

(2) In so doing, it would contribute to attaining two of the objectives of conservation identified in the World Conservation Strategy, Viz.:

(a) maintenance of essential ecological processes and life support systems,
(b) sustainable utilization of ecosystems.

2.3 Background and Justification

(1) Thailand has a number of other wetlands such as peat-swamps, marshes etc. in the Peninsular.

(2) A systematic inventory of these ecosystems has never been made. As a result, very little is known about the extent, nature and species resources of the freshwater wetlands. This lack of knowledge has resulted in the wetlands being regarded as wasteland; and this in turn has caused these rare ecosystems to be converted to uses to which they may prove to be unsuitable.

(3) The UNEP/IUCN Mission to Thailand in 1979 has found that the wetlands harbour a rich water-borne fauna, especially waterfowl. Besides, it has been observed that local people benefit directly from these wetlands, especially through inland fishing and collection of waterfowl eggs for subsistence.

(4) Plans are presently being made to drain these wetlands especially in Peninsular Thailand, for conversion to agriculture though many of these would not be suitable to be so used.

(5) There is thus an urgency to inventorise and assess the resources of the freshwater wetlands and their values before conversion plans are advanced.

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2.4 Activities

The activities would be spread over a period of two years in two phases: Phase I, the inventory phase and Phase II, the development of management objectives in the selected area.

(1) Phase I. Activities would include:

(a) mapping of wetlands using ERTS or other high altitute remote sensing analyses.

(b) field analysis of sample areas for development of classification indices and derivation of classification system parameters.

(c) identification of wetlands with socio-economic and ecological importance for analysis of their qualities to derive a classificatio

(d) Identification of plant and animal species by Thai experts reported to be endemic, rare and endangered

(e) Determination of their status of conservation and identification causes of threat.

(2) Phase II. Planning activities would be based on the inventory developed as a result of activities in Phase I including any information already available. Two likely candidate sites are a portio of Lake Songkla in Southern Thailand (experiencing exploitation) and a representative upland wetland to be identified during inventory:

(a) derivation of management objectives for the selected areas,

(b) formulation of management standards to achieve the objectives,

(c) determination of procedures to attain the objectives,

(d) identification of institutional and financial resources needed to support work,

(e) development of management plans.

2.5 Outputs

(1) Maps of freshwater wetlands in Peninsular Thailand.

(2) A classification of the Freshwater Wetlands.

(3) Assessment of conservation issues of two key areas.

(4) Management Plans for these selected areas.

2.6 Government Input

(1) One scientist would be made available from each of the five government agencies involved.

(2) Participating agencies would contribute to field costs including travel, per diem, remote sensing materials, labour hire and preparation of maps and management plans.

2.7 Aid Needed

(1) Services of two foreign experts, one for each of the two phases

(2) Cost of editing and printing of management plans

2.8 Involvement of National Experts

(1) This project will be implemented by the National Environment Board of Thailand in collaboration with the Royal Irrigation Department, the Royal Forest Department the Fisheries Department. and Kasetsart University. Each of these agencies will second Thai experts to handle the project.

(2) When management plans are ready, their implementation will also be handled by Thai experts, especially aspects concerning the cooperation of the people in the vicinity of the wetlands.

2.9 Training

(1) The project would provide ample opportunity for the training of Thai graduates who might be assigned to assist the national experts

(2) In addition, the national experts themselves would derive experience in the planning of management of natural resources with multiple use.

2.10 Public Relations

Rural populations would be involved in the implementation of the management plans.

PART 3. MANAGEMENT

3.1 Operative Personnel

This shall be determined jointly by the five participating government agencies: the National Environment Board, the Royal Forest Department, the Royal Irrigation Department Fisheries Department. and Kasetsart University.

3.2 Administrative Personnel

In is envisaged that the project administrator shall be appointed by the National Environment Board with the concurrence of the participating government agencies.

The Interim Coordinator is Khun Arthorn Suphapodok, National Environment Board of Thailand.

3.3 Budget

(1) Personnel	1986 $	1987 $	Notes
(a) Foreign experts	15,000	15,000	Aid Needed
(b) National experts	18,000	18,000	National Budget
(2) Travel & per diem			
(a) Foreign experts	4,000	4,000	Aid Needed
(b) National experts	10,000	10,000	Aid Needed
(3) Training cost	5,000	5,000	Aid Needed
(4) Publication cost	-	5,000	Aid Needed
Total :	52,000	57,000	
Summary :			
National Budget :	18,000	18,000	
Aid Needed :	34,000	39,000	

3.4 Reporting Procedures

(1) One month after commencement of the project, the project leader shall present a detailed work plan to the National Environment Board for approval in consultation with the other participating agencies.

(2) The National Environment Board shall communicate a set of the work plan to the aid-agency through IUCN.

(3) Thereafter, there shall be prepared a report on work progress every six moths.

(4) The terminal report shall be prepared no later than 3 months after termination of the project. Details of outputs and plans for follow-up action shall be the main componints of the terminal report.

3.5 References

(1) Referees

(a) Prof. Dr. Peter Jacobs, Chairman, Environmental Planning Commission, IUCN, 1196 Gland, Switzerland.

(2) Literature

IUCN (1979). Conservation for Thailand-Policy Guidelines.

Project: Thailand-Conservation of Endangered fish in Maekhon River

PART 1. OVERVIEW

1.1 **Function:** Support for the investigation and life history study of some endangered freshwater fish.

1.2 **Sector:** Species conservation.

1.3 **Implementing Agency:** Freshwater Fisheries Division, Department of Fisheries.

1.4 **Commencement:** January 1986. **Duration:** Three years

1.5 **Government Input:** ฿ 50,000

1.6 **Aid Needed:** ฿ 154,000

1.7 **Abstract:**

Fisheries resources founded in Thailand has been noted as a very rich and fertile treasury. As many natural spawning areas are destroyed and degraded, the fish production from natural waters is decreased by both quality and quantity.

It should be worth to work for the good economical freshwater fish which is become endanger in natural waters. Those species are about 13 species named on attached table.

For first year, it is programmed for surveying, specimen collection, observation, and gathering needed data. Work in second year is planned for propagating technique, reproduction. The last part will deal with evaluation and suggestion a few principle for a conservation laws.

1.8 **Endorsement:**

2.1 Immediate objectives

(1) To gather information concerned with the life history of some specific species.

(2) To observe fish behaviour and the development for operating on propagation.

(3) To determine a suitable method and selected area for conservation problems.

2.2 Development Objectives

(1) This project would contribute to a national strategy for the sustainable utilization of the matural resources of Thailand through the provision of means to ensure the wise use of freshwater fish.

(2) In so doing, it would have a better control on the utilization and management of fishery resources. Small fishermen can attain better income and better living by means of increasing productivity of fishing efforts.

The increasing on fish consumption among low income population is a great benefit.

2.3 Background and Justification

(1) Thailand had been announced as one of a rich natural resources country in Asia. At present the environment is changed and proved to be unsuitable for living organisms especially fish in matural waters for example lack of spawning and nursery grounds.

(2) Fish seed from natural sources are inadequated to supply the need of fish farmers for aquaculture system developed to serve demand in fish production increased by a growing human population.

(3) The developed Technique of induced spawning as present is considerately advanced to accomplish for seed production in pond culture system

2.1 Immediate Objectives

(1) To gather information concerned with life history of some specific species.

(2) To observe fish behaviour and its development for operating on propagation.

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(2) Fish seed from natural sources are inadequated to supply the need of fish farmers for aquaculture system developed to serve demand in fish production increased by growing human population.

(3) The developed Technique of induced spawning at present is considerately advanced to accomplish for seed production in pond

(4) It is a great advantage to use spawning technique to gain seed fish of wild endangered species.

(5) Recruitment back to natural waters can stimulate increasing fish production, and safe endangered species.

2.4 Activities

(1) Phase 1, 1986: Collecting data and investigation of all species concerned as well as examine the environment involved.

(2) Phase 2, 1987: Studying the fish themselve and aquarium rearing to observe the development and behavior for spawning and tagging method for migration study.

(3) Phase 3, 1988: Evaluation and preparation for a recommendation on conservation laws.

2.5 Outputs

(1) Recommendation for their conservation.

(2) Increase fish production respected to endangered economical species.

2.6 Goverment Input

(1) Participating agencies would contribute to field costs including travel, per diem, and management plans.

(2) One biologists would be made available from FW Division. Dept. of Fisheries.

2.7 Aid Needed

(1) Aid would also be needed for setting up a mobile unit as a task force.

(2) Equipments for rearing and spawning activities.

(3) Editing and publication preparation.

PART 3, MANAGEMENT

3.1 Operative personel

a. Mr. Sanay Pholprasit, Director Freshwater Fisheries Division.

b. Other biologists and Technicians.

3.2 Budget

	1986	1987	1988	Notes
(1) Travel & Field allowance	12,000	25,000	13,000	Nation[illegible] B
(2) Labour Hire	5,000	10,000	4,000	Aid Needed
(3) Equipments	40,000	70,000	20,000	Aid Needed
(4) Publicater	-	-	5,000	Aid Needed
total	21,000	105,000	42,000	

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Freshwater endangered species

specie order	Common name	Scientific name
1.	Mekong Giant catfish	Pangasianodon gigas chevey
2.	Julliens's golden-price carp	Probarbus jullieni Souvage
3.	Blane's striped featherback	Notopterus blanci D ' Dubenton
4.	-	Mystus wyckii (Bleeker)
5.	Chao-Phya giant catfish	Pangasius sanitwongsei Smith
6.	Siamese tigerfish	Datnioides microlepis Bleeker
7.	Soldier river barb	Cyclocheilichthys enoplos (Bleeker)
8.	Golden Carp	Barbichthys laevis (Cuv & Val)
9.	Black-ear fish	Pangasius larnaudii Bocount
10.	Giant bagarius	Bagarius yarrelli (Sykes)

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Species and aspects of the study

Interested species / Aspects	1	2	3	4	5	6	7	8	9	10
Distribution	✓	✓	✓	✓	✓	✓	–	✓	✓	✓
Habitat	✓	✓	–	–	–	–	–	✓	–	–
Food habits	✓	✓	–	✓	–	–	✓	✓	–	–
Migration	✓	–	–	–	–	–	✓	–	–	–
age & Growth	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Reproduction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Propagation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Project: Thailand - Conservation of Freshwater Wetlands in Peninsular Thailand

PART 1. OVERVIEW

1.1 Function: Support for the survey, classification and planning of management of wetlands.

1.2 Sector: Ecosystem conservation - Planning and Management.

1.3 Implementing Agency: National Environment Board of Thailand in collaboration with Royal Irrigation Department, Fisheries Department the Royal Forest Department and Kasetsart University.

1.4 Commencement: January 1986. Duration: Two years (1986-1987)

1.5 Government Input: US $ 36,000

1.6 Aid Needed: US $ 73,000

1.7 Abstract

Thailand has a number of important freshwater wetlands. Though little is known of the resources of these ecosystems, most wetland areas have come under intensive uses which may not be compatible with the capability of the ecosystems to sustain the uses.

It is imperative that the freshwater wetlands be surveyed and their resources inventorised so as to provide a sound ecological basis for the classification for management purposes. One area would then be selected for detailed assessment of their conservation needs with a view to developing management plans for national use, (eg. the use in agriculture, fisheries etc.)

Envisaged to last two years, the first year would be devoted to the general survey and inventory work and the second to conservation assessment and preparation of management plans for the selected areas. Government agencies concerned would handle the work aid is needed to support foreign experts to organize the work and the publication of reports and management plans.

COVER SHEET
PROJECT PROPOSAL SUMMARY

1. Title: An Inventory on Endemic, Endangered and Treatened Plants of Nepal.

2. Applicant: Dr. Tirtha Bahadur Shrestha
Royal Nepal Academy, Kamaladi, Kathmandu NEPAL

3. Institutional Endorsement: This will be part of the botanical research program at the Royal Nepal Academy. The project falls with in the guidlines layed out in the prospectus "National Conservation Strategy for Nepal" authored by HMG/IUCN. The King Mahendra Trust for Nature Conservation will provide the necessary instituional support and the Department of Medicinal Plants will provide laboratory facilities.

4. Project Period: This is a two year project. Start up date will be Summer 1985.

5. Total Budget: $43,000

6. Amount Requested from WWF-US: Year one - $15,000
Year two - $28,000

7. Support from other Sources: None

8. Anticipated Future Request: No

9. Abstract: (See next page)

ITEMS 10 THRU 13 ARE NOT TO BE FILLED IN BY APPLICANT

10. Previous WWF-US Support: No

11. Staff Recommendation:

12. Expiration Date:

13. Staff Project Officer:

Bruce W. Bunting

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BSTRACT:

Nepal lies on the "Cross-roads" of various bio-climatic regions of Asia, and it has become a "meeting place" for the West Himalayan and East Himalayan fauna and flora. The topographical features of the country with the altitudinal variation from 60m at the southern Terai to over 8000m in the Himalayas, offers a wide range of habitats for the occurance of more than 10 different bio-climatic zones. Over 5000 species of flowering plants, 800 species of birds, 600 species of butterflies, 45 species of snakes, 171 species of fishes, 150 species of mammals have been recorded in Nepal. Thus the wealth of fauna and flora in Nepal is remarkably rich and warrants special measures for their conservation. Among them, the endemic plants of Nepal are the highest priority. A study of northwest Nepal demonstrated that 63 species of plants are endemic to an area of 23,000 Km^2 (Shrestha, Ecology and Vegetation of Northwest Nepal, Royal Nepal Academy, 1982). A general survey of some genera has shown that 15 species of *Aconitum*, 4 species of *Meconopsis*, and 10 species of *Primula* are endemic to Nepal. It may be estimated that more than 200 species of flowering plants are endemic to Nepal and a large number of other plants are endangered and threatened.

C. Background:

Nepal depends most heavily on Natural resources. Over 90% of its population (16 million, 1984) depends on agriculture. Rapid growth of population (2.8%) has exerted enormous pressures on the natural vegetation. Agricultural lands are extended even on steep slopes; over 87% of the fuel and fodder are extracted from natural vegetation; cattle grazing into forest and alpine grasslands is still uncontrolled. All of these activities have contributed to the reduction of forest area from 6.4 million hectares to 4.6 million hectares in a period of 15 years (1964-1979). This reduction has taken place in at least 10 bio-climatic zones; disturbing, depleting, and destroying more than 30 different types of natural vegetation.. Thus plant species that were found in abundance some 15 or 20 years ago, are now threatened with extinction. For example, _Michelia champaca_, the famous tree for making furniture in Nepal, ahs now become rare; the famous medicinal plant of commerce, _Rauwolfia serpentina_, is no longer available in natural habitats; the Nepalese larch, _Larix himalaica_, which has a restricted distribution in only a few valleys of central Nepal and therefore quite rare, is valued only as a fuel wood by the local people of these areas.

The rich flora of Nepal is coming under serious threat and it has become urgent to alert the appropriate authorities and the people of the need to protect this valuable natural resource and thereby safegaurd "the natures' paradise".

Although Nepal has five National Parks and six wildlife reserves, the need to protect and preserve genetic plant resources has not been seriously appreciated. The Royal Nepal Academy has therfore approved this project and the King Mahendra Trust for Nature Conservation has agreed to provide institutional support. The Department of Medicinal Plants and the Department of National Parks and Wildlife Conservation have agreed to provide technical support.

D. Methods:

On the basis of a review of the literature, the plant specimens in herbariums in India, Japan, and the U.K., and field notes of various plant collectors along with direct field observations made by the principal investigator, an inventory of plants the Himalayas with restricted distribution will be developed.

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G. References: [and responcibilities]

1. Dr. Hemanta Mishra
   Member/Secretary,
   King Mahendra Trust for Nature Conservation
   and Deputy Director General,
   Department of National Parks and Wildlife Conservation.
   National Parks Building
   P.O. Box 3712
   Babar Mahal, Kathmandu
   NEPAL

[institutional advice]

2. Dr. Samar Bahadur Malla
   Director General,
   Department of Medicinal Plants
   Thapathali, Kathmandu
   NEPAL

[technical advice]

3. Mr. Vijaya Bahadur Malla
   Member/Secretary
   Royal Nepal Academy
   Kamaladi, Kathmandu
   NEPAL

[adminsitrative advice]

I. Literature Cited:

1. Conservation for Develcoment - an introduction to the King Mahendra Trust for Nature Conservation, Nepal. KMTNC Publ. Ser. 1/1984.

2. The IUCN/WWF Plants Conservation Programme 1984-85.

3. "Mountain Develcometn: Challenges and Opoortunities". Proceedings of the First International Symposium and Inauguration of the International Centre for Integrated Mountain Develcoment (ICIMOD), Dec. 1-5, 1983, Kathmandu, NEPAL.

4. National Conservation Strategy for Nepal - A Prospectus. Feb. 1983. Prepared by His Majesty's Government of Nepal in conjunction with the IUCN.

COVER SHEET

1) **Title:** A Study on the Park People Conflict Resolution in Royal Chitwan National Park

2) **Applicant(s):** Uday Sharma

3) **Institutional Endorsement:** His Majesty's Govt. - Nepal
King Mahendra Trust
Dept. of National Parks and Wildlife Consv.

4) **Project Period:** Fall 1985 - 1990

5) **Total Budget:** $50,000

6) **Amount Requested from WWF-U.S.:** $50,000

7) **Support From Other Sources:** Checking into possible funding from The University of Arizona for tuition

8) **Anticipated Future Requests:**

Year 2	$8,450.00	Year 4	$13,450.00
Year 3	$8,500.00	Year 5	4,200.00

9) **Abstract:** (see next page)

ITEMS 10 THRU 13 ARE NOT TO BE FILLED IN BY APPLICANT

10) **Previous WWF-U.S. Support:** None

11) **Staff Recommendation:** Approve $15,400 for 1st year

12) **Expiration Date:** June, 1986

13) **Staff Project Officer(s):**

Bruce W. Bunting

9) ABSTRACT:

Royal Chitwan National Park in the Terai of Nepal is internationally recognized for its exceptional wildlife which includes such endangered species as the tiger Panthera tigris, and the Greater One-horned Rhinoceros Rhinoceros Unicornis.

Over the past several years there has been an increase in the incidences of damage resulting from wildlife invading agricultural fields around Royal Chitwan National Park, as well as loss of live stock from attacks by tigers and leopards. These incidences have led to an actual resentment of the park by the local villagers.

Although considerable research has been carried out on the ecology of the wildlife of the park, little has been done regarding the human ecology and the problem of "park people conflict". This proposal is to fund a Ph.D. candidate to do research on the human ecology of Royal Chitwan Park and to implement pilot projects to reduce the incidence of wildlife interference in the village and agricultural areas surrounding the park.

A STUDY ON THE PARK - PEOPLE CONFLICT RESOLUTION IN ROYAL CHITWAN NATIONAL PARK, NEPAL

By
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A PRELIMINARY RESEARCH PROPOSAL SUBMITTED TO
THE DEPARTMENT OF NATIONAL PARKS AND WILDLIFE CONSERVATION, KATHMANDU AND
INTERNATIONAL INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT, WASHINGTON D.C.

APRIL 1984

NAMES OF THE CONSULTANTS

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Department of National Parks and Wildlife Conservation
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Department of National Parks and Wildlife Conservation
P. O. Box 860, Kathmandu, Nepal.

4. Dr. C. Wemmer
Acting Director
National Zoo
Washington D. C.

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Associate Professor
Department of Fisheries and Wildlife
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INTRODUCTION

Royal Chitwan National Park lies in the lowland inner Terai of Chitwan District, Narayani Zone of Nepal. The present area of the Park is 932 square kilometers, which is a viable representative of the pristine ecosystem of the Chitwan Valley. The park is one of the few strongholds of the rare one-horned rhinoceros (*Rhinoceros unicornis*) and tiger (*Panthera tigris*). It is the home of at least five other listed endangered wildlife species of Nepal (HMG 1971). The park harbors four sympatric species of deer of which chital (*Axis axis*) forms the highest biomass (Tamang 1979). The vegetation of the park is dominated by sal (*Shorea robusta*); the sal forest forms a continually changing mosaic of riverine forest and grassland due to combined effect of floods, fires, and riverine erosion.

Since the establishment of park in 1973, cattle grazing and firewood cutting have been made illegal in addition to the prohibition of all timber harvesting operations. Local villagers at present retain the privilege to enter the park once a year to collect thatch grass and reeds for building materials. In the current year 55,769 people collected thatch grass and reeds for two weeks (January/February); on the average each person collected about two loads of these materials per day (Yadav 1984). For the effective enforcement of park regulations, armed guards from Royal Nepali Army have been posted in all strategic locations of the park.

Although it is claimed by the Park Authority that the human related disturbances in the park is minimal, there have been many recorded as well as unrecorded incidences of trespassing by local people for cattle grazing and fire wood cutting. No one knows for sure the extent of forest damage due to these illegal activities.

From the local people's point of view, the park is more a nuisance than a benefit to them (Mishra 1982 a). Every year local farmers lose s cantial quantities of crops the damage caused by wildlife mostly rhino, wild boar (Sus scrofa), chital, and parakeet (Psittacula krameri). According to one estimate, the crop loss in the villages of Jaimangala, Bankatta, Bhawanipur, Gadauli, and Kurchouli of Padampur Panchayat adjoining the Royal Chitwan National Park was 50-100% (Milton and Binney 1980). Similarly livestock loss to tigers and leopards could be substantial.

As the local villagers have few alternate places to acquire these above essentials of farm life, it is important to know how their life style has been affected by this change. Also since the park does not pay compensation for crop damage or livestock loss, it is very likely that this imposition plus the restrictions imposed upon them are negatively influencing their attitude towards the park.

There have been many studies done in Royal Chitwan National Park largely through the cooperation of the Smithsonian Institution. A great deal of information has been accumulated on the ecology and behaviour of tiger and their principal prey species (Seidensticker 1976 a, 1976 b; McDougal 1977; Smith and Mishra 1981; Mishra 1982 b; Sunquist 1982; Tamang 1982; Dhungel 1982, 1983). Rhinos were studied by Laurie (1978). Yet, "park-people conflict" received very little formal study in Chitwan. Only one general study on the social, agricultural, and economic features of the Padampur Panchayat (Milton and Binney 1980) provides some insight into the people's problem with the park. This latter study also throws no light on how the park is affected by the use of the local villagers, and it does not quantify most of the results. However, Milton and Binney's work will be valuable in providing some questions and hypotheses and making comparisions of some of the aspects of the park-people conflict between 1977 and at present.

Leopold (1933) stressed the need of a good "human management" for better game management. Many others believe a better understanding of the human ecology is essential for any successful conservation activity (Cain 1960, Kellert 1979, Filion 1980, Shay 1980). A classic study was done by Berwick (1983) on the ecology of Maldhari community in Gir Ecosystem, which highlighted the current imbalance between the community and their environment.

In Chitwan it has already been believed that there is a growing conflict between the park and people (Mishra 1982 c). Various members of Rastriya Panchayat since 1979 are continuously raising their voices against the crop loss in the adjoining farms of national parks and reserves due to the damage caused by wildlife (Banstola 1979, Gupta 1980, Thakurathi 1980, Chaudhari 1982, Gurung 1982, Tharu 1983). If Royal Chitwan National Park is to survive in its true sense in the future, it is essential to strengthen the communication system between the park and local people, and the park personnel should attempt to lessen the growing conflicts.

The proposed study aims to explore the extent of these possible incipent conflicts and to test hypotheses to help develop sound management practices to deal with these intersections of legitimate local self-interest and an international treasure of biological diversity.

STUDY AREA

Padampur Panchayat is selected as the study area for testing most of the hypotheses mentioned in this proposal. Of all the adjoining settlements of the Park, Padampur Panchayat seems to be one of the hardest hit by wildlife damage. Padampur is easily accessible by road from Sauraha, the area where Smithsonian Nepal Tiger Ecology Project's headquarter is based. Above all, the villages of Padampur Panchayat already have been studied in 1977 by Milton and Binney (1980), which provides some baseline data for comparison.

HYPOTHESES TO BE TESTED

CROP DAMAGE

Hypothesis no. 1

1(a). There is no difference in the level of crop damage in Padampur Panchayat between 1977 and at present.

1(b). There is no significant difference in level of crop damage among rice, wheat, maize, and mustard.

1(c). Crop damage by different wildlife species is equal in severity.

1(d). Species of wild animals wander equal distance from the edge of forestlands.

The above hypotheses are based on the prediction that increasing rhino population has led to increased crop damage from 1977 levels. Major wildlife species causing substantial damage besides rhino are chital, wild boar, and parakeet (Milton and Binney 1980). The impacts of each of these species should be different for different seasons of a year. Each wildlife species might be raiding the crop at different time of the year depending on their breeding, pregnancy or lambing seasons. The impact may also be based on the behavioural sensitivity of the animal to the human life and the effect of control measures adopted.

Methods

A landholding map of Padampur Panchayat will be acquired from the Chitwan Land Revenue Office. Copies of this map will be used to record the crop types of the area on a monthly basis. The entire area of Padampur Panchat will be covered to record the crop damage. Separate log books will be maintained for each of the nine wards of the Panchayat. The damage will be assessed as percentage crop loss on ward-by-ward basis based on the stratified samples incorporating the variables of proximity to the border of the forest, house density, proximity to human traffic, and aggrassive defences measures.

In making record of each observation of crop ge the type of crop damaged, approximate surface area damaged (where appropriate), wildlife species causing such damage, the approximate distance of the site from the nearest forest border, distance from the nearest human trail, and the direction of the travel of the species will be specified. Settlement map will be used to determine the proximity ~~to~~ To the houses and the house-density. A note will also be made on the details of the aggres~~ive~~sive defence behaviour adapted by the farmer.

Percentage of crop loss is a cumulative total for each ward of all separate crop raiding incidences beginning from the time of planting such crop until the crop is harvested. The result will be cross checked for accuracy by interviewing key informants.

The results obtained will be compared with the data of Milton and Binney (1980) to test the hypothesis 1(a). The same data will also be used to test the hypothesis 1(b).

The anuual crop loss will be derieved based on the average yield per acre. The loss will be converted into annual monetary loss based on the current market price of the products. While estimating the yield per acre, care will be taken to make the estimate realistically comparable to the damaged farm. For example, if the damaged farm is unirrigated and owner did not use machine, estimation of the yield per acre will be made from similar undamaged samples of similar soil type for the year.

The loss will be categorized based on the wildlife species causing such damage: Chital (including all other deer), wild boar, rhino, parakeet; the rest will be lumped under the category of "others." These data will be used to test the hypothesis 1(c).

The recorded distances from the edge of the nearest forest for each separate crop raiding observation will be used to test hypothesis 1(d).

Hypothesis no.

Crop damage is not related to the food availability within the park.

This hypothesis is based on the prediction that heavy crop loss occurs when the natural food is less abundant inside the park. Similar speculation was also made by Milton and Binney (1980) for chital.

Method

The hypothesis will be tested based on the nutrient quality of crops (much from the published data) and the seasonal changes in the availability of principal and preferred foods of wild animals and the nutrient quality of native forage plants. The principal foods of the wild animals will be determined from the published work. Their nutrient quality will be obtained from the proposed AID and Smithsonian studies. ~~The~~ The latter studies do not materialize the principal forage plants will be analysed from Agriculture Campus, Rampur (Nepal) for their nitrogen content. Linear transects will be laid out randomly in suitable habitat types to determine the density of forage plants.

Hypothesis no. 3

There is no difference in attitude about crop damage between wealthy and poor farmers.

The hypothesis is based on the prediction that farmers who own less than 2 Bighas are much more upset over crop damage than those with landholding 2 Bighas or more.

Method

All owners living within 3 Kilometers of park boundary of Padampur Panchayat will be divided into their respective farm sizes: large and small landholdings. A stratified sample will be selected for interview. The interview form will consist of sections to record other information such as tribe, caste, re~~s~~cent settler, long standing settlers, and educational background to examine if these variables affect the attitude.

Hypothesis no. 4

There is no relationship between poaching and levels of crop damage. The hypothesis is based on the prediction that number of poaching incidences and amount of crop damage are positively correlated.

Method

Poaching incidences and the locations will be recorded for a calander year. A suitable technique will be developed in collaboration with local armed guards to record the poaching incidences. However, it will be taken bare that any increased patrolling by armed guards does not bias the data. These data will be correlated with the crop damage data obtained for Hypothesis no. 1.

THATCH PRODUCTION

Hypothesis no. 5

There is no difference in the demand for thatch grass over the last five years.

The prediction for the hypothesis is that due to increased population pressure and due to reduced supply of thatch grass from sources other than Royal Chitwan National Park, the demand for thatch grass has increased. The supply of thatch grass in the park will be estimated to determine the percentage of grass removed each year.

Method

From the existing records of the park, the number of individuals who collected the grass in the past five years will be tabulated. These data will be compared with the current year data. The work proposed to be done by the AID grassland ecologist will also provide valuable information in testing this hypothesis.

LIVESTOCK DEPREDATION

Hypothesis no. 6

There is no difference in the intensity of livestock depredation by wild animals in adjoining villages of the park irrespective of the forest type bordering the villages.

It is predicted that the intensity of livestock depredation in villages bordering the park forest varies with the change in the vegetation types.

Method

Villages of Padampur Panchayat within 1 Kilometer of the forest border will be selected. The type of park vegetation next to these villages will be recorded. People will be interviewed to record their loss of cattle, goats, chicken and pigs to predators such as tiger; leopard; jackal (Canis lupus) and fox (Vulpus bengalensis); and large birds of prey. The interview form will also consist of sections to record information on husbandary methods such as herding techniques and nutrition situation of the victim livestock.

FOREST DAMAGE

Hypothesis no. 7

Cattle grazing and firewood cutting in riverian forest/grassland type and sal forest next to Padampur Panchayat leave no different impact.

Park forests sustain primarily injury in the form of the impacts of grazing by livestock and firewood cutting. As both of these activities are illegal, it will be difficult to make visual counts of wood cutters and cattle entering the park as cattle owners and wood cutters manage to enter the park secretly to avoid heavy penalties. Therefore direct (e.g. visual) methods of data collection have been avoided. Instead, a comparative approach has been selectedd as stated in the hypothesis.

It is pr ted that intensity of catt razing will be higer in riverine forest/grassland type than sal forest due to the presence of high fodder value plants and grasses in the former. It is predicted that the firewood cutting will be intense in the riverine/grassland type due to the presence of miscellaneous trees with heavy undergrowth

Method

Representative number of linear transects will be randomly laid in riverine/grassland type and sal forest types originating from the outer fringe of the forest towards its interior. Relatively subjective data will be collected as impacts (low, medium, high) for cattle grazing and firewood cutting. Records will also be made on other forms of impact such as soil compaction, soil erosion, and bank stability.

Information will also be taken from the cattle proof exclosures that will be set up by a Smithsonian and another researcher for exclosure studies.

ATTITUDE AND DECISION MAKING

Hypothesis no. 8

8(a). There is no difference between the attitude of people exposed to tourism and the people who are not.

8(b). There is no difference in the level of tolerance of their crop damage by wildlife between people who are exposed to tourism than those who are not.

8(c). There is no difference between the attitude towards the park and other natural resources of educated (School Leaving Certificate education or more) and uneducated people.

8(d). There is no difference in attitude towards the park between the native Tharu people and the immigrant hill people.

It is predicted that the people who are exposed to tourism would favour the park and will be tolerant of crop damage as these group of peopl re enjoying some economic fits from tourism which is a byproduct of an adjacent park. The Hypothesis 8(c) is based on the prediction that educated people will understand the value of the park more than the uneducated people and will be more favourably inclined towards the park. The prediction hy for Hypothesis 8(d) is that the Tharus, being an ancient tribe of Terai, have life style which is adapted to living with forests. Therefore, perhaps Tharus are more tolerant to crop damage by wild animals compared to the immigrant people. Based on this possible difference, it is predicted that Tharus have a more favourable attitude towards the park than the immigrant hill people.

Methods

A comprehensive interview form will be developed to record information relevant to above hypotheses. The villages at or near Sauraha, Padampur, and villages bordering Rapti River westwards from Sauraha will be selected as study site. From these villages, based on a technique of stratified random sampling, people will be selected for interview.

Besides testing above eight major hypotheses, qualitative listing of the procurement of herbs and fruits taken by the natives will be made, similar to one done by Berwick (1983) in Gir Forest, Gujrat (India). Attempts will be made to estimate the quantity of the minor forest products removed. The method will be primarily based on interviewing key informants.

DURATION OF RESEARCH

The field research will take two years. The research will be carried out for a dissertation leading to Doctor of Philosophy (Ph. D.) from the University of Arizona, USA. Another two and a half years, one and half year prior to the beginning of the field work and one year after the end of the field work will be required at the university for preliminary course work and completion of a comprehensive dissertation.

BREAKDOWN OF EXPENDITURE ESTIMATE

FIELD EXPENSES

Salary compensation to the investigator for two years in the field in Nepal, per month $ 200	4,800
One research assistant for two years $ 100 per mo.	2,400
Two field assistants for two years, $ 50 per mo.	2,400
Analysis of forage plants in Rampur Campus (Nepal)	1,000
Mails, stationary, photocopying and books $ 200 each	600
Local travels (including gasoline)	1,500
House construction (timber from fallen logs of the park)	2,400
Labour	1,500
Miscellaneous (tape recorder, ropes, etc)	400
Sub-total US $	17,000

FELLOWSHIP

(a) Prior to the actual field work

Scholarship to the investigator for 18 months in USA, per month US $ 700	12,600
Tuition fees at the University of Arizona	4,000
Travel KTM/USA/KTM	3,000
Sub-total US $	19,600

(b) After the field work

Scholarship to the investigator for 12 months	8,400
Tuition fees at the University of Arizona	2,000
Travel USA/KTM/USA	3,000
Sub-total US $	13,400

GRAND TOTAL US $ 50,000

Budget for 1st year.

12 month Scholarship @700/month	8,400.00
Tuition	4,000.00
Travel	3,000.00
	15,400.00

2nd year

6 month Scholarship	4,200.00
6 month Field Research	4,250.00
	8,450.00

3rd year

Field Research	8,500.00

4th year

Field Research	4,250.00
Scholarship	4,200.00
Travel	3,000.00
Tuition	2,000.00
	13,450.00

5th year

Tuition	4,200.00
TOTAL	50,000.00

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CURRICULUM VITAE

UDAY RAJ SHARMA, A.I.F.C., M.S.

[illegible]

1. PERSONAL

Sex	Male
Citizen of	Nepal
Maritial status	Married.

2. EDUCATION

Name of the institution	Years attended	Major subjects	Degrees
University of Minnesota St. Paul, USA.	1980-82	Wildlife management Ecology	M.S.
Indian Forest College Dehradun, India.	1973-75	Forest management Silviculture Forestry allied subjects.	Associate of Indian Forest College (Post graduate Forestry Diploma).
Tri-Chandra College of Tribhuvan University Kathmandu, Nepal.	1970-72	Zoology Botany Chemistry	B.Sc.
Tri-Chandra College of Tribhuvan University Kathmandu, Nepal.	1968-70	Biology Physics Chemistry	I.Sc.
Saraswati Multi Purpose High School Janakpur, Nepal	1958-68	Mathematics Science Geography English language Nepali literature	S.L.C.

3. TRAINING/SEMINAR

Successfully undertaken a study of administration of national parks and reserves from February-May 1978 in Australia, organised by Australian Development Assistance Bureau.

Attended the Fourth Meeting of the Conference of the Parties of Convention on International Trade in Endangered Species of Wild Fauna and Flora (19-30 April, 1983) held at Gaborone, Botswana, as a government representative.

4. EMPLOYMENT RECORDS

1982 – Present

Employer: His Majesty's Government of Nepal, Department of National Parks and Wildlife Conservation (DNPWC).

Job Title: Wildlife Officer

1. Incharge of conservation education section of DNPWC.
2. Editor of Samrakshan Samachar (Conservation News Bulletin), monthly published by DNPWC.
3. Responsible for preparing proposals, conference papers, annual reports, and general corrospondance related to CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).
4. Responsible for implementation of World Wildlife Fund/ HMG Conservation Education Project, Nepal.
5. Work of special nature: Surveyed the forests of Bara and Trijuga for the possible establishment of hunting reserve and wildlife reserve respectively. Surveyed a portion of Dhorpatan Hunting Reserve to update management recommendations.
6. Supervised three trainees, two officers of Rongoon Zoological Garden, Burma and one post graduate biology student of Wageningen Agriculture University, Netherlands; they were undertaking on-the-job training in the management of National Parks and Reserves of Nepal.
7. Member of Rastra Bank Note Committee.
8. Assist the Director General of DNPWC in his day-to-day work.

1980 - 1982

Graduate student at the Department of Entomology, Fisheries, and Wildlife, University of Minnesota.

1978 - 1980

Employer: HMG/DNPWC

Job Title: Assistant Wildlife Officer

1. Involved in the preparation of Sagarmatha National Park Management Plan.
2. Involved in the drafting of the Himalayan National Parks Regulations, 2034.
3. Assisted the Director General of DNPWC in formulating policies and preparing guidelines to the wardens.

1975 - 1978

Employer: HMG, Sagarmatha National Park (SNP).

Job Title: Warden

1. Worked as the Officer-Incharge of Sagarmatha National Park.
2. Surveyed the upper parts of Khumbu region and worked for the demarcation of boundaries in order to establish SNP in 1975.
3. Worked as manager-cum-technician in close consultation with the project manager and experts of HMG/New Zealand Project.
4. Initiated reforestation programmes and supervised the establishment of forest nurseries.
5. Supervised building construction work.
6. Initiated a system of public relation of SNP with the locals.

5. TRAVEL

Professional Business

India, Australia, Papua New Guinea, Botswana, United States of America, and Canada.

Visits

United Kingdom, Singapore, Thailand, Kenya, France, and West Germany.

Within Nepal

Have extensively travelled within the country including areas that are very remote.

6. LIST OF PROF NAL SOCIETIES AND ACTIVIT

Joint Secretary - Nepal Nature Conservation Society
Member - Nepal Forestry Association
Member - Nepal Bird Watching Club.

7. HONOURS AND AWARDS

(i) Fellowship:

(a) Columbo Plan Fellowship for study in India (1973-75).

(b) United Nations Educational, Scientific and Cultural Organization (UNESCO) Fellowship for study in USA (1980-82).

(ii) Prizes received from Indian Forest College, Dehradun (India):

(a) E. P. Gee Prize for wildlife management

(b) Shri V. S. Rao Prize for the best student from a foreign country.

8. RELEVANT SCIENTIFIC, SEMIPOPULAR WRITINGS

Sharma, U. R., and I. K. Drew. 1977. Proposal for a reforestation project in Sagarmatha National Park. Nepal Australian Forestry Project, Kathmandu. Typed mimeo.

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Rhino People / Park Conflict

[illegible]SSAGE # 833
RCV LN 1

[illegible]ANDA 64505

[illegible]

TO: [illegible]ANDY [illegible]AYMOND

FROM: [illegible]

DATE: [illegible] JUNE 1988

[illegible] FURTHER [illegible] ON PROJECT [illegible]

WE HAVE JUST [illegible] THAT THE [illegible] HAS BEEN APPROVED BY [illegible] TO BEGIN [illegible] PROJECT HAS BEEN [illegible] FOR OVERSEAS GRADUATE TRAINING. [illegible] INCLUDES PROVISION FOR [illegible] THIS PROJECT [illegible] COULD BE FUNDED UNDER THIS PROVISION. [illegible] THERE [illegible] BY [illegible] IN THE [illegible] SEVERAL [illegible] WOULD HELP [illegible] RECOMMENDATIONS IN THIS FIELD. [illegible] THE SITUATION [illegible]

REGARDS,

[illegible]

[illegible]

[illegible] EST [illegible]/17/88

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REINTRODUCTION OF GREATER ONE-HORNED RHINOCEROS TO THE ROYAL BARDIA RESERVE, NEPAL: A PROPOSAL

A proposal submitted to the World Wildlife Fund-U.S. on

behalf of the King Mahendra Trust for Nature Conservation

and

His Majesty's Government of Nepal, Department of National Parks

and Wildlife Conservation Office

by

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START-UP DATE: September 1985

AMOUNT REQUESTED: $105,575

This project was originally going to be in Cooperation with the Frankfurt Zoological Society however, they are unable to provide funds. Therefore, it will be in cooperation with World Wildlife Fund and the Smithsonian Institution.

PROJECT SUMMARY

South Asia's rhinoceros populations are declining rapidly. At present only two reserves, one in Nepal (Chitwan) and one in India (Kaziranga), offer much hope for the future survival of rhinoceros. Sound management of this endangered species requires relocation of small populations from source areas to other well-protected reserves where rhinoceros once occurred. We propose to reintroduce 12 rhinoceros from Chitwan to the Bardia Reserve in western Nepal, a sanctuary which supported rhinoceros many years ago. Initial surveys of relocation sites have been completed and techniques for immobilization and transport have been worked out. This proposal follows on the heels of a successful relocation of four rhinoceros from Chitwan to Dudhwa National Park, Uttar Pradesh, which was carried out by staff of His Majesty's Government of Nepal and the King Mahendra Trust for Nature Conservation.

Statement of Problem and Rationale

Over the last few decades, wild populations of large herbivorous mammals in South Asia have been decimated. A case in point is the Greater One-horned Rhinoceros (Rhinoceros unicornis), a species which once ranged from the Brahmaputra River Valley to the Indus but now is restricted to two major reserves, one in India (Kaziranga) and another in Nepal (Chitwan). Poaching pressure and conversion of riverine grasslands to agriculture have reduced numbers of this endangered ungulate within several additional areas in Assam and Benghal. In 1982, 97 animals were poached in Kaziranga alone (Wildlife Institute of India, pers. comm.), or roughly 10% of the population removed in one year. The long-term future of rhinoceros in Kaziranga and in adjoining pocket reserves remains in doubt unless poaching is stopped.

In contrast to the gloomy statistics from Assam, conservationists are buoyed by population trends and protection measures observed in Chitwan. Down from approximately 108 individuals in 1969 (Caughley and Mishra 1968, considered an underestimate), the population had climbed to at least 275 by 1975, (Laurie 1978), and is currently thought to contain over 300 individuals (Mishra unpubl.). Of 35 adult females within our current rhinoceros survey area, only 3 are currently without calves (E. Dinerstein and H. Mishra, in prep.). Reasons for this welcome increase are obvious: since 1973, poaching has been stopped and grazing of domestic stock within the park severely reduced. Critical rhinoceros habitat has also been added to the park, thanks to timely financial support from the Frankfurt Zoological Society for park extensions.

Nevertheless, the conservation of rhinoceros in Nepal remains an unfinished story. Complete protection from poaching and domestic stock diseases cannot alter the fact that Nepal's entire rhinoceros population remains within the confines of Chitwan Valley. To spread the risk of catastrophe, wise management dictates the relocation of a small population of rhinoceros to other Terai reserves. The purpose of this proposal is to outline a relocation strategy to move 12 rhinoceros (6 males and 6 females between 3-6 years of age) from Chitwan to the Royal Bardia Reserve, an area which supported rhinoceros within recent history.

To consider such a move 10 years ago would have been premature. Now, however, many factors point to the timliness of such a venture. First, more is known about the overall ecology of Chitwan and its wildlife than for any other national park in South Asia. Chitwan has been the site of 7 Ph.D. dissertations including studies on rhinoceros (Laurie 1978), tiger (Sunquist 1981, Smith 1984) chital and other tiger prey species (Mishra 1982, Tamang 1982), hog deer (S. Dhungel in prep.) and gharial crocodile (T. Maskey in prep.), and an undergraduate thesis on sambar (Saxton 1984). Similarly, vegetation, plant phenology, diet and habitat selection by wild ungulates, and population ecology of ruminants in the Bardia Reserve have been studied in detail and published (Dinerstein 1979, 1980a, 1980b, in press).

While this latter study was being conducted, the Bardia Reserve was gazetted and afforded full protection from poaching and illegal grazing. Today, it stands as an example of how quickly wildlife populations in South Asia can not only recover, but flourish, if reserves are provided with adequate protection.

The basis for this proposal has evolved from 12 years of experience in immobilizing wild animals in Chitwan, (including 18 rhinoceros), and our current study of the population and foraging ecology of rhinoceros in the very same park. Recently, we participated in all aspects of the capture and relocation of four Chitwan rhinoceros to Dudhwa National Park, Uttar Pradesh. Lessons learned from these experiences have shaped the design of our relocation program. We envision four major phases in our relocation effort. In Phase 1 we will gather all existing information on rhinoceros ecology in Chitwan, determine which individuals are to be moved, and identify primary and secondary relocation sites in Chitwan. Phase II is concerned with the actual capture, transport, and reintroduction of rhinoceros to Bardia. Phase III includes a 2 year follow-up study to monitor the success of the reintroduction. If necessary, Phase IV will involve the reintroduction of additional animals from Chitwan. A more detailed account of each phase is provided below.

Phase 1: BASELINE STUDIES IN SOURCE POPULATION AND TARGET AREAS

Without adequate ecological data to guide managers, relocation of an endangered herbivore from one reserve to another leaves much to chance. Fortunately, studies on rhinoceros food habits, forage quality and availability, movements, home ranges, reproductive activity and population ecology in Chitwan already have been completed or are underway. Laurie's (1978) study in Chitwan demonstrated that the rhinoceros population could be estimated by photographing individuals and identifying them from unique combinations of horn shape, sex, cuts, scars, and epidermal knobs. He also provided descriptive data on food habits and food availability. Over the past year we have been continuing Laurie's work and extending rhinoceros research in new directions. Using Laurie's technique we have positively identified 100 rhinoceros in several study areas in Chitwan. By the end of 1985, we hope to have all of the rhinoceros using the park between Kagendra Mali and Kasara and around Tiger Tops Lodge identified (Figure 1). By October of 1985, we will have decided which individuals will be relocated to Bardia.

December of 1985 will mark the end of one year's study of the diet of Chitwan rhinoceros as determined by fecal analysis techniques. This study is being conducted by two Nepali graduate students as partial fulfillment for a Masters Degree at Tribhuvan University, Kathmandu. A product of the study will be a key to epidermal fragments of rhinoceros forage plants and a photographic atlas of the same. To address the question of to what extent are rhinoceros diets composed of agricultural crops versus natural forage, we have compared fecal samples collected from animals living at the park boundary with animals residing over 3 km from agriculture. Preliminary results from the winter season, when wheat, mustard, and lentils are cultivated, indicate

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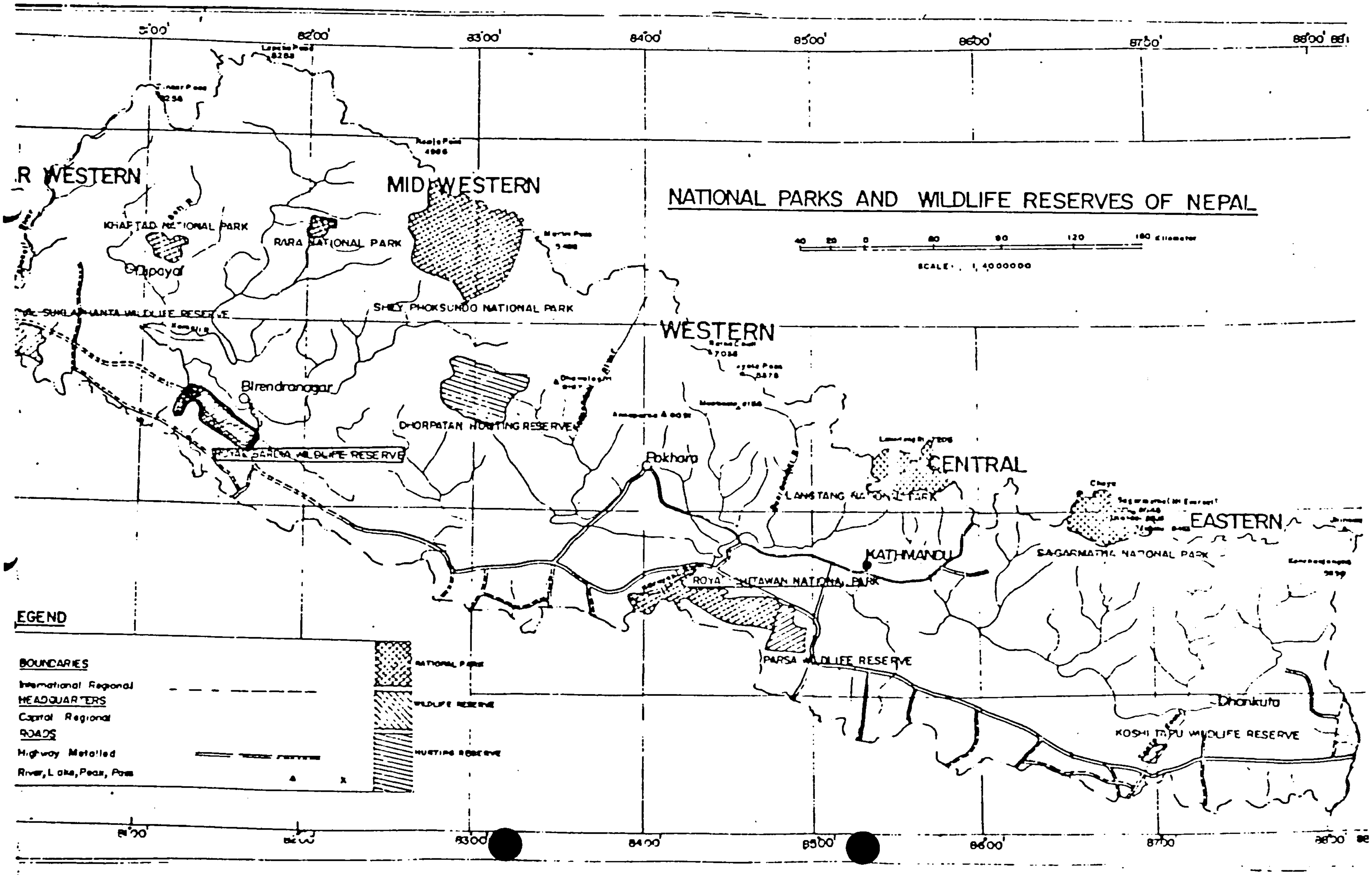

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MIDWESTERN
NATIONAL PARKS AND WILDLIFE RESERVES OF NEPAL
SCALE 1, 4000000
KHAPTAD NATIONAL PARK
RARA NATIONAL PARK
Dipayal
SHEY PHOKSUNDO NATIONAL PARK
WESTERN
Birendranagar
DHORPATAN HUNTING RESERVE
ROYAL BARDIA WILDLIFE RESERVE
Pokhara
CENTRAL
LANGTANG NATIONAL PARK
EASTERN
KATHMANDU
SAGARMATHA NATIONAL PARK
ROYAL CHITAWAN NATIONAL PARK
PARSA WILDLIFE RESERVE
Dhankuta
KOSHI TAPU WILDLIFE RESERVE
LEGEND
BOUNDARIES
International Regional
HEADQUARTERS
Capital Regional
ROADS
Highway Metalled
River, Lake, Peak, Pass
NATIONAL PARK
WILDLIFE RESERVE
HUNTING RESERVE

that the diets of rhinoceros residing in these two areas will be significantly different from one another. Those animals living close to the park border feed heavily on cultivated crops whereas the reverse is true for rhinoceros living more than 3 km from agriculture. These findings are of value in determining how close the proposed relocation site should be to agriculture and in assessing the impact of rhinoceros on crop losses.

The combined efforts of the Smithsonian biologists and the grassland/fire ecologist supported by the King Mahendra Trust for Nature Conservation (KMTNC) and the International Institute for Environment and Development (IIED), will document seasonal changes in the quality and availability of rhinoceros forage species in a variety of grassland and forest habitats. The goal of this effort is to model and predict the densities of rhinoceros within Chitwan in relation to the availability of key forage species. This same model, when tested in Chitwan, will be applied to areas in Bardia and other potential relocation sites to determine potential carrying capacity of these sites.

Other related work in Chitwan has been a study of the effects of seed dispersal and dunging behavior by rhinoceros on the regeneration of woody species in grassland, browsing behavior of rhinos and their effect on vegetation structure in riverine forest, and wallowing behavior (S/NTEP Newsletter issues, 1 and 2, 1984, 1985).

As part of our study in Chitwan, we intend to radio-collar about 30 individuals. To date, 4 individuals, all males, have been fitted with collars. The rhinoceros are located twice each day, and are tracked continuously over 24 hr intervals twice each month. Useful information on movements and home range have already been collected. Moreover, the telemetry study allows the staff to refine skills in immobilizing, measuring, and tracking rhinoceros. The data collected in Chitwan and the experience gained in immobilization are vital to the success of the relocation effort.

The Relocation Site: Why Bardia?

Chitwan National Park (980 km^2) and the Royal Bardia Reserve (348 km^2) are the two largest sanctuaries in the Nepalese Terai (Figure 1). Within recent history, rhinoceros occurred in Bardia but the exact date of extirpation remains unknown. From the perspective of a rhinoceros, Bardia should appear quite similar to Chitwan. All of the major forage species in Chitwan are present in Bardia, especially in flood plain grasslands (Dinerstein 1975, 1979) (see Table 1). One habitat in particular, Khair-Sissoo forest (Acacia catechu and Dalbergia sissoo), a successional riverine forest type, is common to both sites and in Chitwan, supports high densities of rhinoceros. Both reserves are dominated by sal (Shorea robusta) forest, a vegetation type underutilized by rhinos in proportion to its availability.

The primary relocation sites in Bardia, Baghora Phanta and Khoraha Phanta (Phanta meaning grassland), are bordered by a small permanent stream, the Khoraha River, that should serve as an adequate wallow site for the relocated animals (see map in

Addendum 1, page 133). In many ways, the Khoraha River resembles the Dungre and Itcharni Rivers which are frequently used by rhinoceros as wallow sites and feeding areas for aquatic species such as *Paspalum distichum*, *Potamogeton*, and other plants. However, additional wallow sites will be dug in riverine forests near the relocation site.

As part of the relocation plan, Dinerstein returned to Bardia in February 1985 to survey grassland types and potential relocation sites. We were particularly interested in the extent and accessibility of *Saccharum spontaneum* (Kans- in Nepali) grasslands within or near such sites. *Saccharum spontaneum*, a grass that colonizes flood plains, constitutes a major part of rhino diets in Chitwan, as determined by fecal analysis (S. Jnawali and E. Dinerstein, pers. obs.). *Saccharum spontaneum* grasslands were found to be common in Bardia, primarily along the banks of the Karnali River, and should support a healthy population of rhinoceros. More detailed information on the climate, vegetation of Bardia, modifying factors, and successional relationships are provided in Addendum I.

To summarize, much of the ecological data required to develop a successful relocation plan have already been collected. One missing ingredient is high resolution, aerial photographs of the reintroduction site and of Chitwan. Aerial photos do exist for both sites, but they are at least 7 years old. During this interval major monsoon floods have occurred in both Bardia (1983) and Chitwan (1984). The recent flood in Chitwan demonstrated that conservationists' fears of high mortality of rhinoceros during a major deluge are unfounded. In the wake of the worst flood in 30 years only two rhinoceros died. More important to rhinoceros conservation, however, are interpreting the effects of changes in river courses and the deposition of silt on the flood plain. These dynamics determine productivity and size of *Saccharum spontaneum* grasslands (see Addendum I, page 149). Changes between 1978 and 1985 can only be evaluated accurately with aerial photography. Survey flights will be completed before the relocation program begins. The National Aeronautical and Space Administration has been approached to obtain photographs via the space shuttle of both Chitwan and Bardia.

Table 1. Rhino forage plants common to Chitwan and Bardia. Forage plants were identified using fecal analysis techniques and from direct observations.

Browse species:

Callicarpa macrophylla
Murraya koenigii
Cassia tora
Mallotus philippinensis
Pogostemon plectranthoides
Litsea monopetala
Dalbergia sissoo
Acacia catechu
Bridelia stipularia

Forbs:
Polygonum spp.
Cirsium spp.

Graminoids:
Saccharum spontaneum
Saccharum benghalensis
Narenga porphyracorma
Phragmitis karka
Apluda mutica
Vetiveria zyzanoides
Typha elephantina
Cyperus spp.
Arundo donax
Cymbopogon sp.

Aquatics:
Marsilia tetraphylla
Potamogeton sp.

(Source of information from notes of E. Dinerstein and S. R. Jnawali)

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Phase 2: CAPTURE AND TRANSPORT

Researchers from the Nepal Terai Ecology Project and His Majesty's Government of Nepal (HMG) counterparts have, over the last 7 years, routinely captured rhinoceros for transport to zoos. During March 1985, the same people assisted Wildlife officials from the Food and Agriculture Organization (FAO) and the Government of India in the identification, capture, immobilization, and transport of four subadult female rhinoceros to Dudhwa National Park, Uttar Pradesh, Northern India. This recent effort served as a "dry run" for project personnel. It proved a valuable exercise in that a number of logistical problems were encountered and solved expeditiously by Nepali staff. For example, the skill of the HMG and the Terai Ecology Project elephant drivers in "escorting" selected rhinos over several kilometers to enable staff to immobilize the animal next to the shipping crate and crane amazed visiting wildlife officials.

Immobilization techniques for rhinoceros will follow the procedures developed in Chitwan. Over 25 rhinoceros have been immobilized to date by HMG/Smithsonian Institution staff without a single mortality. During the Dudhwa relocation project we held extensive discussions on ways to improve crate design and shipping techniques. Suggestions which evolved from these informal meetings have been incorporated in subsequent crate designs.

At present, we favor flying the crated animals from Chitwan to Bardia to reduce transit times and subsequent stress on the animals. The drive between Chitwan and Bardia takes roughly 10 hours (six hours on a paved road and 3-4 on a dirt track) whereas an airplane flight would require a mere half hour. Usable airstrips exist at Bagmara and Meghauli in Chitwan, two areas from which we plan to capture rhinoceros. Moreover, an airstrip could easily be installed in the area near Shiupur village close to reserve headquarters. In this manner it would be unnecessary to negotiate the rental of a crane to lift the animals from the truck to the stockade.

Nepali wildlife officials have some experience in taming and raising rhinoceros calves. During the Dudhwa operation, the Bardia Wildlife Warden travelled to the Dudhwa relocation site to observe stockade construction, captive management, and release of the animals. For this end of the project, we will follow guidlines and procedures devised in Dudhwa.

Phase 3: FOLLOW-UP STUDY ON REINTRODUCED POPULATION

Much is at stake in the reintroduction of an endangered animal. The probability of successful relocation of herbivores should however, be a simpler task than for an endangered carnivore. Nonetheless, dropping off the animals in Bardia and considering the project a success is not only poor management but also poor science. For these reasons all relocated animals will be fitted with radio-collars and a Nepalese research assistant will be recruited to monitor movements, activity patterns, habitat and diet selection, and behavior for two years after the initial release. The proposed research will partially fulfill the requirements for a Masters' degree for the Nepalese research assistant. Funding is being sought through a memorandum of understanding between the World Bank and HMG.

It is our plan to recruit such an individual prior to the relocation effort so that he/she is involved in all phases of the project. The individual selected will be trained thoroughly in telemetry techniques by Terai Ecology Project staff.

The Bardia reserve is gridded with an excellent road network that will simplify obtaining compass bearings from known reference points. All location data will be plotted on the project IBM-PC and with the use of a digitizer and a home range program, the movements of the animal and habitat selection will be documented.

Part of this effort will also include chemical analyses of several important rhino forage plants. These data will help explain why rhinoceros move between habitats and enter cultivated lands at different seasons of the year. Such data on forage quality when combined with additional information on forage production are essential for determining the potential carrying capacity of rhinos in Bardia and whether and where subsequent relocations should take place.

Progress reports will be submitted semi-annually to the World Wildlife Fund.

Benefits to human inhabitants of Bardia and Chitwan

Local villagers might view the reintroduction of a large, potentially dangerous crop raider with some alarm. At present villagers who reside along the southern border of the reserve complain about crop losses attributed to wild boar, elephant, nilgai, chital, monkeys, and peacock. To alleviate their fears and simultaneously reduce crop damage from other wild animals, we favor the construction of a solar-powered electric fence along the border with agriculture. These fences have proved quite successful in East African and some Indian parks (including Dudhwa) where large mammals periodically enter crop lands. These fences require little cost and low maintenance. Fence construction would undoubtedly increase crop yields around the park and improve relations with local villagers. Where appropriate, small tree nurseries and fuelwood plantations could be incorporated into the fencing design, addressing another need of local inhabitants.

We have also requested funding to fence a 25 km area around Sauraha in Chitwan National Park for similar reasons. This area supports the highest density of rhinos in Chitwan and is also under severe pressure from villagers who collect firewood, graze cattle, and cut grass illegally within the park.

Phase 4: EVALUATION OF INITIAL RELOCATION PROGRAM

At the conclusion of the follow-up study, we will evaluate the success of the reintroduction program. Within this period, it is hoped that all relocated animals will have become established and several females about ready to conceive. If deemed appropriate we will attempt a second relocation effort to Bardia and possibly the Sukla Phanta reserve, 100 km west of Bardia.

PROJECT PARTICIPANTS AND RESPONSIBILITIES

The success of a relocation effort of this scope hinges upon each participant understanding the goals of the project and their assigned duties. Individuals involved in the proposed relocation program and their roles in the project are outlined below.

Dr. Hemanta Mishra- Project Co-ordinator.
Duties: In charge of overall project, delegating authority to other individuals as deemed necessary

Dr. Sundar Shrestha - Project Veterinarian
Duties: Assist in immobilization efforts, care of animals prior to transport

Dr. Eric Dinerstein- Technical adviser
Duties: Identify (ie. sex and age) all individuals to be moved prior to beginning of relocation program. Survey of rhino reintroduction sites in Bardia. Advise Nepali research assistant on follow-up study.

Dr. Bruce Bunting - Assistant veterinarian
Duties: Assist in handling and care of captured rhinoceros.

Khuber Gurung- Senior Mechanic/Technician
Duties: In charge of logistics, transport of animals

Ram Prit Yadav: Senior Warden, Chitwan National Park
Duties: Co-ordinating officer in Chitwan operation

Krishna Man Shrestha: Senior Warden, Royal Bardia Reserve
Duties: In charge of Bardia relocation

Ram Lotan Subbha: In charge of elephants for capture operations

Man Bahadur Lama: In charge of game trackers

Nepalese Research Assistant: In charge of follow-up study of relocated animals in Bardia

TIMETABLE:

September 15. Begin planning phase.
October 15. Schedule flights for aerial surveys of Bardia and Chitwan.
Decide upon individuals to be moved to Bardia

Construct shipping crates, and stockades in Bardia.
Arrange for crane rental.
Assemble solar powered electric fence

Late November through February. Complete relocation of 12 animals
Begin follow up study in Bardia

November 1987. Evaluation of reintroduction.

BUDGET:

	Cost in US dollars
Aerial surveys (map production, graphics)	23000
Airstrip construction in Bardia and improvement in Bagmara	7000
Equipment:	
drugs	500
immobilization equipment	650
15 radio collars @ 225 each	3375
2 receivers @ 1500 each	3000
generator, battery charger	1200
antennas	300
compasses, other tracking paraphernalia	300
data processing equipment	2300
2 solar energizers @350 each	700
fencing equipment for 22 km in Bardia @ $300/km	6600
fencing equipment for 25 km in Chitwan	7000
crate construction at $460/crate, 12 crates	5500
diesel/gasoline (Chitwan)	2000
diesel/gasoline (Bardia)	2000
stockade construction: 12 stockades at @ 1000 each	12000
Crane rental 30 days at $250/day	7500
Truck rental (if planes are unavailable)	
4 trucks at $50/day for 30 days	6000
tractor rental	
4 tractors at $40/day for 30 days	4800
Sledges: 4 at $150 each	600
Hired labor:60 people at $2/day for 30 days includes workers at Bardia and Chitwan	3600
Miscellaneous (tools, ropes, cables, tires)	5000
Publication of reports, photographs	1000
Total	105,575

Note: This budget does not include airplane and/or helicopter expenditures. A proposal to cover these expenses is under consideration by the U.S. government.

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ANNAPURNA NATIONAL PARK: THE NEPAL PLAN FOR JOINING HUMAN VALUES AND CONSERVATION OF A MOUNTAIN ECOSYSTEM

By

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and

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ABSTRACT

The paper briefly describes the local context of the Annapurna area: its geological, natural, and human ecology. The Nepal Plan for conservation of the Annapurna area is presented. The unique proposal for the park to be managed under the King Mahendra Trust for Nature Conservation is introduced. The proposed management zones of the park are discussed together with some of the issues to be analyzed in the future management plan for the park. The concept for the Nepal Plan is to have the Annapurna National Park demonstrate how a nationally established, but privately managed park can serve as a catalyst for socio-economic development and increased environmental awareness in nearby communities and the nation as a whole.

1. The Annapurna Area

The Annapurna area is well-known internationally and in Nepal for its beautiful mountains and unique ecology. The area is bounded to the north by the dry alpine deserts of Dolpo and Mustang, to the west by the Dhaulapiri Himal, to the east by the Marsyandi Valley and to the south by valleys and foothills surrounding Pokhara. The southern slopes of this area receive some of the heaviest rainfall in Nepal (over 5000 mm per year) which has created a unique ecology different from other regions of the Himalayas. This area supports mountain laurels (Lauraceae), lush Rhododendron forest (R. arboreum, R. barbatum, R. campanulatum), bamboo jungle (Dendrocalamus spp., Arundinaria spp., Bambusa spp.), diverse orchid flora (Orchidaceae), and a rich variety of birds and mammals including Himalayan Monal pheasant, Danfe - the national bird of Nepal (Lophophorus impeyanus), Himalayan tahr (Hemitragus jemlahicus), barking deer (Muntiacus muntjak), serow (Capricornis sumatraensis), ghoral (Nemornhaedus phoral), Himalayan bear (Selenarctos thibetanus), musk deer (Moshus chrysoaster), blue sheep (Pseudois nayaur), red panda (Ailurus fulgens) and snow leopard (Panthera uncia). In direct contrast to the southern slopes the northern slopes of the Annapurna area are mostly dry grassland steppe due to the rain shadow created by these majestic peaks. Here blue sheep and snow leopard can be found and possibly the rare Great Tibetan sheep (Ovis ammon hodgsoni).

The geology of the region exemplifies the uniqueness of the Annapurna Himal. Twenty-five million years ago India and Asia were separated by the Tethys Sea. The sea was transformed into land by the collision of these two land masses or plates, resulting in the formation of the Himalayas. One of the rivers that drained the ancient Tethys Sea, the Kali Gandaki, was able to erode the mountains as fast as they arose, creating the world's deepest gorge, well over 6000 vertical metres below the peaks of Annapurna and Dhaulagiri. The Kali Gandaki, therefore, predates the mountains through which it flow. Today signs of this ancient sea are seen in the small black stones collected by people of the region which are fossil ammonites dating from over 100 million years ago.

2. The Nepal Plan (1)

"The Nepal Plan" summarizes a series of concepts and approaches developed in Nepal to provide protection for the mix of human and natural systems of this area. The plan was inspired by the Tourism Master Plan of 1972, the work and writings of Karna Sakya, the King Mahendra Trust for Nature Conservation, the Department of National Parks and Wildlife Conservation, the Department of Forests and other agencies and of HMG along with other individuals such as John Blower of FAO and Lt. Col. (Jimmy) Roberts and Hermanta Mishra. The Annapurna National Park would be a multi-use park, incorporating recreation and tourism along with forestry, agricultural and the needs of local people who will be participants in managing the park and the resources it protects. The park complex will also incorporate a wildlife refuge.

Creation and management of national parks has traditionally been the province of government agencies. However, the role of private organizations represents a parallel and growing segment of the world's protected areas. Unencumbered by legislation, private institutions have the advantage of being able to innovate with new approaches to management and local participation (2). For example, a private agency has the ability to apply funds generated by a reserve into development of the area to establish self-sufficiency. In contrast a government agency must deposit funds in the central treasury discouraging entrepreneural local management. On the other hand, private agencies cannot match the security of government creation and are potentially subject to government's power of eminent domain. For this reason, IUCN insists that to qualify for the UN List of National Parks and Equivalent Reserves the "highest competent authority in the country" must be involved in establishing the park designation (3).

The Nepal Plan seeks to join the benefits of both institutions. (The legal structure of private management referred to in this paper must still be subjected to legal analysis and comment). As with other parks in the kingdom, Annapurna National Park would meet the international park standards for the government would sanction trust management and ensure its security. It is proposed that actual management of the complex be the responsibility of the King Mahendra Trust for Nature Conservation which was legally established in 1982 under KMTNC Act 2039. Despite increasing interest in private approaches to conservation, no such organization has undertaken responsibility for an area of such global importance as Annapurna. Although recently created the King Mahendra Trust seems well qualified for the task.

3. Zoning and Management Issues

How can the King Mahendra Trust protect the area's natural and cultural resources, allow continued local use of the natural resources, incorporate recreational use of the same resources and protect these resources for Nepal's future generations? This is the essence of the challenge which the Nepal Plan seeks to meet. Once a commitment has been made toward the establishment of the Annapurna National Park there major tasks must be addressed: research and production of a management plan; physical construction of park facilities and training of personnel.

As Jim Thorsell, Executive Officer of the IUCN Commission on National Parks and Protected Areas, has pointed out, one of the most essential steps in park establishment is preparation of a management plan (4). In a number of Latin American and Caribbean countries, rather than beginning with a full fledged management plan, a more preliminary "Operational Plan" or interim guidelines serve as a practical guide during the first few years (5). Given the unique integration of uses and the private initiative of the Trust, such a preliminary planning approach has much to recommend it.

An excellent point of departure for management planning are the objectives identified by Karna Sakya in his proposal of December 1982 on "Annapurna National Recreational Area or Rashtriya Prakritik Manoranjan Sthall" (6) which are:

"a) To ensure the sustainable utilization of species and ecosystems such as forests, wildlife and fish, and to yield the greatest sustainable benefit to the present generation, while maintaining its potential to meet the needs and aspirations of the future generations (WCS).

b) To exploit the optimal tourism potential and improve recreational facilities in order to open a new chapter of resort tourism, which enriches our foreign exchange receipts strengthens the balance of payments and increases government revenue.

c) To preserve the ethnological and cultural heritage of the region, so that it would remain as a reminder to future generations of the historical achievements of their forefathers, which they left in trust for them.

d) To help the local economy and to develop tourism ancillary industries such as farms, orchards, poultry and handicrafts".

Noting that rainfall in this area is perhaps the highest in the whole Kingdom, Karna Sakya identifies the additional objective of prevention of deforestation to avoid downstream flooding and erosion.

Management objectives should also be established for the "zone of influence", the areas and communities which exert direct impact on the park and vice versa. As a private agency it may actually be easier for the Trust to be involved in human development and public participation in the surrounding region than other agencies or HMG.

In developing the plan for the park it is important to start small with financial resources and personnel capable of being maintained from resources generated within the park. A key to local acceptance is selection and training of locals to manage the area (while retaining awareness of the pressure which can be exerted upon local guards for special favours to friends and relatives). The Trust, based in Kathmandu, must recognize the desirability of implementing action as close to the resource as possible. Like the Department of National Parks and Wildlife Conservation, the Trust must balance the value of local decision making and responsiveness to local priorities against its own need for central control and national perspective -- this will be especially difficult with the Trust's first major project.

Based on preliminary resource analysis, in the Nepal plan the national park complex is divided into six management zones.

The Protection Zone is centred on the Annapurna massif but extends at least to the peak of Dhaulagiri including the Kali Gandaki River (a major migratory route for birds moving between Tibet and India) to the west and the Marsyandi River Valley on the east. The Annapurna sanctuary located approximately in the centre of the park in a high alpine amphitheatre surrounded by seven mountaineering peaks over 6,700 m, and four trekking peaks under 6,000 m. Ecosystems of the park range from subtropical sāl forest to high alpine shrub and tundra and include bamboo forest, birch forest and a large expanse of rhododendron forest.

Even absent other management zones the core of the Annapurna National park alone meets international criteria for a national park including a unique mix of ecosystems mostly unaltered by human exploitation. Exploitation and occupation will not be permitted in this zone and visitor entrance will be managed.

The key to the Nepal Plan is to buffer the protected core with sustainable human use in the zone of influence. Ringing the Annapurna massif, the recreational zone will be actively developed for tourism. Tourist facilities may include licensed tea houses and lodges (the Trust could provide training for locals owning and managing such facilities) as well as camping in specified locales. Bringing the existing somewhat chaotic situation under control with minimum resentment and loss of local revenue will require sensitivity. Check points for trekking and park entry permits and fuel supply for trekkers will be essential.

The effective management of this zone poses a major challenge for the Trust: to address the recreational use while preserving the fragile mountain environment will be no small task, to do so in a fashion responsive to local cultural needs (themselves in a state of flux) will be especially daunting. It is important to be aware that priorities among different segments of local communities are not the same and care must be taken to make the park planning a consensus building, rather than divisive, process.

Tourism is Nepal's main source of foreign exchange and the only source of cash in isolated mountain regions. The Annapurna region already is internationally renowned attracting 21,119 trekkers in 1983 (in contrast to Sagarmatha National Park (Everest's) 6,732 (7). The social and ecological ripples from these visitors are considerable and can be summarized as follows:

-- The environmental impact of trekking can be disproportionate to tourist numbers as a result of the support staff of guides and porters. The ratio is commonly 2-1 for organized mountain groups, 0.5 for middle class independent trekkers to none for the low budget trekkers. On the other hand, economic contributions to the society as a whole is the reverse. The maximum local benefit is derived from the independent middle class trekkers because organized treks primarily expend funds in Kathmandu or in Pokhara.

-- Trekking tends to be concentrated both seasonally and physically. An early priority for the Trust must be research on existing trekking -- what activities are taking place, duration of stay, mapping of tourist movements, analysis of fuelwood purchase and impact upon local society. Wherever possible such baseline information should use Nepali individuals or institutions. Trekking, even at existing levels, may be exceeding the carrying capacity of the Annapurna area. The research plan should seek means to increase the economic contribution of visitors at current levels rather than simply increasing their numbers.

-- Fuelwood consumption can result in deforestation, soil destabilization, erosion, landslides and downstream flooding. Tourist generated fuelwood demand is growing rapidly. A typical climbing expedition in Sagarmatha, for example, lasts two months and requires four loads of wood per day for a total of 8,000 kg of firewood. In contrast, a sherpa hearth burns 5,000 kg of wood per year. One solution mandated by the National Parks and Wildlife Conservation department in 1980 required trekkers to carry kerosene sufficient for the duration of their stay. The appropriateness of a similar approach must be analyzed by the Trust: can the ban be enforced on small trekking groups; how does one replace income loss to local populations? Even if a fuelwood ban caused increased use of those inns which did not rely themselves on wood, such owners represent a different segment of society than those who cut wood for sale to survive. There is reason to believe that the Annapurna park complex may be capable of meeting both visitor and local fuelwood use on a sustainable basis.

-- More difficult to address than the direct fuelwood needs of trekkers are the secondary environmental and social impacts caused by growing recreational use and the resulting disruptions on the local economy. The ripples of impact are as follows: recreational use converts fuelwood into a cash crop leading to a change in local life style and an increased desire for high cost food which in turn leads to increased cutting as one of the only local sources of cash; the increased wealth leads to larger houses and hotels requiring more wood for cooking and heating; the wealth is also converted into larger herds of yak (and sometimes nontraditional species like sheep and goats) which increases overgrazing; in addition to larger herds, more residents have small herds and as youth move into trekking rather than herding, the stock is less well dispersed leading to local overgrazing; the increased demand for dairy products by trekkers and thereafter locals, causes concentration of herds near villages also resulting in overgrazing; finally as a result of tourist demand and high levels of consumption inflation becomes a new element with which the local culture must contend with almost no appropriate tools (8).

-- Development of park infrastructure such as trekking lodges, provides an opportunity to demonstrate alternative sources of energy to the local population and to educate visitors to natural and cultural issues. One issue the Trust must address is local vs Trust operations of such facilities -- the former generating local benefit, the latter maximizing educational/interpretative values. The ideal is probably a mix. Similarly the park may provide local employment but must seek to avoid employment which is primarily for menial tasks.

-- Unlike Royal Chitwan national Park where park revenue from tourism constitutes less than 25% of the government financial inputs, the objective in Annapurna is for the budget of the park to be subsidized by tourism within a very short period (9). With the existing tourist base and effective local involvement in management and protection such a goal seems attainable. This is especially the case if increased revenues can be generated by a switch from adventure to holiday or resort tourism.

-- Although a formal agricultural zone is not proposed, areas for intensive agriculture should be encouraged within the recreational zone to expand local support and income generated from tourism. Provision of effective agricultural extension service by the Trust is an opportunity to integrate the park into the surrounding communities through provision of concrete benefits.

Near the heart of the Annapurna Sanctuary is an important opportunity to establish a research zone for scientists focussing on study of mountain ecosystems and to monitor the dynamic systems of the Nepal plan. Rehabilitation of the facility at Kuldi Ghar could provide a base for study of the park's diverse ecosystems and the impact in the nearby community forest and seasonal grazing zones. In a very real sense the research zone and adjacent areas add a biosphere reserve in the heart of the national park complex.

The Nepal Plan recognizes the existence within the park of several seasonal grazing zones. In a region of such limited land resources and where yak or yak/cattle cross breeds are important symbols of wealth, the challenge is to ensure that grazing use is sustainable, not eliminated.

Traditionally the timing of seasonal migration of livestock from higher to lower elevation in response to available pasture was coordinated by elected village guardians. If a grazing management system is established it must be aware of such traditional regulating mechanisms. On the other hand, if the traditional approach is incorporated by the Trust to control management decisions it must be able to adapt to changes in ownership structure and mix of species caused by the new tourist induced cash economy mentioned previously. Given the fundamental role of grazing in the local society, meaningful participation in designing a compatible grazing system could be the single most important objective of the Trust if its new park paradigm is to succeed.

Although sport hunting is generally not considered a compatible use in a national park controlled hunting by local people as well as citizens of Nepal and other countries would be allowed in an adjacent wildlife reserve. Such a reserve could be established in the area known as the Pipar Pheasant Reserve, a high forest and alpine area on the flanks of Machapuchare peak containing at least five of the six known Himalayan species of pheasant together with another 140 species of birds.

The Community Forestry Zone represents existing or reforestation areas set aside under local control primarily for use as fuelwood. Tourist demand for fuelwood is a serious and immediate issue and is likely to be accelerated by establishment of the park. Such demand competes with traditional uses for construction, shakes, litter for latrines and animal bedding, medicinal and ritual herbs, fuel for ceremonies and cremations as well as the major local needs for cooking and heating. Not only must the tourism demand be met, it cannot be allowed to drive fuelwood prices beyond local means.

At Sagarmatha, New Zealand established two nurseries for reforestation with pine and fir seedlings primarily to provide local employment and environmental education. In that case park regulations prohibited introduction of fast growing exotic species as would probably also be true at Annapurna, but this should be studied. Coupled with reforestation must be a strategy to protect seedlings from browsing by livestock, especially goats and sheep. The tempting solution by purchase of these animals must be carefully considered as the owners are often the poorest in an already poor part of the country.

When considering alternatives to effective forest management, the Trust should include an attempt to reintroduce the shinganaua, the indigenous village firewood resource management committees which were discontinued after the forests were nationalized in 1957. However, such a reintroduction will not itself be easy; the Trust, based in Kathmandu, is likely to be seen as distant as the government whose nationalization of the forest led to their demise in the first instance. In addition, we should not be naive in application of traditional forms, as the shinganaua would be asked to regulate a different world, one heavily stressed by the influx of tourists and cash competing with local needs. The social organization of any community forestry projects will have to balance income expectations of different segments of local society and the needs of the Trust to obtain self-sufficient management.

Three other issues must be addressed: training, alternate technology and architectural compatibility of any new construction.

First is the use of local style of construction which takes advantage of existing experience on climate stability, availability of local materials, limited available skilled labour and avoids transportation problems. The goal is an infrastructure which can be maintained with local human skill and financial resources. All travel and trekking to the Park will start in

Pokhara, 30 km south of the sanctuary and the termination of the road making it ideal to introduce concepts of cultural and natural conservation to trekkers. Proponents of the park generally agree, however, that the park headquarters is best located at the village of Ghandrung.

Second is training. With a growing system of parks, exchange of personnel and training with other parks in Nepal is an increasing option. In Sagarmatha, local sherpas were sent for training to New Zealand with considerable success and the Trust should seriously consider these international opportunities. The Trust's goal should be to have management in local hands at the earliest practical moment. It has also been pointed out that in the absence of large mammals such as are found in Chitwan, it should not be necessary to have a large army or police force associated with the park. This in turn substantially lessens management expenses and increases prospects for self-sufficiency.

Third is the question of alternate technology, especially to meet the pressing fuelwood problem. The first objective must be to address the problem if possible through sustainable use of existing resources before resorting to, or becoming enamoured by, more exotic technological alternatives.

The fuelwood issue is not simple and ill considered efforts can cost time, money and valuable local credibility (10). Attempts to improve use or efficiency of existing techniques may not be a good strategy. At least in Sagarmatha, sherpas already use wood rather sparingly. Restraints of time, inconvenience, difficulty in cooking large amounts of food and local resistance to food cooked out of doors all made solar cooking an inappropriate alternative. Solar waterheating, however, did have a role for houses using large quantities of hot water, especially for those who have to pay cash for fuelwood. This was not the case for the poorest who collect wood themselves. More popular than solar for water heating was an auxiliary heater built into a traditional hearth. Finally in isolated locales where labour costs are low mini/micro hydro schemes can compete with large hydro schemes when the latter could not take advantage of economies of scale. These may be particularly appropriate for lighting and cooking in tourist lodges. An important element the operational plan will be a realistic match of needs, alternate technology, and traditional techniques.

4. Conclusion

The Annapurna region contains a unique mix of human and natural values. The directive of His Majesty's Government (HMG) to conserve and develop the Annapurna Himal (11) has inspired those concerned with conservation in Nepal to formulate an approach as unique as the resources they seek to preserve. Led by the King Mahendra Trust, public and private institutions will join hands to meet the needs of man and nature in the Annapurna National Park.

Footnotes

1. The authors bear the sole responsibility for any errors resulting from the consolidation of the idea of others. The plan is put forward not as a final statement but as a means to encourage the establishment of this important park and to focus discussion on the creative management ideas of the Trust -- a potential model for third world park development.

2. Bradley Cross. 1983. Private Ecodevelopment Centers: an Approach Toward Sustainable Development.

3. IUCN Commission on National Parks and Protected Areas. 1978. Categories, Objectives and Criteria for Protected Areas.

4. J. Thorsell. "Management Planning in the Hindukush-Himalaya Region" (this volume).

5. J. Barborak, C. MacFarland and R. Morales. 1982. "The Operational Plan: a Useful Tool for Improving Management of Protected Wildlands", unpub. paper presented at the World National Parks Congress, Bali, Indonesia. 11-22 October 1982.

6. Karna Sakya. 1982. Annapurna National Recreational Area or Rashtriya Prakritik Mancranjan Sthall: a proposal.

7. Unless otherwise indicated information on Sagarmatha National Park is summarized from the following sources: Bruce E. Jefferies, "Sagarmatha National Park: The Impact of Tourism in the Himalayas" Ambio Vol. XI, No. 5, 1982, p. 274-281; B.E. Jefferies, "The Sherpas of Sagarmatha: The Effects of a National Park on the Local People", J. McNeely and K. Miller (eds.) see note 1, page 473-477; B.A. Coburn "Sagarmatha: Managing a Himalayan World Heritage Site" PARKS Vol. 9, No. 2, July, August,

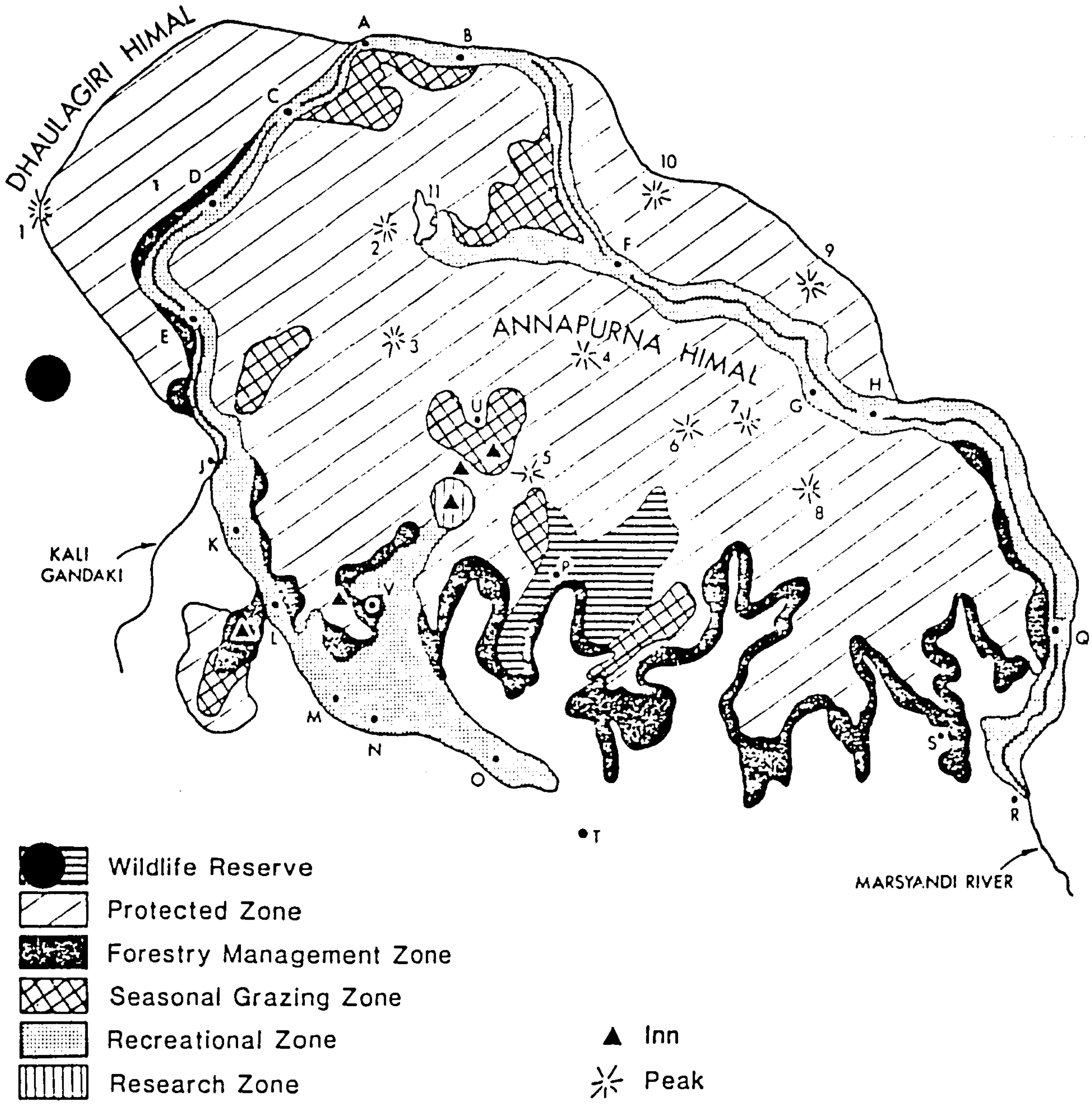
8. This is not to imply that tourism alone is the problem. While the scale is greater, tourism is not the first source of cash in those mountain societies. Instead tourism substitutes for revenue lost when north/south trade in salt and wool ended with the closure of the border with Tibet in 1959.

9. B.W. Bunting. (Unpubl.) Annapurna National Park Concept paper.

10. B. Coburn. 1982. "Alternate Energy Sources for Sagarmatha National Park" PARKS Vol. 7, No. 1, page 16-18, April, May, June.

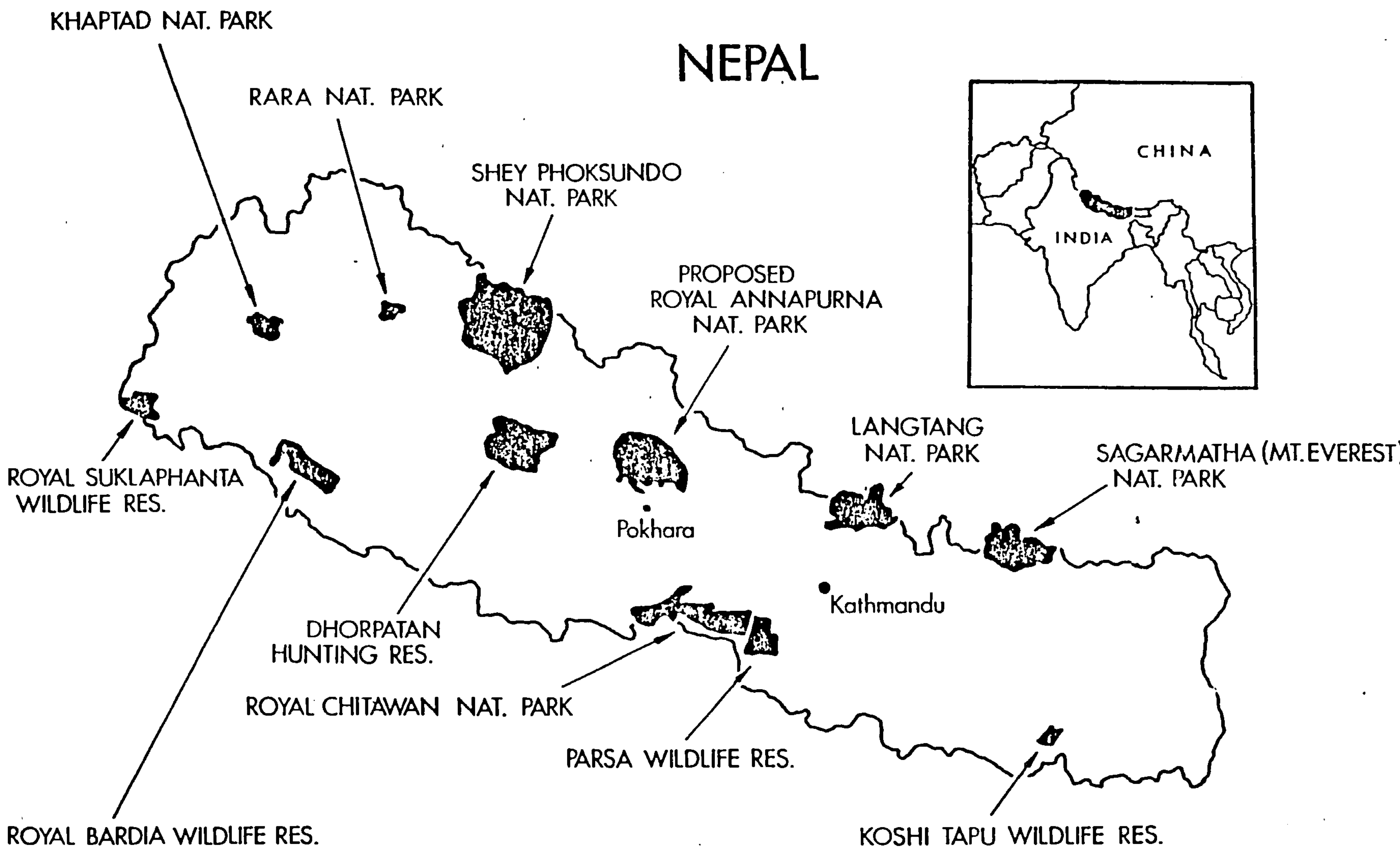
11. "Royal Guidelines, Directives, HMG Takes Number of Decisions" The Rising Nepal, Feb. 13, 1985, page 1.

PROPOSED ROYAL ANNAPURNA NATIONAL PARK



KEY:

A	Kagbeni	L	Ghorapani	1	Dhaulagiri
B	Muktinath	M	Birethante	2	Tilicho Peak
C	Jomsom	N	Chandrakot	3	Annap. I
D	Tukche	O	Naudanda	4	Annap. IV
E	Ghasa	P	Machhapuchhare Base Camp	5	Machhapuchhare
F	Manang	Q	Syangi	6	Annap. III
G	Bardang	R	Lamjung	7	Annap. II
H	Chame	S	Ghandokhara	8	Lamjung
J	Tatopani	T	Pokhara	9	Pisang Peak
K	Sikha	U	Annapurna Base Camp	10	Chulu
		V	Gandrung	11	Tilicho Lake



NEPAL
KHAPTAD NAT. PARK
RARA NAT. PARK
SHEY PHOKSUNDO NAT. PARK
PROPOSED ROYAL ANNAPURNA NAT. PARK
LANGTANG NAT. PARK
SAGARMATHA (MT. EVEREST) NAT. PARK
ROYAL SUKLAPHANTA WILDLIFE RES.
DHORPATAN HUNTING RES.
Pokhara
Kathmandu
ROYAL CHITAWAN NAT. PARK
PARSA WILDLIFE RES.
ROYAL BARDIA WILDLIFE RES.
KOSHI TAPU WILDLIFE RES.
CHINA
INDIA

COVER SHEET

1. Title: Annapurna National Park, Nepal
   Feasibility study of protected status and community involvement

2. Applicant: King Mahendra Trust for Nature Conservation (KMTNC) Broughton Coburn, Mingma Norbu Sherpa, Chandra Prasad Gurung

3. Institutional Endorsement:
   Dept. of National Parks and Wildlife Conservation UK Committee for Nepal

4. Project period: June 15-Dec 31, 1985

5. Total Budget: $19,100

6. Amount requested from WWF-U.S.: $19,100

7. Support from other sources:
   Telephone, telex and other logistical support provided by KMTNC baseline materials to be assembled from a wide variety of cooperating institutions and individuals.

8. Anticipated Future Requests:
   Based upon the study results, a major joint park project in the Annapurna is anticipated as the flagship project of the WWF-KMTNC relationship.

9. Abstract: (next page)

10. Previous WWF-US support: None

11. Staff recommendation:

12. Expiration date: Feb 1, 1986

13. Staff project officers: Bruce Bunting
    Michael Wright

9. Abstract:

The Kingdom of Nepal is situated among the world's highest mountain peaks, the Himalayas, and between two major zoogeographic realms, the Paleartic and Oriental. The uniqueness of Nepal is exemplified in its varied biogeography ranging from subtropical forests of Royal Chitwan National Park to the stark beauty of Sagarmatha National Park containing Mt. Everest, the earth's highest point. Six national parks, four wildlife reserves and two hunting reserves cover almost six percent of the Kingdom.

The Annapurna Himal has been proposed as a national park for well over a decade to protect its unique flora resulting from high rainfall, its unique wildlife, spectacular scenery and the world's longest altitudinal transect, some 6400 meters, from the floor of the Kali Gandaki valley to the peak of Dhaulogiri. These attractions have made the Annapurna Nepal's most heavily trekked area (over 20,000 in 1983).

Although recognized as worthy of national park status, designation has been delayed while the remainder of the system was consolidated. In addition the Dept. of Parks and Wildlife Conservation has not had institutional mandate to find the delicate balance between nature preservation, tourism demands and local human needs. A very creative approach is now possible through the newly created King Mahendra Trust for Nature Conservation. WWF-US Nepal program has been acting jointly with the Trust to promote protected area establishment in the Annapurna. Bruce Bunting and Michael Wright recently presented a paper which provides a more detailed description of the project issues (an edited version is attached as Appendix I to this proposal).

The specific action for which funding is now sought is to conduct a six month investigation of the social, economic and management issues to be addressed prior to determining the size, nature and method of protected area creation. The survey will be by two Nepalese and one outside expert long experienced in Nepal. Despite its somewhat increased costs, the team approach is prudent with such a brief time frame and will maximize creative interaction. The foreign (US) member has been chosen and the two Nepalese approached -- the latter two have extensive community experience in the Annapurna region and the former was involved with the establishment and management of Sagarmatha National Park. The survey will provide the opportunity for initial community involvement and an institutional baseline for decision making at the KMTNC Trustees meeting Feb 1986.

I. Project Description

A. For physical description of the project area and management and human issues, please see paper on Annapurna National Park prepared by Dr. Bruce W. Bunting and Michael Wright for the International Workshop on the Management of National Parks and Protected Areas in the Hindu Kush - Himalaya, Kathmandu, May 6-11.

B. Prior to the establishment of this protected area, it has been agreed by the endorsing institutions and other concerned parties that a preliminary survey of the proposed site be conducted in order to: assess local needs and responses relevant to protected area status and management, to identify initial areas and projects for development, and to investigate the potential for local involvement. Such a survey is needed in order to best integrate ultimate management goals with local needs, the local socio-economic and physical environment, and tourism.

C. Provision of baseline data and recommendations for the preparation of a management plan, for initiating legal action necessary for establishment of this protected area, and for beginning preliminary management and development activities.

II. Methods/Plan of Action

During an initial two-month survey of the Annapurna Himal, the survey team will identify physical, administrative, political, cultural, socio-economic, environmental and other features of the survey area (see tentative border description in paper by Bunting and Wright) pertinent to designation and administration of protected area status, and record their present condition. Specific topics will be addressed according to the outline below, with attention to historical and recent land management changes, culturally-influenced factors, tourism influences, and sites or situations requiring special attention. Geographical areas of critical study include the Annapurna Sanctuary, the Naudanda-Ghorepani-Ghandrung triangle, the "Pipar Himalayan Pheasant Reserve", Tilichho Lake, and the Marsyangdi and Taatopaani hydel project areas, in addition to particular focus on heavily touristed and poplated areas, and disturbed areas below treeline.

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Survey information will be gathered at the site through personal interview, questionaires and as time allows, site inspection. Supplemental information will be provided from outside the survey area through personal interviews with scholars, officials, businessmen and others concerned with future management issues of the Annapurna area, and survey of relevant literature.

A. <u>Phase one: data gathering/community involvement</u>

1. Description/overview of biophysical features
    a. note of unique features
    b. note of sacred sites or other areas of religious or cultural importance
    c. existing land uses
    d. pertinent notes, where available, relevant to existing scientific literature of the area

2. Development projects
    a. document existing large and small scale projects
    b. document planned projects (including roads and hydro, as well as mining, cottage industries, etc.)
    c. an overview of purpose, need, expected results, perceived results and impact of existing and planned projects
    d. identify potential sites for small "basic needs" development work through interview and brief visual inspection:
        - drinking water
        - trail improvement
        - obvious micro-hydel sites
        - other alternate energy schemes
        - fuelwood/fodder plantations (including political feasiblity and space for fencing)

3. Human Impact
   a. Tourists
      - survey impact of trekking
      - document condition and impact of campsites, latrines, litter, garbage disposal, etc. Suggest suitable alternate sites, if indicated.
      - document existing trek routes and carrying capacity of areas. Determine numbers in trekking groups, fuelwood consumption, agricultural products used
      - suggest potential 'alternate' trek routes and side routes
      - survey tourists with the purpose of determining the reaction to protected areas designation, willingness to pay an entry fee, destinations and styles of travel preference, etc.
      - survey existing tea shops and lodges with the purpose of determining fuel and firewood consumption patterns and costs, and trends in local lodge growth and siting and management practices

   b. Local Residents
      Interview/survey/discuss with village leaders and Panchayat representatives and villagers including women, the following topics (incl. where, when, what kind, how much):
      - most urgent development needs
      - special village problems
      - ongoing projects/development plans
      - hunting/wildlife sitings
      - medicinal plant collection
      - firewood collection (incl. management techniques)
      - fodder collection
      - local grazing and seasonal grazing (and management), especially changes and special situations- grazing vs. feeding
      - condition of trails, drinking water, bridges, pastures, forests, etc.
      - survey local people with the purpose of determining the reaction to protected areas designation, willingness to pay an entry fee, destinations and styles of travel preference, etc.
      - reliable flow of small hydro water?
      - law enforcement
      - fire, flood, landslides
      - interest in long-term employment for hunters
      - note unaesthetic development and architecture

4. Administration
   a. list offices, health posts, schools, radios, and buildings suitable for parks staff
   b. document significant, perceived or expected environmental and socio-economic impact of a.
   c. cost estimate of restoration of existing buildings at Kuldi Ghar for possible office and staff quarters for research activities

5. Other
   a. local interest in park involvement and availability of suitable rangers, guides, concessionaires, etc.
   b. local interest in training programs for rangers, innkeepers etc.
   c. obvious sites for hotel(s), parks headquarters visitors center(s) interpretive or warning sign(s), etc., if any
   d. archaeological sites
   e. traditional (local) natural resource-dependent commercial activities such as timber and mining (iron, lime, gems, etc.)
   f. environmental issues of pilgrims and traders, and special needs therein. Characteristics of resumption of trade (and possibly tourism) with Tibet
   g. possibility of temporary hire of local residents to assist in conducting monitoring activities, Sundras preliminary visitor profile or lodge use surveys
   h. identify geopolitical and physical features and rationale affecting boundary and zone definition
   i. identify possible long-term job potential for local people

6. Kathmandu/Pokhara Follow-up (before and after survey)
   Meetings with Planning Commission (Mr. Sanju)
   Dept. of Medicinal Plants (Dr. T.B. Shrestha)
   Dr. Hemanta Ram Bhandary (medicinal plants)
   Land Resource Mapping Project (Brian Carson, P.B. Shah, et.al.)
   Remote sensing (Diter and others)
   Community Forestry Project
   The Lumle Project (Jon Heusch, et.al.)
   Central Immigration, Tourism and Mountaineering Depts. (statistics)
   Resource Conservation and Utilization Project
   Ex Serviceman Assoc. (Lt. Ram Baha dur Gurung)
   Karna Sakya
   Dept. of National Parks & Wildlife Conservation
   Dr. J.G. Campbell
   Col. J.O.M. Roberts
   Dr. Andrew Manzardo
   Nepal Mountaineering Assoc. (concerning training station and museum at Manage)

Harkga Grung
topographical survey- obtain maps of area
trekking company representatives (interview and response survey)
resident scholars and anthropologists having worked in the survey area
survey/interview/discussion with district leaders: obtain Panchayat maps
World Bank survey on Myrsandi

B. Phase two: analysis

Goal of the survey is not data *per se* but analysis to assist KMTNC, WWF and HMG decision making. From the inception survey team will begin intra-team analysis and will maintain close liaison with KMTNC in Kathmandu. Mid-project report and meeting will analyze information to date and design second phase of the project.

Analysis will include:

- identification of areas of special concern for conservation, areas of special stress and locations where land use capabilities need further study
- consideration of alternative border areas or size with indications of relative merits (physical/geographical subset)
- possibilities of initiating the protected area in stages with recommendations and justifications of such staging (biological uniqueness, threat, community receptivity)
- alternate mixes of zoning and alternative management approaches or subsets for the various zones and rationales
- methodologies to build initial community support and longer term community involement in management
- institutional alternatives or subsets on both designation and management and rationales (ex designatin under Parks and Wildlife Conservation Act but KMTNC management: park care with zone of recreation in surrounding area; KMTNC- community Panchyat management agreements (easements?) in recreational zone)
- identification of communities most responsive, and hostile to protected area and interests which might encourage support (including analysis of local techniques which could be integrated into longer term management plan)

C. <u>Phase three: report preparation</u>
Report preparation to be completed by Jan 15, 1986

a. An executive summary (including photographs) suitable for presentation at the KMTNC Board of Trustees Meeting will be prepared summarizing information combined in the Confidential Report
b. A Confidential Report on the feasibility of establishing a protected area in the Annapurna Region.
    1. Full analysis of the project survey and interview data and information
    2. Management recommendations including alternatives recommendations. This should incorporate boundary information (along with alternatives boundaries).
    3. Collection of reference materials, including maps, literature, photographs, etc. which will be organized in an appropriate file system for easy reference.
    4. Indexing on maps of geopolitical boundaries, all development projects (past, current, and proposed) administrative centers, tourist routes, land uses, (especially noting grazing and agricultural activity), heavy use and special use areas, etc.
    5. Update of pertinent existing literature and reference materials where applicable (ie. land use maps, incorrect village locations, etc.).
    6. Identification of area and subjects needing more indepth study and analysis.
    7. Synopsis of survey data material in appropriate form (graphs, charts, etc.).
    8. Schedule for establishment of protected areas, including plan and budget for gradual incorporation of sub-regions (1. Onaudana-Ghorepani-ghanlu Deutrali section. 2. Kali gandki 3. Mary sardi 4. Lunjung Himal)

D. Schedule

Weeks 1-2:
-letters of introduction
-preparation of maps and documents (to be used in a permanent KMTNC or DNP library file and a duplicate for WWF-US)
-preliminary discussions adn interviews; contact with experts, Nepali and foreign
-printing of survey forms

Weeks 3-9:
-survey of Annapurna Himal visits to district centers
-full team survey S.E. slope followed by individual concentration (by subject or geographic area) of team members

Week 10-12:
-follow-up interviews and discussions
-literature review
-mid-term report preparation: report to be submitted to KMTNC and WWF-US by end of week 12

Week 13-15:
-Discussion and review strategy for remaining 3 months by KMTNC and WWF-US of mid-term report (analysis); preparation of revised study
-involvement of specialist- legal, institutional, etc.

Week 16-20:
-completion of further survey work with concentration identified in mid-term report and review

Week 21-24:
-follow-up and report preparation
-final report to be submitted to KMTNC and WWF-US by Dec 30, 1985

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III. Budget

Survey team	
Geographer/local community experience (Nepali)	4000
Community resource specialist (US)	8000
Institutional /park specialist (Nepali)	4000
Research assistant (Kathmandu) 2 months	200
Transportation	
Seattle-Kathmandu (one way)	1300
Nine round trips Kathmandu to site ($60 each)	540
Porter (90 days at $2.00)	180
Logistical Support	
Telephone, telex	gratis KMTNC
Support services in Kathmandu	
Materials	
Books, documents, maps (permanent file of KMTNC)	140
File - film with processing 40 rolls at 9.00 US	540
b&w film " " 40 " " 4.50 US	
Report preparation and duplication:	200
TOTAL:	19,100

Film Proposal Working Title:

FARMING TROPICAL RAINFORESTS

Native & experimental management systems

The following materials are presented to you for review. They are currently in development and should not be considered final. Alternative research, production and budget options may be pursued.

As considerable effort has gone into the planning of this project and because of the highly competitive nature of the film industry, Mr. Lippman asks that these materials be reviewed only within your organization and not be shown to or discussed with anyone outside of your organization without Mr. Lippman's prior approval. Your cooperation in adhering to this request would be greatly appreciated.

ABSTRACT

Objective: Provide an informative analysis of the causes of current tropical rainforest (TRF) destruction and its impact on global stability.

Reveal how contemporary and ancient native forest peoples have utilized productive and self-sustaining resource management systems.

Explore how experts translate indigenous and modern scientific methods into viable techniques and strategies for successful TRF development.

Examine the successes, failures and realistic options for TRF management.

Distribute the project in several languages to the general public and those who are in positions to utilize productive and sustainable TRF management techniques.

Strategy: Produce a set of three documentaries that explores the complex causes and far-reaching effects of TRF destruction and examines how native and experimental resource management techniques can be used to reduce this deforestation. (Option A)

Distribute these documentaries in developed and underdeveloped countries to the following:

- o Policy makers, personnel and students in agriculture, forestry and international development via a 28-minute videocassette. (Option B)
- o Jungle settlers via a 28-minute 16mm film in conjunction with extension personnel and agroforestry model plot establishment. (Option C)
- o General public via a 58-minute television program. (Option D)

	*Option A	Option B or C	Option D
Total Cost:	$321,230	$240,268	$268,634
Amount Raised:	98,500	98,500	98,500
Amount Requested:	$222,730	$141,768	$170,134

*For the policy maker, jungle settler and television audience versions. Various production and budget options can be considered. The total costs for each option would increase by an estimated 2.7 factor for Western Hemisphere, Asian and African versions.

Contact Person: Norman Lippman, Project Director
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(314) 725-3313

Affiliated With: The Mayan Society of St. Louis and the St. Louis Ambassadors Foundation, 501 (c) 3 IRS-approved, not-for-profit corporations.

OVERVIEW

- About tropical rainforests (TRFs)...
  - more than one-half of their area destroyed within last 100 years
  - area the size of Missouri destroyed every two months
  - represents a potential major economic base for the tropical Third World (TTW)
  - provides economic/political stability in TTW
  - remains vital to the stability of earth's climate patterns

- By year 2000...
  - three-fifths of global population will reside in tropics
  - extensive and intact TRFs will virtually disappear, if deforestation continues at the current rate
  - high likelihood of economic and political instability related to effects of decreasing TRF resource base and increasing population
  - TRF destruction will have a severe impact on environmental, economic, and sociopolitical systems

- Environmental impact...
  - potentially productive land laid waste for decades
  - rainfall patterns becoming less predictable in tropical and temperate zones
  - carbon dioxide levels that cause "the greenhouse effect" will increase and are predicted to raise the average global temperature six degrees Fahrenheit
  - this temperature increase could reduce U.S. corn production by as much as 30%

- Economic impact...
  - elimination of new potential forest materials, medicines and food crops when one million plant and animal species become extinct due to TRF degradation and destruction
  - loss of irreplaceable medicines, food products, and forest materials that cannot be produced in other environments (i.e. curare, essential to all modern heart surgery)
  - loss of major agricultural and forestry income generated by the TRFs and effected areas in TTW
  - resulting in reduction of these countries' abilities to repay debts and sustain employment for increasing populations
  - two-fifths of the U.S. economy depends on raw materials generated in the tropics, along with U.S. export markets existing within these countries

- Sociopolitical impact...
  - shrinking TRF resource bases combined with expanding populations and collapsing economies produce unstable sociopolitical situations (i.e. El Salvador and Haiti have the highest levels of deforestation and population density in Central America and the Caribbean, respectively, and are among the most unstable environmentally, economically and sociopolitically in these regions)

o This documentary project...

- contrasts previous documentaries that depict the situation fatalistically
- takes a unique approach by in-depth and interdisciplinary examination of...
    * the causes and effects of TRF destruction
    * indigenous and experimental TRF management technologies
- explores positive approaches to TRF management from a realistic point-of-view
- stresses the impact of unsuitable development policies and techniques in TRF destruction
- concentrates on responses to TRF destruction
- examines productive and sustainable methods developed by indigenous groups and modern research and demonstration centers for reducing deforestation
- examines the reconstruction, testing, development, transfer, and application of traditional and experimental TRF resource management systems
- summarizes way to manage the TRFs for the long range benefit of all of us

EXPANDED SUMMARY

By the year 2000, three-fifths of the world's population will be living in the Tropics. Extensive population growth now occurs throughout the lowland tropical forests. Less than half of the TRFs remain in the world. These forests are being destroyed at the rate of an area the size of Missouri every two months. At the current rate of destruction, extensive and intact TRFs will have disappeared almost completely by the year 2000, except for a few remnants in the western Amazon and Central Africa. These remaining forests will be disturbed and deforested by the year 2020.

Tropical lowland forests are vital to the earth's climate patterns. They "help to protect watersheds, recharge the water table, maintain patterns of rainfall, and improve air quality." (National Research Council's Committee on Research Priorities in Tropical Biology, 1980). The economic and political stability of the Third World balances precariously on its eroding agricultural base. As TRFs are destroyed...soils lose their nutrients, rainfall becomes more erratic, soils erode more rapidly and firewood becomes scarcer. The combination of these occurrences could cause the already intense human suffering and political tension in tropical Third World countries to reach an explosive level.

Most documentaries dealing with the subject of TRF deforestation end with a fatalistic lament that the problem is beyond solution. If their conclusions were hopeful, the solutions were seen as taking the form of new technology introduced from outside the jungle.

By contrast, this documentary project does neither. The problem of TRF destruction is not minimized. Indeed, the documentaries' openings provide a startling overview of this destruction's causes and effects. However, current technologies used by certain native groups in the effected areas offer hope. The project examines how these native technologies are being improved and translated into working solutions by modern researchers throughout the tropics. It explores newly developed modern forest management techniques and how these and native solutions are tackling the problem.

The causes and effects of TRF destruction deserve further study. In the Western Hemisphere versions, the deforestation problem and potential responses in Mexico, Central America, the Caribbean, and South America will be explored. They will focus in part on the Mayan area of Mexico, where productive and sustainable agricultural and forestry systems are still being used by one of the most traditional descendants of the Maya, the Lacandon. Ancient Mayan raised-field swamp farming systems excavated in Belize provide supporting subject material. At various Latin American resource development and demonstration stations, we will learn about the reconstruction, testing, development and transfer of re-discovered indigenous TRF technologies in addition to newly developed techniques. A modern agricultural development failure in the Amazon and the successful raised-field farmers of Ecuador, along with the contemporary food producing strategies of the Chontal Maya, the Cakchiquel Maya and the descendants of the Aztecs, complement the other subjects examined in this documentary project.

Providing an in-depth presentation of contemporary Lacandon technology makes this project unique. No documentary project has examined sufficiently the complex causes of TRF destruction, its far-reaching consequences, contemporary indigenous and modern experimental alternatives to this destruction. The series will stress the role of unsuitable development policies and techniques in the destruction of the rainforest; showing how the productive and sustainable methods of indigenous groups and scientists can reduce the effect of deforestation. Rather than consume and destroy the world's TRFs, we can learn to manage them.

METHOD

This series will include interviews with experts in forestry, agricultural development, agroecology, tropical botany, anthropology, archaeology and geography. Part of the narrative thread will be provided by informative and personal interviews with campesinos and native forest peoples. The documentaries will contain vivid on location footage and sound filmed in rich and varied TRFs. They will explore indigenous and experimental TRF management systems, as previously explained in the Expanded Summary section.

One documentary version could be distributed in the appropriate languages both in the developed and underdeveloped world to policy makers, personnel, educators and students in forestry, agriculture and international development. TRF development field personnel could use a second version with a simplified narration as an educational and motivational tool in their field work with TRF settler communities. The goal would be to involve the settlers in the creation and harvesting of community TRF management model plots appropriate to their conditions and needs. A third version could be broadcast to the general public with a narration less technical than the one presented to policy makers. These three versions could be produced concerning three separate geographic regions: Latin America and the Caribbean, Asia, and Africa. The first set might be produced for Latin America and the Caribbean. The proposal presents the personnel, interviewees and consultants appropriate for the Western Hemisphere versions.

More than seven and one-half hours of 16mm film and 35 hours of sound have already been produced for the Latin America and the Caribbean versions. This footage was shot over a 14-month period in the Lacandon Jungle and will be augmented by an additional 12 1/2 hours of film to be shot by a professional film crew.

PERSONNEL

o Producer/Director/Writer

Norman Lippman serves as the Documentary Film Project Director for the Mayan Society of St. Louis and the St. Louis Ambassadors Foundation. He studied documentary film with Arthur Barron, former head of the Columbia University Film Program and a renowned documentary filmmaker for "CBS REPORTS." Lippman's previous documentary credits include: producer/director/writer of Keepers of the Forest, director/field producer of a Guatemalan reforestation television commercial, ethnographer/field producer for El Quetzal and cinematographer/field producer for The Treasures of Corn.

Lippman spent two years working in the rainforests and highlands of the Mayan area of Guatemala and Mexico as an ethnographer, director of agricultural development and director of field testing for integrated development projects. Through his work in this area, he developed extensive first-hand knowledge of the people and the region. He has a broad network of contacts to draw upon throughout the area. This field work provided experience and knowledge beyond those of a filmmaker alone — Lippman knows what is both agriculturally and culturally significant to this project and how to turn it into an effective film. Lippman also studied tropical agriculture with Dr. Hugh Popenoe, Director of the Center for Tropical Agriculture at the University of Florida.

Lippman lived with the Lacandon Maya Indians for over fourteen months. By first learning their language and sharing in their work, rituals and pastimes, he became a trusted friend and member of the community. He later returned with his cinema equipment and continued to participate in agricultural, ceremonial and domestic activities; while filming them. With this personal approach, Lippman filmed and recorded most of the Lacandon material for the proposed documentaries. His rapport with the Lacandon and the jungle settlers allows the audience to more fully enter their world.

Comments on the quality and commercial potential of the footage shot to date include those of Douglas Leonard, Director of Broadcasting for the St. Louis PBS affiliate (Channel Nine), who wrote: "I recently met with Mr. Lippman to discuss his project and to look at some of his film footage. I was impressed with the variety and quality of the footage. I believe that Mr. Lippman is highly capable and that, with proper funding, a very important and attractive documentary could be produced. Channel Nine is most definitely interested in broadcasting this program, and while I cannot speak for other PBS stations, I feel that a substantial number of those stations would also broadcast it." (See Appendix for the Director's Resume.)

Lippman has already filmed the entire annual agroforestry cycle of the Lacandon. Their agroforestry system will be the documentaries' primary example of successful indigenous resource management. With the eyes of a filmmaker and an agronomist, Lippman filmed how they manage the jungle in sustainable and productive ways. Having this footage "in the can" sets this documentary project apart from those of other filmmakers who can only describe an indigenous annual agroforestry cycle, but who don't have the footage to illustrate it nor the rapport, time or knowledge to get the footage. Lippman has worked in film, agriculture and ethnography in Latin America. He also speaks both Spanish and Lacandon Maya. In short, he is well qualified to direct this project.

Lippman has worked with the professional, experienced documentary film crew comprised of producer, soundman and editor Peter Combs and cinematographer William Combs. Lippman is seeking their services because of the high quality of their film work, their familiarity with the Mayan area and Latin America, and their ability to work perceptively with minimal intrusion. Additionally, David Howard, an accomplished documentary film editor, has offered to serve as Supervising Editor for the film. John Huston, an award winning cinematographer; and Eric von Schrader, a noted director of video documentaries, may be offering their services, also.

o <u>Editing Supervisor</u>

<u>David Howard</u> is a brilliant Emmy award winning film editor editing for Maritz Communications and Schwartz & Associates. Mr. Howard specializes in editing non-theatrical film with emphasis on documentary film. He has received numerous Emmy Awards, Cine Golden Eagle Awards, and other major distinctions. He will provide excellent editing and post-production supervision.

o <u>Sound Recordist, Editor, and Post-Production Consultant</u>

<u>Peter Combs</u> has gained recognition on both the East and West coasts for his expertise in sound recording, editing, producing, directing and post-production consultation. He has won several first place awards both at the New York Film Festival and at the American Film Festival. He is currently a post-production consultant for a MGM/United Artist film and two Universal Studios films. He has produced several documentary and educational films for PBS TV, European TV and for private industry. He works as the Director of Editorial and Post-Production Operations for the American Film Institute. He is planning to record sound during the return filming in Latin American and the Caribbean, as well as working on the editing and post-production of this project.

o <u>Cinematographers</u>

<u>William Combs</u> is a noted cameraman and award winning documentary filmmaker. Since 1973 he has worked in documentary and educational film and video in California, New York, London, and Mexico. He worked as cameraman for Alan Landsburg Productions. He has served as Technical Director of the Film/Video Division for Synertek (subsidiary of Honeywell Industries). He is planning to serve as cameraman during the return shooting in Latin American and the Caribbean, as well as assisting in the documentaries' post-production.

<u>John Huston</u> has won numerous awards for his educational and documentary film work, including New York Film Festival awards, Cine Golden Eagles and a Participating Emmy award for an educational series. He is experienced in 35mm and 16mm cinematography, having worked professionally in these media for the past fifteen years. Mr. Huston may shoot interviews for this project.

o Production and Post-Production Consultant

Eric von Schrader is an award winning documentary video and filmmaker. He produced and directed a weekly magazine program for the ABC affiliate in St. Louis. In addition to field producing a segment for the MacNeil-Lehrer Report (PBS), he wrote, produced and directed four documentaries for the PBS affiliate in St. Louis. He has agreed to act as script consultant, as well as production and post-production consultant on this project.

INTERVIEWEES AND CONSULTANTS

Dr. Alwyn Gentry directs research for the United States Agency for International Development on potentially useful plants of the Eastern (humid) Andes. He is Curator of Botany at the Missouri Botanical Garden, the world's most active organization carrying out research and exploration in tropical botany. Dr. Gentry is conducting active research on patterns of jungle diversity. Relying on his knowledge of potentially useful jungle plants, his extensive experience in tropical field work, and his knowledge of many jungle utilization schemes; Dr. Gentry will be interviewed concerning the regional impact of rainforest destruction, the diversity of jungle ecology, the effectiveness of native forest management techniques, and the ethno-botanical knowledge of indigenous people regarding plants with medical and industrial applications.

Dr. Stephen R. Gliessman serves as Director of the Agroecology Program at the University of California in Santa Cruz and is the author of The Ecological Basis for the Application of Traditional Agricultural Technology in the Management of Tropical Agroecosystems. He recreated, tested, refined and transferred indigenous agroecosystems in Mexico. Dr. Gliessman agreed to be both an interviewee and consultant for this documentary. He will discuss the productivity and ecological impact of various indigenous resource management schemes that he has researched.

Dr. Arturo Gomez-Pompa is a consultant for the Division of Ecological Sciences in the United Nation's Man and the Biosphere Program. As the Founder and Director-General of Mexico's National Institute of Biological Resources, he directed research on the productivity and applicability of indigenous resource management systems. He contributed to the National Research Council's Report on Research Priorities in Tropical Biology. Dr. Gomez-Pompa agreed to be an interviewee and consultant for this project; concerning the reconstruction, testing, improvement and transfer of various appropriate indigenous agroecosystems in Mexico.

Dr. Norman Hammond is Associate Professor of Archaeology at Rutgers University, co-editor of a book entitled Maya Archaeology and Ethno-History and has edited a monograph on Archaeology in Northern Belize. Dr. Hammond has agreed to discuss the pre-Hispanic Mayan raised-field system currently being excavated in his investigations in northern Belize.

Dr. James Nations, an anthropologist, who is a Reviewer for the National Research Council's Office of International Affairs, the Congress of the United States' Office of Technology Assessment, and the National Geographic Committee for Research and Exploration. He has also agreed to be an interviewee and consultant for this project. He has published an article entitled "The Evolutionary Potential of Lacandon Maya Sustained Yield Tropical Forest Agriculture." Dr. Nations speaks Lacandon Maya and has conducted extended field work in various Lacandon settlements. He currently conducts research concerning the human impact on the TRFs of Latin America. Dr. Nations will present an in-depth view of the causes and effects of TRF destruction on both the local and international levels.

Dr. Hugh Popenoe has agreed to be a consultant and an interviewee for this project. He will discuss the potential of leguminous tree crops and Indonesian household gardens. Dr. Popenoe is a Professor of Soil Science, Director of the Center for Tropical Agriculture, and Director of the International Program of Agriculture; all at the University of Florida at Gainesville, Florida.

Dr. Pedro Sanchez coordinates the Tropical Soils Program for North Carolina State University. He authored a book entitled The Nature and Properties of Tropical Soils and was a contributor to a recent publication by the National Research Council, Ecological Aspects of Development in the Humid Tropics. He served as Senior Advisor for the World Bank INIPA project in Lima, Peru, and was responsible for coordinating Peru's agricultural research extension and education system. We plan to interview Dr. Sanchez about World Bank activities, how tropical soils must be managed for sustained yields and his views on non-indigenous-based development strategies for the rainforest.

Dr. Nigel Smith from the University of Florida's Department of Geography was a consultant to the World Bank on International Agricultural Research and has agreed to be interviewed for this project. He wrote the book entitled Rainforest Corridors, which examines the successes and failures of Trans-Amazon development projects and he will discuss these examples in these documentaries. He will explain the impact that plant breeding could have on tropical agricultural development.

Dr. Victor Toledo is a researcher for the Institute of Biology at the National Autonomous University of Mexico, as well as an advisor to the Latin American Office of the United Nations Program for the Environment. He is presently working for the International Program of the Nature Conservancy's Biogeography Project which will create a selected Bibliography on Indigenous Environmental Knowledge. His research emphasizes the ecological knowledge and subsistence strategies of Indians and peasants of rural Mexico. Dr. Toledo has designed a model for the multi-use management of a TRF based on indigenous subsistence strategies. He has agreed to be a consultant and interviewee, concerning these indigenous resource management systems.

Dr. B.L. Turner II is the Director of the Graduate School of Geography at Clark University. He co-edited the book, Pre-Hispanic Maya Agriculture. He is currently authoring a book entitled Prehistoric Intensive Agriculture in the Tropics. He has co-directed research on the raised fields of northern Belize. Dr. Turner has agreed to be both a consultant and an interviewee, concerning ancient and contemporary indigenous resource management systems throughout the Americas.

Dr. George M. Woodwell has agreed to be interviewed concerning the effect that deforestation has on the carbon dioxide concentration in the Earth's atmosphere and the effect of this carbon dioxide concentration on global climate. Dr. Woodwell is a member of the Carbon Dioxide Assessment Committee of the National Research Council and Director of the Ecosystems Center at the Marine Biological Laboratory at Woods Hole, Massachusetts.

The aforementioned experts will be used as resources for the finished project. Not all of them will be seen on camera.

FUNDING

The St. Louis Ambassadors Foundation and the Mayan Society of St. Louis are IRS-approved 501 (c) 3, not-for-profit corporations administering grants and tax-deductible contributions for this project. The St. Louis Ambassadors Foundation was established in 1971 to provide support for educational, cultural, and artistic activities. The Mayan Society of St. Louis was founded in 1968 for the purpose of presenting educational programs on the Maya and other indigenous American cultures.

To date, the documentary project has received $98,500 in grants, contributions and pledges. See the Appendix for various production/budget options and the detailed budget for the 58-minute, general television audience version. The policy maker and jungle settler versions would be shorter (27 minutes each). These shorter versions could be edited cost effectively from the 58-minute television audience version's film, sound and research materials.

APPENDICES

Norman Lippman
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Clayton, Missouri 63105
(314) 725-3313

Relevant Experience:

1985	Producer, director, writer and editor for Keepers of the Forest, a 28-minute documentary pilot on the causes, effects and native alternatives to tropical rainforest (TRF) destruction, filmed in Central and North America, funding administered by the Mayan Society of St. Louis and the St. Louis Ambassadors Foundation.
1984	Videographer for a documentary on the creation and development of the New City School in St. Louis.
1983	Videographer and editor for Times Beach Christmas, July 30, 1983, a 28-minute documentary pilot on the impact of dioxin contamination on the inhabitants of Times Beach, Missouri, presented at the School of Social Medicine, St. Louis University Medical School.
1980	Director, photographer, and sound recordist for a multi-media presentation on the Lacandon Maya for the Mexican Department of Education and Agriculture in Mexico City.
	Director and Field Producer for a reforestation campaign TV commercial produced by the Guatemalan government's Forestry Institute.
	Co-director/field consultant for the documentary sequences taped with the Lacandon of Naja, Mexico, for The Vanishing Forest produced by Video Chiapas.
	Liaison for Associated Press coverage of Lacandon Jungle, Mexico.
	Ethnographer/field producer for El Quetzal, a 27-minute documentary on the natural history, the mythical and historical role of the resplendent quetzal bird, produced by the Guatemalan government, aired on Guatemalan TV and distributed internationally.
1979-1980	Cinematographer/ethnographer for The Treasures of Corn, a 27-minute documentary on the indigenous and modern corn production and processing in Guatemala, produced for Guatemala corn growing and processing associations.

1978-1979	Researcher, cinematographer, and sound recordist for a documentary film concerning the highland Maya of Joyabaj, San Andres Sacabaja, and Cubulco, Guatemala. This documentary has been vaulted until it can be safely continued.
1978-1979	Director of field tests at a 45-acre Agricultural Research and Demonstration Center in the Department of Quiche, Guatemala, for the Habitat Quiche Agricultural Development Program (HQADP.) Directed field testing and storage testing for over 150 varieties of legumes, basic grains, fiber crops and vegetable crops for HQADP. Provided extensive in-depth training to a Guatemalan counterpart in the theories and practices of agricultural field testing and technology appropriate to the needs and means of local Quiche Maya Indians and Mestizos for HQADP.
1977	Director of agricultural development for a lowland agricultural cooperative in the Department of Quiche, Guatemala, funded by Catholic Relief Services (CRS.) Directed field tests in which 73% of the cooperative members participated in testing and subsequent cultivar distribution (funded by CRS.) Designed and performed semi-block randomized field test with 13 species of edible legumes (173 varieties), five species of basic grains, and fiber crops (funded by CRS.) Designed and planted an experimental orchard with nine species of spice crops, six species of nut and fruit crops and two varieties of bamboo (funded by CRS.) Introduced and cultivated 28 species of vegetable crops obtained from the Chinese Agricultural Mission in Guatemala (funded by CRS.)
1976	Directed an agricultural project in the department of Chimaltenango, Guatemala, as a part of the earthquake relief effort supported by the Guatemalan Emergency Committee and the Canadian Embassy.
1975	Farmed 200 acres of grain, legume, and vegetable crops in Missouri.
1974	Directed and filmed ethnographic film on the Highland Maya of Chiapas, Mexico.

1973	Worked at the Student Farm Project at the University of California at Santa Cruz.
1971-1972	Formed the Columbia University Video Collective and produced three 28-minute programs for public access TV in New York City.
1971	Assistant Editor on documentary film financed by Columbia University, New York City.

Recent Lectures and Presentations:

March 12, 1985	Seminar, preview and critique of the video documentary Keepers of the Forest on the causes, effects and possible solutions to TRF destruction, presented at the Missouri Botanical Garden attended by Dr. Raven and research staff.
April 21, 1983	Lecture/slide presentation for the "Man in his Environment" lecture series sponsored by the Missouri Botanical Garden on The Most Traditional Descendants of the Maya, The Lacandons: Their Agriculture, Cosmology and Environment.
February 27, 1983	Co-authored and photographed the cover article in the St. Louis Post-Dispatch Sunday Magazine entitled "The Maya."
December 1, 1982	Lecture/slide presentation for an Anthropology course, "Modern Aztec and Maya" at the University of Missouri-St. Louis.
June 24, 1982	Lecture for a film study course at the University of Missouri-Rolla on "Documentary Film."
June 21, 1982	Lecture/slide presentation for a graduate level course in Visual Communications at Webster University on "Ethnographic Film Work with the Maya."
May 23, 1982	Slides of the Maya selected in competition and presented at the St. Louis Art Museum as part of the St. Louis Visual Catalogue II, sponsored by the Women's Caucus for Art.
January 8, 1982	Lecture/slide presentation for the Mayan Society of St. Louis on "The Lacandon."

Language Proficiency:

Fluent in Spanish, conversant in Northern Lacandon Maya, some knowledge of Quiche, Achi and Tzotzil languages (latter three are also Mayan languages).

Institutional Training:

Film and Video, COLUMBIA UNIVERSITY, (New York, NY). Studied on academic scholarship and maintained Dean's List academic standing.

Plant Science, Center for Tropical Agriculture, UNIVERSITY of FLORIDA (Gainesville, FL). Studied on two academic scholarships plus honorary academic fraternity.

Video Field Production, NORTH AMERICAN TELEVISION INSTITUTE (Chicago, IL).

Spanish Grammar and Conversation, UNIVERSITY of PLASTIC ARTS (Guadalajara, Mexico).

Areas of Mayan Field Work:

Northern Lacandon agriculture, cosmology, and ritual. Quiche and Achi agriculture, cosmology and ritual (Palo Volador).

PRODUCTION AND BUDGET OPTIONS

Option A. Produce three finished versions totalling 114 minutes: the policy maker (28 minutes), the jungle settler (28 minutes), and the general television audience version (58 minutes). This would be the most cost efficient option.

Option B or C. Produce a single policy maker or jungle settler version, which would be the most expensive to produce per minute for the finished product.

Option D. Produce only the 58-minute general television audience version.

	*Option A	Option B or C	Option D
Total Cost:	$321,230	$240,268	$268,634
Amount Raised:	98,500	98,500	98,500
Amount Requested:	$222,730	$141,768	$170,134

*For the policy maker, jungle settler and television audience versions.

The total costs for each option would increase by an estimated 2.7 factor for Western Hemisphere, Asian and African versions. (For example: Option A for Western Hemisphere, Africa and Asia would cost approximately 2.7 as much as doing it in one location--$321,230 x 2.7 = $867.321.)

Various production and budget options can be considered. The more versions edited from the existing production effort the more cost efficent the project becomes. The following detailed budget is for Option D--the 58-minute general televison audience version.

BUDGET

Pre-Production--three and a half months				Total
Producer/Director/Writer	3 1/2 mos	@	$ 3,000	$10,500
Site scouting, On-site interviews, and Film and publication library search:				
U.S. Travel (Washington, DC; N.Y.C.; Worcester, MA; Austin, TX; Madison, WI), Air & ground				1,200[a]
Per Diem	17 days	@	$90	1,530
Latin American Travel (Mexico, Belize, Costa Rica, Panama, Ecuador, Brazil, Guatemala), Air & ground				4,000
Per Diem	49 days	@	$50	2,450
Additional travel expenses (Customs brokers, Lawyer fees, Business meals, Gratuities and Miscellaneous)				1,500
Vaccinations, Passports, Customs arrangements	5 persons	@	$60	300
Production consultants	10 days	@	$250	2,500
Sony audio package	2 mos	@	$150	300
Tape stock	25 hrs	@	$4	100
Honorariums for interviewees	9 persons	@	$100	900
Contingencies				2,000
Total Pre-Production				$27,280

Production--two months: 22 filming days, 16 travel days, 8 rest days[b]

Producer/Director/Writer		2 mos	@	$3,000	$ 6,000
Camera operator filming		22 days	@	$250	5,500
Camera operator traveling		16 days	@	$125	2,000
Sound person filming		22 days	@	$150	3,300
Sound person traveling		16 days	@	$75	1,200
Assistant camera filming		22 days	@	$125	2,750
Assistant camera traveling		16 days	@	$62.50	1,000
Production assistant filming		22 days	@	$50	1,100
Production assistant traveling		16 days	@	$25	400
Consultants/Liaisons		10 days	@	$100	1,000
Honorariums for interviewees		8 persons	@	$100	800
Travel air & ground and excess baggage					
U.S.		5 persons	@	$1,200	6,000
Latin America		5 persons	@	$4,000	20,000
Customs and Customs broker					1,500
Per Diem					
U.S.	3 days x	5 persons	@	$90	1,350
Latin America	40 days x	5 persons	@	$50	10,000
Location supplies: Audiotape, Batteries, Quartz bulbs, Gels, Gaffer tape, Expendables					1,700
16mm film stock		25,000 ft	@	$.18	4,500
Arriflex camera package		7 wks	@	$1,100	7,700[c]
Nagra audio package		7 wks	@	$314	2,200
Sony crystal synch audio package (backup)		7 wks	@	$86	600
Sungun and Light package		7 wks	@	$330	2,310
Sachtler tripod package		7 wks	@	$100	700
3500-watt electric generator		2 wks	@	$175	350
Lab processing and Work printing		25,000 ft	@	$.3	7,500
Contingencies					6,000
Shipping to labs					500
Total Production					$97,960

BUDGET-continued

Post-Production--four months				Total
Producer/Director/Writer	4 mos	@	$3,000	$12,000
Editor	50 days	@	$220	11,000
Transcriber and clerk	5 days	@	$80	400
Editorial equipment	4 mos	@	$1,250	5,000
Editorial supplies	4 mos	@	$150	600
Narration writer	2 days	@	$250	500
Narrator				1,500
Recording session plus stock				500
Music and effects				1,000
16mm mag film	48,000 ft	@	$.05	2,400
Transfer time	24 hrs	@	$37.5	900
Transfer single system to 16 mm mag film				400
Mix session	16 hrs	@	$100	1,600
Mix stock				325
Mix protection track				60
Optical tracks	4,320 ft	@	$.31	1,340
Internegative	6,000 ft	@	$.63	[illegible]
Checkprint	2,160 ft	@	$.27	[illegible]
Optical effects, credits, titles, subtitles				4,000
Conformer				3,000
C.R.I.	2,160 ft	@	$.935	2,019
Answer print	2,160 ft	@	$.55	1,190
Release print	1 print	@	$300	300
Transfer and stock: film to videomaster				900
Videotape 1 inch and 3/4 inch dubs	10 copies	@	$120	1,200
Contingencies				3,500
Laboratory shipping				400
Total Post-Production--				$60,394

General	
Project administration, Secretarial, Office, Accounting, Telephone and Postage	$ 8,000
Insurance: Equipment, Negative, Faulty stock and camera, Workers' compensation, Third party pd., Liability, and Errors and Omissions	8,000
Total General--	$16,000

Research, Project Administration, and Film Production Completed to Date[d]	Funds Sought	Income[e]	Total
Producer/Director/Researcher/Writer 4 mos @ $2,500	-0-	$10,000	$10,000
Project administration, Secretarial, Office supplies, Transportation, Telephone, Postage, Film stock, Processing, Workprinting, Audio, Video expenses, Photography, Xeroxes, etc.	-0-	19,500	19,500
Office space (in-kind contribution)	-0-	2,500	2,500
Word Processing (in-kind services and facility contribution)	-0-	5,000	5,000
Services loaned to the project: Producing, Directing, Researching, Writing, Camera, Sound, and Production and Post-Production equipment use	-0-	31,000[f]	31,000
Total Research, Project Administration, and Film Production Completed to Date-----------------------	-0-	$68,000	$68,000

BUDGET-continued

TOTAL FILM PROJECT COST:			$269,634
Income to Date			
The Missouri Arts Council	$ 6,000		
The St. Louis Arts and Humanities Commission	$ 3,500		
The Missouri Committee for the Humanities	$20,000		
Private Contributors	$31,500		
	$60,000		
Total Grants and Contributions[g]		$60,000	
In-kind Services		$ 7,500	
Loaned Services and Facilities		$31,000	
TOTAL INCOME TO DATE:		$98,500	-98,500
TOTAL AMOUNT SOUGHT:			$171,134

BUDGET NOTES:

a) If archival material is found which will cover the Brazilian and Ecuadoran segments of this film, then 13 days of on-site scouting and pre-production interviews, as well as transportation expenses can be saved, totaling $3,150. The cost of copying archival material can be taken out of the pre-production, production, travel, and per diem expenses saved by using this library material instead of shooting new material.

b) During the pre-production film library search, site-scouting, and interview period, it may be determined unnecessary to film in Guatemala, Panama, Ecuador and Brazil. The project could save as much as $10,000 by eliminating from the budget six filming days, four travel days, 10 per diem days, and some transportation, customs brokerage and customs expense for these locations.

c) Victor Duncan three-day week rental rates rounded off.

d) Research, project administration and film production completed to date has yielded research and discussion with interviewees and consultants which has led to an extensive film treatment; 15,000 ft. of processed and workprinted film and 35 hours of sound covering the entire annual agricultural cycle of the Lacandon; the logging and breakdown of the film.

e) Income includes grants, contributions and loans, and in-kind services received from the Missouri Arts Council, the St. Louis Arts and Humanities Commission, the Missouri Committee for the Humanities, and private contributors.

f) The project director is only being paid for four months of his work to date. He is loaning the project 14 months of research, film work, and film equipment use in the Lacandon jungle which has produced this project's most valued footage. He is also loaning the project 11 months of his labor as a producer/writer/researcher, as well as editing equipment use. The loan of these critical services, which significantly reduces the cost of producing the film, reflects his concern that this documentary reach a wide audience.

g) Of the total grants and contributions, $30,000 has been spent, and $30,000 remains unspent. The remainder of the Total Income To Date is covered by In-kind Services and Loaned Services and Facilities.

North Carolina State University

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Tropical Soils Research Program

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P. O. Box 5907
Raleigh, N. C. 27650 U.S.A.

May 29, 1984

Mr. Norman Lipman
7745 Mohawk Place
St. Louis, MO 63105

Dear Mr. Lipman:

This is to reiterate my interest in the conversation that we had last Friday related to the possible NOVA film on tropical deforestation. I believe the way you are approaching it, in which not only do you include the catastrophic school of thought but also what is being done about it, is an excellent idea. I hope you can go ahead with this film, and we will be most delighted to make arrangements so you can visit our project sites in Yurimaguas, Manaus, and West Sumatra, Indonesia. For the Indonesian situation, it would be necessary to contact the Director of the Centre for Soils Research, whose address is as follows:

Dr. M. Sudjadi, Director
Centre for Soils Research
Jalan Ir. H. Juanda 98
Bogor, Indonesia

The address of Dr. Salati in Piracicaba, Brazil, is as follows:

Dr. Eneas Salati
Director, CENA (Centro de Energia
Nuclear na Agricultura)
Caixa Postal 96
13.400 Piracicaba, S.P.
Brazil

Enclosed you will find some publications related to our findings in the Amazon.

With very best regards,

Pedro A. Sanchez, Coordinator
Tropical Soils Research Program

PAS/ted
Enclosures

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télégrammes : Unesco Paris
télex : 204461 Paris

référence : SC/ECO

20 June 1984

Dear Mr. Lippman,

Thank you very much for your call and for your letter of 4 June. I am very much interested in your project and, as I told you, I will be very happy to accept your invitation as a consultant for your documentary project and I will be happy to be interviewed.

I have discussed your project here and the MAB Secretariat at Unesco will be happy to help you in this important endeavour if you so wish.

I will be at the Harvard Forest at Petersham Mass. for some time starting from middle September. You can contact me there.

Yours very truly,

A. Gómez Pompa
Division of Ecological Sciences

Mr. Norman Lippman
7745 Mohawk Pl.
St. Louis, Mo. 63105
U.S.A.

Graduate School of Geography

CLARK UNIVERSITY

950 Main Street
Worcester, Massachusetts 01610
617/793-7336

May 7, 1984

To Whom it May Concern:

I have been in contact with Mr. Norman Lipman regarding a proposal to produce a film for Nova on the subject of tropical deforestation and means of constraining this phenomenon. In my opinion, Mr. Lipman has an excellent perspective on the topic and has woven together an interesting approach to it. Namely, to examine past land uses compared to actual uses in the world today. He has gathered a diverse and excellent group of experts on the topic, ranging from ecologists--botanists to geographers--archaeologists. The result could be a most interesting program on alternative land uses that have worked or could work to promote agricultural production while retaining substantial areas of forest.

Having worked on several projects of this sort, both within the United States and Europe, I am most impressed with Mr. Lipman's sincerity, objectivity, and thoroughness.

If further comments are needed, please contact me.

Sincerely,

BLTu

B. L. Turner II
Director

BLT/mh

DEPARTMENT OF GEOGRAPHY
UNIVERSITY OF WISCONSIN - MADISON

324 Science Hall
Madison, WI 53706
608 - 262 - 2138

May 16, 1984

Mr. Norman Lippman
7745 Mohawk Place
St. Louis, MO 63105

Dear Mr. Lippman:

I appreciate being informed about your projected film for NOVA on tropical deforestation and on indigenous alternatives to current approaches to development. Both are topics on which I have done research in Amazonia. I want to express my strong support for the project. There is considerable interest right now in indigenous and traditional peasant cultivation systems, including prehistoric systems such as raised fields. We are finding that such systems are often more productive and more ecologically sound than are modern agricultural techniques. Attention to this in a NOVA film could influence development thinking.

Your plan to include material on the Lacandon Indians and on the Belize raised fields is sound. For the prehistoric fields you should get some aerial coverage for they can be very impressive from the air. The Belize fields are not that numerous, but there are large numbers in Veracruz. Even better are those in the Guayas Basin, Ecuador, which are a few minutes by plane or car from the major city of Guayaquil. The raised fields of northern Colombia and northern Boliva are also very photogenic but are harder to get to.

The only prehistoric raised fields still in use are the Chinampas at the edge of Mexico City, which can be easily photographed by air or on the ground. For experimental fields, see those in Tabasco via Gómez Pompa or Steve Gliessman.

If I can be of further assistance in any way, let me know.

Sincerely,

Bill Denevan

William M. Denevan
Professor

WMD/dt