

BIOSPHERE RESERVES FROM THE EUROPEAN PERSPECTIVE

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The concept of biosphere reserves was born with the Unesco-MAB program in 1971, though it became operational in 1976. It had its origin in the MAB Project 8 on the "conservation of natural areas and of the genetic material they contain." This concept has been internationally recognized as an advanced and important tool in conservation, as exemplified by the World Conservation Strategy (1980), and it is commonly employed by other organizations, particularly IUCN, UNEP, and FAO. Currently, cooperation is emerging between Unesco-MAB and the Economic Commission for Europe regarding the establishment of a network of "representative ecological areas"--in other words, biosphere reserves--in northern Europe.

The biosphere reserve concept has undergone further evolution during the 10 years after its conception (Di Castri and Robertson 1982). To this evolution we have contributions from the experiences--both successes and failures--gained during the "older" type of conservation prior to the MAB program; in developing countries there is need to integrate conservation more with development; better appreciation of the social and economic factors that affect all protected areas; new ecological thinking and methods as well as new management concepts are forcing us to modify our conservation practices, and so on. A certain milestone in this respect was the statement by the 1981 MAB Scientific Conference "Ecology in Practice" (Unesco 1982) that the main objective of the biosphere reserve concept is conservation of the representative ecosystems of the world and of their components.

Although the biosphere reserve as a concept has a strong global dimension--the network of different biosphere reserves has certain properties of its own besides purely local functions--the very local environment is affecting and will affect both the theory and practice of reserve management. Thus we may expect that the biosphere reserves have somewhat different contents and different functions in different environments. The major "environment" in which the biosphere reserves exists is of course the human environment; i.e. there are both social and economic dimensions to them as well as psychological and esthetic expectations directed at them. Europe forms a special environment for the biosphere reserves, but so do all other areas of the world. So what is the European perspective?

One of the features in Europe is that there are few if any sites left that could be considered "natural" in the strict biological and historical sense. The Mediterranean landscape has undergone both natural and man-made changes for thousands of years, and what we see now are in most cases sites at various successional stages. Yet for a visitor a good many parts of the Mediterranean scene are still quite natural. The same applies, for instance, to the forested areas of Finland. Those forests, up to the

Arctic Circle at least, are products of past drastic and wasteful forestry practices, which were connected with slash-and-burn agriculture in the east and tar-burning for export in the west (Soininen 1974). In the north, reindeer grazing, and over-grazing at times, has among other things had its impact on the ecosystem. The system has evolved as a response to past practices, and after the old practices have ceased to exert their influence, the "natural" ecosystem may evolve in an "unnatural" direction, just to add to the conceptual confusion that exists around the term "natural."

Europe may appear rather homogenous as regards conservation practices and possibilities, at least from the global perspective, but a more detailed picture is highly diverse. In western and northern Europe the average population density may vary from 12 inhabitants/km² in Norway to 315/km² in Belgium and 379/km² in the Netherlands. Yet the percentage area protected does not follow a simple (negative) linear function of the population density, but there exists large deviations (Table 1). As to the sizes of the protected areas, the great majority of them are small, from a few hectares to a few hundred hectares (cf. Poore 1981). In 1980, there existed 77 protected areas over 10,000 hectares in size in western and northern Europe (Poore 1981). However, half of them, or 39, were situated in only four countries, namely Finland, Iceland, Norway, and Sweden--that is in countries with relatively low population density. In addition, there were five areas of the same size category in Svalbard (Spitzbergen). The rest of the large areas were divided among Austria, Federal Republic of Germany, France, Great Britain, Italy, Spain, and Switzerland.

The creation of the protected areas in Europe, be they national parks or other nature reserves, took place in the past in different countries in different ways. Usually they were the results of the actions of diverse pressure groups or concerned citizens and organizations, and commonly very little scientific input was involved in the process. Also, the amount of land that was available biologically, financially, or otherwise was variable between different countries and also within each country; so the history of the protected areas in Europe may appear to an outside observer almost "haphazard."

According to the count in October 1981, there existed 209 biosphere reserve sites in 55 countries. Out of these sites some 78 were situated in Europe (Table 2). Biosphere reserves have been established in 20 European countries, with Bulgaria and United Kingdom being the leading countries as far as the numbers go. (In addition, there were four biosphere reserves in Tunisia and one in Egypt, though not all of those sites represent the Mediterranean biogeographical province.) Again the picture behind these figures for Europe is much more diverse than what is revealed by these statistics alone. Most of the biosphere reserves had not been originally established as biosphere reserves, but usually some national parks or other reserves have had their status changed, though in France, for instance, the management of the national parks comes close to the biosphere reserve concept (cf. Leynaud 1978). In the application of the concept we find a nearly full spectrum from nominal to (nearly) fully functional biosphere reserves. This wide array of practices may not

Table 1. Protected areas in some European countries in relation to size and population density in each country (adopted from Poore 1981).

	<u>Area km² of the country</u>	<u>Av. pop. density</u>	<u>Percentage land area protected</u>
Austria	83,850	89	3.0
Belgium	30,513	315	0.4
Denmark	43,042	117	0.2
Finland	337,000	14	1.9
France	551,607	91	0.6
Germany, Fed. Rep.	248,600	249	1.69
Iceland	103,000	2.16	8.42
Ireland	70,283	45	0.15
Italy	301,262	183	0.99
Luxembourg	2,586	131	5.5
Netherlands	36,175	379	4.04
Norway	323,878	12	1.73
Svalbard	62,422	0.05	49.0
Spain	504,741	72.5	0.29
Sweden	499,800	18.4	4.07
Switzerland	41,293	154	3.9
United Kingdom			
Great Britain	227,463	239	0.78
N. Ireland	13,600	112	0.22

be a drawback as such as there is so little room for maneuvering in densely populated areas. However, one of the tasks for Europeans in the future is to proceed with heightened efforts to implement the management philosophy and practice that belongs to the concept. It also requires an even more intensive scientific input to study the existing constraints in the foundation and management of biosphere reserves. One conspicuous feature is the nearly total absence of biosphere reserves in northern Europe, which has certain historical and administrative reasons, but the future may change this situation.

Also, among the already existing biosphere reserves there may be some that do not and will not in the future conform to the overall requirements as set by the biosphere reserve concept, and some consideration may be given to changing their conservation status to something else.

The concept of biosphere reserve entails a special role for man in the conservation process, both as a participant in the actual management and as a "consumer" of the products of conservation. As to the management, there are two levels: the formal administrative level, usually the government, and the local people who are living inside or within the immediate sphere of influence of the reserve.

In a number of cases the conservation sites in Europe are situated away from population centers, in the "periphery" of the country, for some

Table 2. The numbers of biosphere reserves in Europe (in October 1981).

Austria	4	
Bulgaria	17	
Byelorussian SSR	1	
Czechoslovakia	3	
Denmark	1	(in Greenland)
France	3	(including Atoll de Taiaro)
German Democratic Rep.	2	
Germany, Federal Rep.	1	
Greece	2	
Hungary	5	
Ireland	1	
Italy	3	
Norway	1	(in Svalbard)
Poland	4	
Portugal	1	
Romania	3	
Spain	5	
Switzerland	1	
United Kingdom	13	
U.S.S.R.	6	(incl. all reserves in the Soviet Union)
Yugoslavia	2	

obvious reasons. To give some examples, all of the national parks in England and Wales are situated in the so-called Less Favoured Areas or Special Investment Area (MacEwen and MacEwen 1982). The very same situation obtains in Finland, where the great majority of protected areas (at least area-wise) have been founded in the north, where local economy is weaker, per capita income lower, the average population density lower with the consequent effect on political power, and the general dependence upon agriculture and forestry deeper than elsewhere in the country. To this we may add the reindeer husbandry that requires large areas to succeed. Although the reindeer husbandry stands to gain from conservation measures, there still exists potential for conflict, among other things, in the conservation of the big predators like wolf, bear, and wolverine (Pulliainen 1982).

The relationship of the local people with conservation is not only a matter of their immediate attitude towards the definition of the roles of the protected areas, but much wider questions are involved. These questions are closely connected, among others, with the general agricultural policy in each country (MacEwen and MacEwen 1982). The agricultural sector in western and northern Europe has been changing as a response to the general surplus production of food (Raymond 1980/1981), which in turn has created more structural changes and new pressures within agriculture. Thus especially the small farmer in the periphery is hard

pressed by economic and social matters. For the farmer, it may not be so much a matter of "maximizing his profit" rather than "maximizing his survival" in the present situation. This is even more so if the governmental policy is vacillating or if different governmental branches remain uncoordinated as regards agriculture, land use, and conservation, for that matter. It may be asking too much for the local people to show enthusiastic support for conservation, and especially for conservation of a genetic material that is not very concrete or "visible" or economically feasible. (In some places the government is compensating for the lost production in case the farmer agrees to maintain a low-yield farm animal stock that needs genetic protection.) In case of lack of immediate financial returns, the local people may see conservation of the land as conservation for the outside "rich and affluent" (Nash 1978). There may exist pressures, by outside people and even by the government itself, towards "rustic way of life," but in agriculture the landscape is very much the result of the production methods, which in turn are dictated by such economic factors that are at least partially outside the agricultural sector. Thus there is need to study the possibility of affecting the landscape also by indirect financial means, or through taxation, which, through agricultural practices, work towards better maintenance of biotic diversity. Thus participatory planning and management of landscape conservation by and with the local people can be an additional key to the long-term success (Bortolotti 1978).

It may be true that in a number of cases regulated tourism is an answer in the long run (Budowski 1976), but the changeover from the situation now may be painful for both the government and the local people. It has been said that one of the most endangered species in such a situation is human, the local inhabitant (Mills 1982); conservation and development cannot work parallel to each other without special measures. Thus in Europe, or at least in some parts of Europe, we are facing a situation that is not far removed from that in many developing countries, which only calls for better coordination and understanding of the conservation policies all over the world (cf. Lusigi 1981).

It is often stated that nature is "deteriorating," but at the same time this may be partly a result of the changing kind of perception of nature by urban people. "Enjoyment" is a value-laden term, and the values may be changing for such socioeconomic reasons that are totally outside the biological realm (Hayes 1976).

The conservation "map" of Europe is thus many-faceted, but the biosphere reserve concept is making and will make in the future a very important contribution to it. It does not replace, say, the national parks, but with the goal of preserving "representative areas and ecosystems" it has a very important niche to fill. The biosphere reserve also stands a better chance to accommodate the human social dimension with the overall objectives of conservation. An important key to the future is research at many levels: in biology, economics, sociology, psychology, management sciences, anthropology, and even history.

So what can we do and what should we do in Europe in terms of producing better management of biosphere reserves and other protected areas?

First of all, the European picture as regards conservation shows various degrees of successes in different countries and at different sites. By comprehensive view we may learn, especially from successes, better ways of dealing with the existing problems; it might even be possible to transfer some of these lessons outside Europe.

Europe offers a place where we have records to look back to history for hundreds of years and where we can study the effects of past conservation measures, be they such by design, by default, or by accident. The history of population and of agriculture in Europe are well known, and we also have a rather long series of observations, direct and indirect, of past climatic changes that have affected the vegetation patterns, agricultural production, etc. (cf. Glass and Eversley 1965; Soininen 1974; Mead 1981; Wigley et al. 1981). Study of the past may be indispensable for any follow-up study of the present management practices. (One more climatic factor in today's world is the acid rain, which does not obey the administrative boundaries of the world.)

There have been attempts at using the island equilibrium theory as developed by MacArthur and Wilson (1967) in the planning of the best size and shape of nature reserves. The usefulness of this theory has also been criticized for both theoretical and practical reasons (cf. Poore 1981). However, this approach may still be useful, if properly applied, in its ability to offer criteria for the follow-up and management of the protected areas. It can offer, post hoc, a tool whereby we can measure the extent of interactions between the reserve and its surroundings in the historical context (cf. Diamond 1981). In terrestrial systems we seldom have perfect "islands," but the degree of insularity may vary. Thus the importance of what happens outside the reserve itself is even more clearly expressed. Such knowledge is a necessary precondition for any adaptive management scheme, for the determination of the "scope of activity" of the biosphere reserve (Hayes 1976). (We should note that the very structure of the biosphere reserve with its core/buffer zones is especially well amenable to such an approach.)

It is often stated that the biosphere reserves can be places where natural evolutionary processes can continue. This is certainly true, but there also exists another facet to it. The biosphere reserves may serve as evolutionary reference points to all the changes that may be taking place outside the area. That is, in changing conditions the selective pressures may cause extremely rapid evolutionary changes in those stock that survive (Bradshaw and McNeilly 1981), and so we should not look at man-made changes in negative terms only. A changing world is apt to produce new diversity, while the diversity that exists in the protected areas "is already there." So these two processes only complement each other. The way we see the process of evolution is also dependent on the ways we see and apply the theory of evolution and of natural selection (Tuomi and Haukioja 1979; Tuomi 1981). The way we see the selection process in nature should also affect our management practice; the currently common view of genes as units of selection may be too narrow as it tends to forget the individual organism in the context of evolution. So there is certainly more to the conservation of "genetic material" than population genetics alone (cf. Wright 1980).

One final question deals with the word "representative" that is connected with the concept of biosphere reserves. It is an interesting question when we ask about the "representative" reserves that either do or do not represent. Do we are facing more a question about the quality of ecological land classification. The year 1975 has developed a global classification of biogeographic regions, but there is need for a suggested refinement of this classification at the regional level (De Camargo and Robertson 1982). This is necessary for the further development of the biosphere reserve network, and we will need to know in more detail what the existing reserves actually represent through time. Here we have a problem where pure theory in biology can be helpful.

Surveying and mapping of land is a necessary prerequisite for any ecological classification. The classification has to be successful without an explicit theory. As wrote Rowland Shapton, "A successful classification is a better understanding of the system under study; it will not only indicate the paradigm (the normal science model) through which [1970]. Applied to land, each map and classification is seen to be an expression of theory and related hypotheses. The facts observed, described, and categorized are ordered in what has gone on and what is taking place in the features are particularly significant in reflecting what is at work there. Land classifications and maps are theories about the land's structural organization, the application of theory. In short, the land classifications concern their theoretical basis and then their methodologies."

So the key question for the future success of the biosphere reserves and of any conservation measures is the quality of management. It involves clarity and honesty about the management objectives and a requirement for an explicit presentation of the management rules. Without such explicitness we do not know where we did right or wrong, and we cannot learn from the process. An architect may design an aesthetically pleasing house, but without clear technical feasibility it can not be built. A good strategy is selective instead of comprehensive (Row 1972); a management plan that tries to address too many things at the same time is bound to fail. The development of conservation management should become a common, coordinated field of activity between all countries and all continents; there is no alternative to learning each other in this field.

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BIOSPHERE RESERVES FROM THE SOUTHEAST ASIAN PERSPECTIVE

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INTRODUCTION

Management of reserves in developing countries such as most of the countries of Southeast Asia (ASEAN: Indonesia, Malaysia, Philippines, Singapore, and Thailand) (Figure 1) in general, should combine the goal of nature conservation with the need of the people, especially of those living close and around reserves. Such a management approach should not separate the interest of the people from the objectives of conserving flora and fauna. On the contrary, it is of utmost importance that the management of reserves in developing countries proceeds to a point of harmony like a fish swimming in the sea of people. Reserves should never be isolated from the people like islands separated from the sea.

Therefore, the concept of biosphere reserves as special areas selected to represent the major habitat types on a global basis, both within natural and altered environments, is also recognized in Southeast Asia. It is time to consider in what way cooperation between our ASEAN countries can improve or make more effective the national reserve systems (of each country).

ASEAN NATURAL RESOURCES

Southeast Asia possesses some 30 percent of the world's tropical rainforest, the most diverse of all terrestrial ecosystems in its number and variety of plants and animals and the dominant ecosystem in the region. Over long periods of time, indeed until recently, Southeast Asia people have been in a fairly harmonious balance with their natural environment. Today the delicate balance is rapidly being upset as people continue to assert themselves as the ecological dominant. The rapid increase of local and worldwide human populations also make conservation of rainforest ecosystems more difficult. Local people destroy the forest for shifting cultivation and more recently for cash-crop profits. The increasing world population has created a rapidly growing market for wood and wood products.

The significant role of tropical rainforest in providing economic goods and raw materials, in controlling soil erosion, in maintaining favorable climatic conditions, and in being an important reservoir of genetic diversity is fairly well established. The tropical rainforests of Southeast Asia are specially recognized for their richness in species diversity.

Between them the ASEAN countries contain the complete world resources of a large number of plant and animal species, particularly those species confined to the Sundaic (Malaya, Java, Borneo, and Sumatra) and Wallacean (Philippines, Sulawesi, Moluccas, and Lesser Sundas) areas.

Responsibility for the preservation of these resources is shared. In some cases species migrate or disperse across international frontiers and effective management of such species is clearly a matter of cooperation between those countries.

The Southeast Asian seas cover an area of 8.9 million sq. km or about 2.5 percent of the surface of all oceans. In these waters almost all types of topographical features are found, such as shallow continental shelves, deep sea basins, troughs, trenches, continental slopes, volcanic, and coral islands. The distribution of water and land alone characterized the Southeast Asian waters as one of the most complex areas on earth with numerous large and small islands subdividing the region into different seas connected by many channels, passages, and straits.

PROBLEMS

The rapid rate of deforestation in the ASEAN area is a clear illustration of conservation problems and must be counterbalanced by more effective nature conservation program. The word conservation implies more than simply preserving the environment and saving wild plants and animals--much more important for ASEAN nations is the need to protect the human environment. IUCN, for instance, defines conservation as "the management of resources of the environment with the purpose of achieving the highest sustainable quality of human life." This definition implies that no conservation movement has any meaning of significance to man unless its ultimate goal is also to help human life. Therefore, ecologically sound management of ASEAN's natural resources is imperative for the future welfare of its people.

Resource management agencies in Southeast Asia typically lack sufficient training, techniques, tools, and funds to cope adequately with the situations they are supposed to regulate. Therefore, at the present stage of forest technology the tropical rainforest is being treated as a nonrenewable resource. The mechanisms of regeneration being not fully understood, and considering the rate at which forested areas are being denuded, mankind might lose all its rainforest before it acquires the knowledge to regenerate them.

The seas of Southeast Asia are, collectively, one of the world's richest marine ecosystems. While little is known about its very complex ecology or about current rates of catch, it is obviously underexploited; however, the shallow parts are certainly overexploited already at the present time. Nevertheless, its vast wealth is threatened not only by fishermen but by other human activities on the rivers, estuaries, and swamps that feed it, and on the continental shelf. Rivers are dammed and their flows of nutrients halted. Estuaries are used as sinks for urban and industrial wastes. Coastal swamps are drained for agricultural and urban development. Oil drilling and tin dredging on the continental shelf create additional hazards for marine life. The effects of such activities are not merely local but extend throughout the fisheries of Southeast Asia.

Some conservation problems illustrated above, like those pertaining to the environment, are complex problems. First, there is the awesome

knowledge gaps on the economic and ecological significance of various species and their ecosystems. In the developed countries, these problems are extended to the habitat needs of species that do not even seem to be useful. On the other hand, it is in the third world where problems assume a complexity of their own. Hard choices often have to be made between the competing claims of scientists for conservation leaving untapped the economic potential of sizable areas and the pressing demands of fundamental human needs for food, shelter, employment, communication, and development. The situation is likely to be exacerbated in decades to come. A UN forecast highlights that the world population reaches some 5.0 billion by 1985, from a little over 3.5 billion in 1970, the requirements for food, energy, and natural resources have to increase by 40 percent just to maintain the present unsatisfactory standards of living of much of the population. To meet these requirements, more and more forests have to be cleared for roads and houses, and more factories for jobs and foreign exchange. In the ASEAN region, the scenario is no different. If the present trend is maintained, the population in the ASEAN countries will continue to increase from some 270 million now to 350 million by 1990 and 450 million by the year 2000 (ASEAN-COST 1982).

Given the mounting socioeconomic and demographic demands, nature conservation cannot be considered in isolation from local society. Rather it must be approached within the context of broader national and regional developments. For the problems of nature conservation are not scientific alone. They are also social, economic, political, and statistical in character. Therefore, the concept of biosphere reserve is among others intended to cope more adequately with the conservation problems within the ASEAN region.

ASEAN HERITAGE RESERVES

ASEAN shares many things in common. They share the same aspirations for economic development and enhancement of the quality of life as well as similar problems arising out of overpopulation, environmental deterioration, and the adverse ecological effects of unsound exploitation of resources. The best approach to these common goals and problems is regional cooperation and the sharing of expertise.

It is both in the interest of the peoples of the ASEAN region and to mankind as a whole to protect sufficiently large areas representing all ecosystems, both marine and terrestrial. Moreover, proper management of those conservation areas that can sustain use for passive recreation will be at the base of the establishment of an important tourist industry, which will provide--apart from a valuable financial revenue--employment for the rural population in adjacent areas.

With a fauna and flora spanning the Indo-Malayan, Wallacean, and Papuanian subregions (Udvardy 1975) ASEAN is in a unique position to contribute to global efforts at conservation.

With a coordinated approach and commitment to protecting an ASEAN natural heritage, the ASEAN members between them can ensure the

long-term conservation and survival of a larger number of vertebrate (and probably also invertebrate) species than any other similar association of nations anywhere in the world. Effective protection, however, will depend on successful mutual cooperation in the field of wildlife management and reserves management in the form of national parks and biosphere reserves among the members of ASEAN.

Therefore, cooperative efforts should be made to protect sites of special interest within ASEAN and elsewhere, to make accessible to the scientific and other groups make them available for visitation by citizens of ASEAN's countries and elsewhere. Such sites would have unique richness or combinations of wildlife, spectacular scenery, highest peaks, volcanoes, glaciers, etc. The best ASEAN examples of all major biotypes represented in ASEAN. Such sites should be agreed upon as ASEAN heritage reserves and an international fund established to help share the costs of preserving these parts of ASEAN's extremely rich heritage.

I see at least three ways in which cooperation between ASEAN member countries could benefit the management of reserves.

Agreement by each country to establish an adequate reserve system so that diversity of species or seed source, birds and migratory animals, etc., is maintained. Standards of legislation, status and protection and also a real requirement should be agreed.

Cooperation in forming transboundary reserves. Some reserves permit direct resource sharing. They permit the creation of larger, biologically more viable reserves than either country can afford alone. The existence of such reserves prevents anomalies such as persisting on one side of a boundary resources that the other country is trying to protect on the other. A start has been made with the linking up of the Lajang Entail reserve in Sarawak (East Malaysia) with the Gunung Serapiang and Kalinur reserve in West Kalimantan. Further cooperation should be possible between Malaysia and Indonesia and between Malaysia and Thailand in this respect. Indonesia is also negotiating similar cooperation with Papua New Guinea with which it shares a long boundary.

Agreement of assistance between member countries in management of shared rare or endangered species. For example, one country may face problems maintaining small population numbers of a rare or endangered animal which aid from another country in the form of spare animals for reintroduction or loan of animals for interbreeding may well help solve.

For example, Borneo is the largest remaining portion of ancient Sundaland--land of the Asian mainland when sea levels dropped during the drier, cooler periods of the Pleistocene era--however, due to the political situation the island was divided into Northern Borneo under Malaysia (Sarawak, Sabah) and Brunei (an independent sultanate) and Southern Borneo (Kalimantan) under Indonesia. Figure 2 shows the original habitat types of Borneo, which remains the main distribution center for many genera of the Indo-Malayan fauna and Malesian flora. The distribution of species over Borneo is far from uniform. Apart from

of birds, mammals, and natural plants or distribution there are severe differences among regional divisions which presumably reflect differences in geography, soils, and previous land use decisions during the Pleistocene period. In the last century (from 1911) onward, the distribution of species does not correspond to a pattern of ecological zones or units. Bracey figure 11, showing land use, shows the land frontiers of Java, Sulawesi, and Sumatra, and the boundaries of the reserves.

Transfrontier reserves are not necessarily dependent entirely on the land use patterns of the area concerned, and a number of other factors are involved. The first is the geographical position of the boundary. If it is improved, in the case of rivers, the river boundary is where the habitat is contiguous on the opposite side of the boundary. The neighboring country should not permit any incompatible form of land use or activities, e.g., hunting, immediately adjacent to the boundary of the reserve, and where possible it should declare a similar reserve with equivalent, or even higher, status on its side of the boundary thus forming a transfrontier reserve.

Furthermore, Asian countries are linked by ocean currents and shared seas. Their marine resources are not confined to different land masses and their populations, such as turtles, dugongs, whales, and oceanic fish stocks are, shared by two or more nations. Neglect on the part of one nation could wipe out a critical habitat of one species may mean its disappearance to a neighboring country. Similarly, pollution or destruction of productive habitats in one nation may affect production off the very next day's down current.

To coordinate activities with the ASEAN heritage reserves, Indonesia has proposed the establishment of a center and secretariat to coordinate ASEAN cooperation in national parks and reserves management (ASEAN-UNEP, 1980). The center will monitor the progress that each member country is making in safeguarding ASEAN's heritage. Data gathering is intended to advise any member or group of members to establish a reserve for the protection of a particular species or preservation of a rare vegetation formation whether by the form of national parks or other protected area categories. Hopefully, the center will ensure that the current natural heritage of ASEAN will be retained intact and a selection of the future needs of mankind in looking at resources, to which such expertise would be beneficial.

CONCLUSIONS

The ecosystems approach should be used as the management tool. This implies that the basic planning unit should, for example, be the catchment area rather than political boundaries. This also implies that the impact of any project is measured in terms of the degree to which it impairs ecosystem functions.

The management of forest ecosystems in ASEAN should not strive merely for optimized output but also for ecological stability.

Perhaps more than on land, especially within ASEAN, there is the need for multinational collaboration and regional strategies for the management and conservation of marine resources.

The application of the biosphere reserve concept can mitigate land use and social problems and should be encouraged further in future establishment and management of parks and other protected areas.

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BIOSPHERE RESERVES AND THE PRESERVATION OF BIOLOGICAL DIVERSITY

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INTRODUCTION

The biosphere reserve has a somewhat different meaning to each person involved. It is indeed not surprising that, say, a national park superintendent's perception of a biosphere reserve differs from that of the rancher whose land abuts the park. However, these perceptions converge on an overriding purpose that is central to the biosphere reserve concept--the preservation of natural diversity. In this paper, yet another perspective is provided, that of a conservation biologist who sees the Biosphere Reserve Programme as the best available means of protecting the biological components of natural diversity on a global scale.

The loss of biological diversity ranks high among the most significant problems facing the world today (IUCN 1980; CEQ 1980). At present, this loss, measured in the rate of extinction of species worldwide, is estimated to be ten times that which has prevailed naturally throughout geologic time and is projected to increase many fold before the century is out (Myers 1979; Ehrlich and Ehrlich 1981). In fact, a recent edition of one of the most authoritative texts in biology (Orians and Purvis in press) identifies the present extinction crisis as one of the several major episodes of mass extinction in the history of life on Earth. In all likelihood more than a million species will have been irretrievably lost by the year 2000, and most of these will have been neither scientifically named, described, nor evaluated for their potential usefulness to humanity.

It can be argued that all organisms have an inherent right to exist whether or not they have immediate practical value (Ehrenfeld 1978). But a more vital argument is that the quality of the human environment, and indeed the very existence of civilization, is based on the life-supporting natural ecosystems comprised of the myriad plants, animals, and microorganisms inhabiting the Earth. Thus, the diminution of natural areas and the disappearance of species forever represents a threat to the survival of humanity.

Recognizing this threat, Unesco's Man and the Biosphere Programme identified at its inception Project 8, "The Conservation of Natural Areas and the Genetic Diversity They Contain" as one of its primary goals (Unesco 1973). The Biosphere Reserve Programme evolved as the means of fulfilling this goal. Its achievements will depend in part on further scientific development of conservation biology, the field that attempts to understand biological diversity and how to preserve it, and its application to the design and management of biosphere reserves. The purpose of this paper is to discuss the concept of biological diversity, explain its importance, and outline the scientific research component of the biosphere reserve, which is crucial to the development of conservation biology.

THE MEANING AND IMPORTANCE OF BIOLOGICAL DIVERSITY

In a general sense biological diversity can be defined as the variety of life forms. The acronym BIODIVERSITY, however, and the word biodiversity may contain within it the most important components of biological diversity: the genetic diversity and species diversity.

First consider genetic diversity. Among genetic scientists and conservation biologists, genetic diversity refers to the types of different genes, the relative abundances of these genes, and the degree to which they potentially contribute to phenotypic variation among individual organisms. Genetic diversity is central to the concept of biological diversity, since genes are the ultimate source of biological diversity at all levels of biological systems (i.e. molecular, organismal, population, species, and community).

Genetic diversity is significant to the conservation of biological diversity for two major reasons. First, genetic diversity in wild organisms represents a critical resource for the genetic improvement of domesticated plants and animals. For example, crop plants, such as wheat, maize, and rice, upon which most of the world depends for food, require continuous genetic improvement through artificial selection to increase yields and confer resistance to disease. Given the continual increase in the size of the world population, the capacity for genetic improvement of crop plants becomes even more critical. This capacity can only be maintained by preserving the most diverse range of genetic strains of organisms possible as sources of potentially valuable genes. These sources include wild relatives of currently important domesticated organisms as well as wild species whose potential remains unexplored (see Franklin and Soule 1981).

The second reason for preserving genetic diversity is that it may determine the survival capacity of species themselves. The "pool" of genetic diversity within a species constitutes an adaptive buffer to present environment as well as a store of adaptive options for new environments, or environmental change. The loss of that diversity, which is often associated with reduction in habitat and population size, may not only contribute to extinction by closing future evolutionary options, but may decrease the viability of individual organisms, thus the probability of a species's short-term survival (Franklin 1980; Soule 1980; Franklin and Soule 1981).

The other major component of biological diversity, species diversity, represents a resource for humans as well as a requirement for ecosystem health. As resources, hundreds of familiar examples can be given of chemicals used in medicine and industry derived from wild plant species. In fact, it has been estimated that more than one half of the pharmaceuticals in use today contain as ingredients chemical compounds derived from plants, while many thousands of plants with unknown therapeutic value remain unscreened (1972; Myers 1973). So not only does the loss of species bring about both the disappearance of potentially important genes, but of potentially important "chemical factories" as well.

Species diversity plays a key role in ecosystem function, thus the capacity to provide life supporting resources and so-called ecosystem

services (Ehrenfeld and Mooney in press). The relationship of species diversity to ecosystem stability is a central precept in biology (Goodman 1975). Although the extent to which species can be lost from ecosystems without impairing their function is not known, catastrophic consequences are certain at some point. In fact, cases are known in which certain 'keystone' species support large assemblages of other species (Gilbert 1980). The extinction of these keystone species will lead to a cascade of extinctions, which could amount to the loss of an entire subcommunity and its contribution to ecosystem services.

The significance of ecosystem function to humans should be quite obvious. Ecosystems perform numerous functions upon which society is completely dependent. These include, for example, such 'free services' as maintaining the quality of the atmosphere, soils, and fresh water, providing pollinators and nutrients for agriculture, and helping control potential crop pests and vectors of disease.

In addition to the practical and economic aspects of biological diversity, there are also the less tangible but still important recreational, aesthetic, and spiritual values of nature, which many (e.g., Ehrenfeld 1978), including this author, believe are essential to the quality of life for humans.

HOW BIOLOGICAL DIVERSITY IS LOST

The way in which the Biosphere Reserve Programme works to preserve biological diversity can perhaps be best appreciated by understanding how biological diversity is lost. Although many scientists are quite certain that biological diversity is currently being lost at a greater rate than at any time in history, it is nonetheless difficult to precisely characterize that loss. This is true for at least two major reasons. First, only a minute fraction of all species are monitored well enough to keep track of their status. Thus we have little ability to identify which species are going extinct and exactly what are the direct causes. Second, even when the extinction of a species has been noted, the amount of genetic diversity lost along with it is unknown. While the amount of genetic diversity contained in a species can be determined by biochemical techniques, this has only been done for a few hundred species (see Nevo 1978 for review). One thing that has been demonstrated by these studies is that a species can contain a surprising genetic diversity, but that the amount varies from one species to another.

Recognizing that our information on species' extinction is quite limited, and that which we do have may not give an accurate measure of the loss of biological diversity anyway, extinction is still our central concern. What then is known about the biology of extinction? The fossil record shows that extinction is a common event in geologic time, and appears to be the ultimate fate of all species (Gould 1982). Further, the natural extinction of local populations occurs throughout the lifetime of a species and is probably more frequent than generally thought, particularly in smaller organisms (Murphy and Wilcox 1982). Most species consist of many such populations and it is the accumulation of local population extinctions that ultimately leads to the extinction of a species. It is believed the extinction of local populations is normally counterbalanced by

establishment of new populations due to migration of individual organisms from surviving populations of the same species elsewhere. However, as protected natural areas such as biosphere reserves become increasingly surrounded by developed land, fewer populations are left to provide the natural dynamic balance between extinction and establishment of local populations (Pickett and Thompson 1979). One can therefore see how the loss of habitat and its isolation can greatly increase the likelihood that local extinction events will accumulate and result in the eventual extinction of a species over its entire range. Thus a process which is inevitable for all species, but normally occurs on a geologic time scale, is condensed to a historical time scale through human interference.

Protected areas that become isolated by surrounding developed land share certain similarities with true islands or natural island-like habitats. In particular, both are surrounded by relatively inhospitable habitat. What is most significant to conservation is that naturally isolated areas generally hold far less biological diversity than non-isolated areas of comparable habitat and size. This should not be surprising given the considerations just discussed. Since it is likely that some of the same ecological processes that have made islands relatively depauperate will be operating in reserves, conservation biologists have been particularly concerned about the effects of habitat loss and isolation. Research from a broad range of independent scientific disciplines (see Soule and Wilcox, 1980) suggests that the combined effects of habitat loss and isolation, sometimes called "insularization," pose a serious threat to the capacity of protected areas to preserve biological diversity. For example, studies of islands created by the rising post-glacial sea level in the past several thousand years, indicate large losses of species due to the effects of insularization (see Diamond 1975; Terborgh 1974; Wilcox 1980).

The above and other considerations have led to the concept of minimum area requirement (Lovejoy 1980). The minimum area requirement can be defined as the smallest amount of area required to ensure the long-term survival of a particular species or community. Consideration of minimum area requirements is necessary to provide an adequate margin of safety against extinction due to the inevitable insularization facing most protected areas. The estimation of a minimum area requirement is a complicated process (see Wilcox in press) based in part on predicting the probability of extinction given different population sizes.

A simplified explanation of the minimum area requirement is that it is the smallest amount of habitat area needed to support a self-sustaining population. "Self-sustaining" means that it is large enough, has the proper composition (age classes and sex ratio), and structure (pattern of dispersion of its individuals) to minimize the likelihood of extinction due to chance events. A population with the minimum characteristics required to meet these criteria is said to be a "minimum viable population." This concept is discussed in more detail in an excellent review by Schaffer (1981). Schaffer, for example, has applied the minimum viable population concept to existing data on the population biology of grizzly bear in Yellowstone to determine its minimum viable population and area requirements. These studies have been used to aid the U.S. Fish and Wildlife Service's grizzly bear recovery effort.

THE BIOSPHERE RESERVE: PRESERVATION AND RESEARCH

The increasing exploitation of land and natural resources is unquestionably the single greatest cause of extinction throughout the world. The result of expanding economies and populations, the rate of exploitation will continue to grow for decades to come. As more and more land and resources are needed ecosystems could well be taxed to the point where they become incapable of continuing to provide these resources. The only way to ensure that natural ecosystems will be able to provide the food, fiber, fuel, and scientific resources necessary for future generations is by developing modes of land and resource use that allow the preservation of biological diversity. This, of course, is exactly what the Biosphere Reserve Programme endeavors to accomplish.

The biosphere reserve concept is basically a land use philosophy, which has three major objectives. These are explicitly stated by the Task Force on Criteria and Guidelines for the Choice and Establishment of Biosphere Reserves (Unesco 1974) as: (1) the preservation of the diversity and integrity of natural ecosystems and of the variety of species and their genetic diversity; (2) the provision of areas for ecological and environmental research (consistent with (1) above); and (3) the provision of facilities for education and training.

The keystone of the Biosphere Reserve Programme is a global network of reserves established by individual nations. Thus, the Biosphere Reserve Programme operates on two levels. On the international level it establishes guidelines and encourages nations to set up reserves. On the national level, MAB national committees or other bodies design and propose areas for biosphere reserve designation. The international connection allows for feedback and transfer of information among different nations concerning reserve design, management, and research. It is this feature in particular that sets biosphere reserves apart from all other protected area concepts.

The Biosphere Reserve Programme is both a testing ground for and a product of the scientific theory on the design and management of protected areas. Evaluation of the results of such testing improves management of both existing biosphere reserves and the design and selection of additional reserves. The integration of such ongoing research with design and management is particularly important because, at present, relatively little is known about biological diversity, including how to preserve it--even though this is the principal mandate of the Biosphere Reserve Programme. As Di Castri and Loope (1979) have pointed out, the need for a better scientific basis for conservation is consistently underestimated. Although a broad outline for the types of scientific activities that are needed in biosphere reserves exists (e.g., Unesco 1974; Franklin 1977; Franklin and Krugman 1979), detailed guidelines and protocols are still very much in the early stages of development. However, some important advances were made recently at the Indo/U.S. Workshop on Conservation and Management of Biological Diversity cosponsored by India's and the United State's MAB committees (Anon. 1982). An overview of the findings and recommendations concerning scientific activities made at the workshop should help highlight current thought on this subject.

Three major areas of scientific activities were recognized as necessary for biosphere reserves. These are: inventory and monitoring of the elements of biological diversity; ecology and resource utilization of human populations; and ecological monitoring and research.

Inventory and Monitoring

The most basic requirement for any reserve is an inventory of biological diversity. This involves the collection of information on biological diversity in a biosphere reserve, or in an area where establishment of a biosphere reserve is being considered, and its storage using a data management system. Ideally, the data management system consists of an interactive computer system with graphics or mapping capabilities providing not only for the storage, but also for the updating and retrieval of data on the occurrences (geographic locations) of biological elements and the environmental factors potentially influencing them. The biological elements include, at the very least, vegetation types and species of conservation concern (those that are rare, threatened, endangered, or of significant economic or scientific value). Environmental factors include such things as soil types, drainage, climate, land use, and so on. In addition to these basic data, which are available (or becoming so) for many countries, occurrences of all species of the well-known plant and animal taxa (e.g., vascular plant species, vertebrates, and some well-known invertebrate taxa) should be digitized (stored by computer).

Once an inventory is established it can be updated as new information accumulates. Routine field surveys at regular intervals are in fact encouraged particularly for certain sensitive species or entire taxa. For example, Britain has annual bird and butterfly counts, which are organized as part of a long-term monitoring effort. The absence or presence of a species is recorded each year for 10- by 10-kilometer-square quadrants comprising a grid covering the entire country. The Biological Records Centre of the Nature Conservancy Council digitizes the data and maintains a continually updated atlas of the geographic distributions of virtually all birds and butterflies, in addition to other taxa. Biological diversity inventories such as these take years to develop and few biosphere reserves have them as yet. They are nonetheless an essential component of the biosphere reserve concept and all biosphere reserves must eventually develop their own inventory systems. Actually, most countries as well as provinces and states have existing institutions--zoological and botanical surveys--that collect and store such information. These existing programs are in fact often enlisted to assist in the establishment of biodiversity inventories.

The regular updating of element occurrence data on the basis of field surveys serves as a system for monitoring the status of biological diversity. Thus the combined inventory/monitoring system is a crucial component of a biosphere reserve, since it provides not only a basis for reserve design, but a means of guiding management strategies as well. Monitoring is particularly important because of the possibility of the insularization-induced effects on plant and animal populations that were previously mentioned. There are in addition, however, numerous external

threats to the reserve communities, the potential effects of which must be continuously monitored. These threats include acid precipitation, toxic chemicals, and other forms of pollution that are even becoming commonplace far from industrial areas.

Human Ecology and Resource Use

The biosphere reserve concept recognizes that the cooperation and support of the local community is crucial to the success of a biosphere reserve. Because the creation of a biosphere reserve places certain limitations on land use, these restrictions cannot be easily implemented or enforced without the consideration of the people residing in and around a reserve. In some instances, the biosphere reserve actually places an economic burden on residents whose livelihoods depend on the land. A typical example is the farmer whose livestock or crops are raided by wildlife from within the core areas. Although the circumstances differ somewhat, this particular problem is nearly universal. Whether it is the Maasai in Kenya or the corn farmer in the United States, a similar problem is posed to both by predators and large herbivores, respectively. It is clear that for success the costs and benefits of biosphere reserves must somehow be shared by society at large. This dilemma is still largely unresolved.

A more serious problem yet, common in developing countries, is meeting the needs of native people who live in the reserves. Conflicts arise when their use of the reserve interferes with its principle objective, of preserving biological diversity. The solutions to this problem obviously have profound moral, practical, and political implications.

India's Nilgiri Biosphere Reserve provides a good example of the challenges facing a government attempting to integrate the needs of native peoples within a biosphere reserve. At least nine major tribal ethnic groups live in the region encompassed by the proposed reserve, which includes various parts of the states of Tamil Nadu, Kerala, and Karnataka. One of these tribal groups, the Cholaikas, are the last true hunters/gatherers of the subcontinent.

It is believed that the ecological impact of the Cholaikas and the other tribal groups was minimal until large tracts of tropical deciduous forests were cleared for planting teak, eucalyptus, coffee, tea, and wattle. The loss of forest habitat and the cultural disruption accompanying the development of large plantations has resulted in the breakdown of many of the traditional practices of the tribals. In many places they have been forced into using their land and resources in ways inimical to the long-term protection of the very forests that would otherwise have provided their livelihood indefinitely.

As part of the scientific activities of Nilgiri Biosphere Reserve, India proposes research on the ecological role of the tribals in the reserve area. The objective of the research is to collect sufficient data on the tribals to develop plans for incorporating their needs into the overall reserve design. The viewpoint adopted by the Indo/U.S. workshop report (op cit) was that the cultural heritage and diversity of the tribals is an integral component of the Nilgiri reserve's biological diversity.

The types of research proposed to assist in reconciling the needs of the tribals with the biosphere reserve are as follows: demographic studies to assess the current and projected sizes and distributions of the tribal groups; studies of land and resource use and the impact of this use on biological diversity; and ethnographic studies to document the irreplaceable cultural heritage of the tribals and to assist in the impact assessments. These studies will be used as a basis for implementing demonstration projects that are designed to assist the tribals in adjusting land and resource use.

Ecological Monitoring and Research

Aside from protecting areas for the sake of biological diversity, biosphere reserves are meant to serve as sites for long term collection of basic ecological data. Thus research in the biosphere reserve serves two roles: it provides for increasing our knowledge in ecology in general and improves the scientific basis for design and management of biosphere reserves. In addition to helping answer scientific questions, an ongoing program of ecological data collection also constitutes the routine monitoring mentioned above as part of inventory and monitoring.

It is convenient to distinguish two major types of ecological research: ecosystem and population studies. Ecosystem research involves investigations into the structure and function of ecological communities on a large scale. The main objectives of this type of research as proposed in the Indo/U.S. workshop include the following: to analyze the structure and function of the major community types in the biosphere reserve; to investigate factors regulating the size and dynamics of plant and animal populations; to determine impacts of anthropogenic and natural perturbations upon ecosystem function; and to assist in the development of management strategies that promote the preservation of biological diversity, including those which allow optimization of resource use on a sustainable basis. Actually, the methodology and objectives of ecosystem research are fairly well established. Ecosystem research has generally been the focus of MAB's International Biological Programme and is merely being carried over to the Biosphere Reserve Programme (Franklin 1977).

Much less well developed, but recognized as critically important, is research on plant and animal populations. These population studies focus on the research and monitoring of selected species. The purpose is to provide a scientific basis for the management of threatened or endangered species and for developing reserve selection and management guidelines that focus directly on individual components of biological diversity (i.e., species' populations).

An initial step in the methodology of this research is to tie in with the biological diversity inventory. The computer-based biodiversity inventory serves as a tool for population monitoring and research. The distributions (ranges) of individual species can be studied, and by overlaying the individual ranges, geographic patterns of species diversity can be examined. Combining these with data on features of the landscape--environmental factors and land use--produces a system for

basic and applied research on biological diversity. The goal is to increase understanding of the various factors, both natural and human-related, which influence the distribution of species individually and collectively. Assembling information on the geographic distribution of biological diversity also assists directly in reserve design and management by ensuring the maximum amount of diversity is incorporated and maintained within the reserve boundaries.

Another important aspect of population studies is the role they play in estimating minimum area requirements. Basic information on population dynamic and genetic characteristics of species in the field are required to make these estimates. Also, the process of estimating minimum area requirements necessitates compiling information about organisms in the reserve and helps to pinpoint species that are especially susceptible to extinction. Finally, a particularly important aspect of population studies is the monitoring of selected animal species as indicators of particular types of disturbance or disruption of particular habitats. Some examples would be raptorial birds as indicators of levels of pesticides in the food chain of a community, or kingfishers as indicators of the overall health of an aquatic ecosystem. These species thus act as early warning indicators of ecosystem health, possibly helping avert major disturbances.

CONCLUSION

Scientific research and monitoring is a key component of the biosphere reserve. A variety of factors relating to human disturbance have potentially negative effects on biological diversity. An especially significant problem inherent in setting aside any protected area is insularization, the tendency of the area to become island-like.

Our ability to manage these and other problems is limited to a large extent by the state of conservation biology, the scientific discipline that attempts to deal with the problem of the loss of biological diversity. A thorough understanding of the process of extinction, for example, and its relationship to reserve size and surroundings is lacking. Yet immediate action guided by such an understanding is required to protect some of the last pristine tracts of unique habitat types and the species they support. An answer to this apparent dilemma is to integrate ongoing research and monitoring with the selection, establishment, and management of reserve system such that their effectiveness is improved as advances in conservation biology are made.

It is certain that pressure on the land and the biological resources it supports will reduce the present extent undisturbed natural areas on earth to mere fragments in the coming decades. Little can in fact be done to alter this trend, as it is in large part an inevitable consequence of the growth in the size of world's population. The best that can be hoped for is that conversion of the natural landscape and exploitation of biological resources can be carried out in a manner that minimizes the loss of biological diversity and keeps the life support capacity of the biosphere intact. This is a problem of global dimensions requiring application of scientifically sound land and resource management mainly on the local level. And the best available solution is provided by the strategic framework embodied in the biosphere reserve concept.

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BIOSPHERE RESERVES: THE VIEW FROM THE UNITED STATES

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I have been asked to discuss briefly the concept and the reality of biosphere reserves as they exist in the United States today and to look ahead to the future with an eye toward predicting the future evolution of the system. To do this, I believe it would be helpful to take a critical look at where we are, and how the concept of the biosphere reserve has changed during the eight years since the United States established 12 units of its national park system and 13 areas within its national forests as biosphere reserves.

The United States' enthusiasm for the concept of establishing a world network of biosphere reserves was firmly recorded in the proceedings of the Stockholm conference on the global environment in 1972. The enthusiasm became a matter on the government's action agenda in 1974, when the United States and the Soviet Union underscored their resolve to establish biosphere reserves on their respective territories as a provision of the summit communique between Presidents Nixon and Brezhnev. Although the idea of establishing a world network of biosphere reserves became a key project in Unesco's Man and the Biosphere Program in 1973, funding to support a global selection effort was not forthcoming from United Nations organizations. The U.S./Soviet decision may well have saved the project, because it gave the project international visibility and in incentive to get on with the business of designation.

After the summit, the biosphere reserves project had momentum and there was considerable urgency in reaching decisions on areas to be designated, lest the momentum diminish. Unesco had just the year before published its guidelines for selection of biosphere reserves, and they presented the United States with a dilemma. The ideal reserve was envisioned as a well-protected area of the earth's surface sufficiently large to include a representative diversity of the ecosystems of a particular biome, and administered so as to provide sites for baseline observational research on undisturbed ecosystems, to take place in a securely protected core zone, as well as experimental sites where manipulation would be encouraged to find and demonstrate better ways to manage ecosystems for improving the well-being of people. These manipulations would take place in a buffer zone surrounding the core zone. By coordinating the research activities in the core and buffer zones, the scientific information needed to support the sustainable conservation or--if you prefer--the integrated development of the characteristic ecosystems of the region, would result. Unfortunately, such ideal multiple-use research and demonstration sites were not readily available for designation. If the United States wanted to begin a biosphere reserves network, it would have to depart from the platonic in favor of the pragmatic.

The strategy involved the pairing of securely protected national parks and monuments with experimental research areas, all under federal administration. The parks and monuments contained the large, strictly

conserved core zones, which most of the experimental areas lacked. The experimental areas, however, provided the opportunities for manipulative studies and demonstrations that are primary activities in the buffer zone. By pairing the two kinds of biosphere reserves within the same biome, it was hoped that the multiple purposes of the biosphere reserve would be achieved.

The United States biosphere reserve network today reflects this cluster concept. Of its 38 biosphere reserves, 22 can be considered to serve primarily as core zone areas, and 13 primarily as experimental research areas, with only 3 providing the balance of opportunities that characterize the ideal. This "hybrid" system contains many of the world's most comprehensively studied natural and managed ecosystems, where human knowledge has been advanced in ways that have significantly improved man's stewardship of natural resources and the quality of human life. Despite their prominence as research areas, the network of biosphere reserves is far from realizing its potential. Let me discuss a few of the problems, and the opportunities.

FIRST AND FOREMOST PROBLEM

The nation's biosphere reserve network is still an embryo when it comes to protection of a representative diversity of its 20 biogeographic regions. This problem is by no means unique to the United States as there is no domestic network anywhere that today satisfies this essential criterion. In many countries, particularly in the tropics, just defining a representative ecosystem-level diversity still constitutes a formidable task. However, in most of the developed countries, understanding of ecological diversity and the factors that influence it has reached a point where a consensus on the ecosystems to be represented in the biosphere reserves of a particular biogeographic province is possible. New biosphere reserve selection procedures adopted in the United States utilize multidisciplinary teams of scientists to arrive at this consensus. In the extremely diverse southeastern evergreen forest biogeographic province (Austroriparian sensu Udvardy 1975), the team readily reached agreement on 27 ecosystems, identified primarily on the basis of predominant vegetation. In smaller and less diverse provinces, fewer ecosystems would be defined, but it is difficult to envision a province in the temperate zone with fewer than a dozen ecosystems requiring representation. Because only a few of these ecosystems generally occur in a particular area, multiple reserves are required in each province to complete the network. The existing network of biosphere reserves is a good first start, but each province (except the southeastern evergreen forest) still requires a systematic analysis to identify and nominate qualified sites that will achieve the conservation purpose of the network.

To avoid proliferation in the number of biosphere reserves and to encourage cooperation among ecologically related sites, we are considering the possibility of naming biosphere reserves after the biogeographic province, or a subregion within it, and including a number of qualified sites within each reserve. Under this approach, Glacier National Park might be part of a multi-site Northern Rocky Mountain Biosphere Reserve, which would include the existing biosphere reserve sites in this subregion

as well as others, which may be determined to qualify for nomination at some future date.

While the individual sites would be able to display their own plaques, hold a dedication, and otherwise participate in the full benefits of biosphere reserve status, the advantage of the approach would be to emphasize the broader mission of the designated areas within the region as a whole. We have already adopted this approach in the southeastern evergreen forest province where the New Jersey Pinelands and the Congaree Swamp National Monument are being nominated as the first units of a South Atlantic Coastal Plain Biosphere Reserve, which may ultimately include as many as six sites under nearly as many different administrators. Once a group of sites has been united under the common biosphere reserve designation, voluntary mechanisms for coordinating monitoring, research, educational, demonstration, and training activities could be voluntarily established. This remains a future goal, but one that promises both increased effectiveness and cost savings in carrying out these activities.

Another important challenge is to find better ways to spread the word about biosphere reserves. Biosphere reserves provide an important new dimension in world conservation, and have been prominently mentioned in most major studies on the subject. Unfortunately, in the United States, the biosphere reserve does not command instant recognition, even among scientists and resource managers.

Many people who are somewhat familiar with the biosphere reserve regard it as just another designation applied to an already well recognized conservation area. Few see biosphere reserve status as conferring a new dimension to the mission of the designated area whereby the designated site becomes a part of a growing global network of cooperating areas that are making major contributions in protecting the ecological and genetic diversity of the planet, and in developing ways to sustain this diversity indefinitely for the spiritual and material benefit of people. To help develop a constituency for biosphere reserves, U.S.-MAB has put together guidelines for site managers to use in communicating to a variety of constituencies about the biosphere reserve and its programs. The guidelines provide many suggestions to help achieve the objective of an effective communication program in each biosphere reserve.

In the arena of science, an impediment to effective collaboration is the lack of a comprehensive compendium of information on the history of scientific study in each biosphere reserve to serve as a basic and readily updatable reference for those with a need for access to this information. The need for such references is particularly apparent in making international collaboration possible, as original studies and reports may be unobtainable in many overseas locations. To help remedy this problem, the National Park Service has begun a program to prepare comprehensive bibliographies and a history of scientific study for each of its biosphere reserve areas. There is an indication that the Forest Service is planning to initiate the first such compendium in its Coweeta Biosphere Reserve in North Carolina. In order to promote international collaboration, we have placed top priority on carrying out these studies in biosphere reserves along our international boundaries. A project has been initiated along the Mexican border at Organ Pipe Cactus National Monument, Arizona, and

one is planned for Big Bend National Park in Texas. I am pleased to announce our intention to begin an assessment this year at Glacier National Park, and look forward to exploring opportunities for cooperation in this effort with other land managers in the region, and particularly with our colleagues from Canada. Our experience has shown that these studies provide an exceptional means for involving a large number of scientists in developing both an immensely valuable reference as well as the perspectives needed to formulate scientific and resource management programs that respond to the important problems of the region. As an example, it is worth noting that the first volume in the series has just been completed for the Great Smoky Mountains Biosphere Reserve, and involved 93 scientists in its preparation.

If you would like a copy of this report, or would like to be placed on the list to receive volumes for Glacier or another biosphere reserve, I have a sign-up sheet here for this purpose.

As a primary function of the biosphere reserve is research, the success of the network depends on the support for broad-based programs that help us understand how ecosystems are structured, how they function, how human activities affect them, and how they can be used for human benefit on a sustainable basis. For many years, biosphere reserve status cannot only increase the direct support of the reserve administrators for their own research on the site, it can also serve as a strong inducement for outside researchers to utilize the site. These potentials, which are only partially realized today, will become more fully realized in the future as the size and scientific value of biosphere reserve data bases grow, and as securely protected sites for observational and experimental research become less available. Even though many biosphere reserves have well-funded research programs, the designation itself has not been much of an influence in developing them. Most of the reserves have serious deficiencies, particularly in the area of long-term monitoring where the pay-off in terms of fulfilling the site's management objectives may be years away. A major challenge in the years ahead will be to make the biosphere reserves the intentional, rather than the incidental, beneficiaries of agency support, and to build multidisciplinary research programs that serve both the short-term goals of management and the long-term goal of sustainable conservation of ecological resources of the region and the world. Maintaining the continuity of research programs in natural areas has always been difficult, given the impermanence of personnel and objectives. Yet, in the biosphere reserve we have an opportunity, and indeed an obligation, to detect and head off a growing array of environmental and land use problems.

It is becoming painfully obvious that conservation of the world's natural diversity will be possible only if most of its people want it to happen because they perceive this to be essential to their personal well-being. If our biological heritage is to survive the assaults of human civilization, the spiritual benefits we have so successfully used to support conservation in the developed countries will increasingly have to be supplemented by demonstrations of conservation's many economic benefits. In the developing world, the challenge will be to demonstrate all of these benefits, and to do so persuasively and quickly. Biosphere reserves are

places--in some countries, the only places--where a growing body of knowledge about the planet's ecosystems will be put to work in practical ways to educate, enhance sensitivity to the natural world, and give people the skills to use it wisely. Because of this, they can be an important moral force for the betterment of mankind by fostering consultative interactions and providing places where people work together to solve problems at the local, regional, and global level.

During the months ahead, the US-MAB project on biosphere reserves, in cooperation with various agencies and organizations, will be bringing scientists and others together from various parts of the world to begin this consultation on a few of the more pressing problems. In August, a major symposium and workshop is planned in Washington to look at ways in which the recent advances in genetics and conservation biology can be applied in managing plant and animal populations in a world vastly different from the one in which they evolved. Early next year, representatives from several nations will meet in the Everglades Biosphere Reserve to develop perspectives on the problems of the world's large wetland reserves, and ways to address them through cooperative research. Later next year, we hope to utilize the dedication of the Virgin Islands Biosphere Reserve as a springboard for an international workshop on conservation of biological diversity in the Caribbean region, and perhaps provide a catalyst for developing a biosphere reserves network in this important region.

As we commemorate the 50th anniversary of the international peace park, let us not forget that the designation of these sister parks as biosphere reserves confers upon us, their stewards, a special obligation to work together to solve the many problems that threaten to nullify the honor bestowed upon them by the world community. I am sure we share the hope that from the spirit of this conference will come, in the weeks and months ahead, concrete plans for action that will allow us to translate the moral force of the biosphere reserves into practical achievements in conserving the priceless natural heritage of the region.

THE FUTURE OF THE BIOSPHERE RESERVE
IN NORTH AMERICA AND ABROAD:
OPPORTUNITIES FOR COOPERATION

A VIEW FROM CANADA

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Only two biosphere reserves were designated in Canada during the first decade of the Unesco Man and the Biosphere Programme. One is a rather small area of about 1,100 hectares at Mont Ste. Hilaire, which is one of the Monteregian Hills in the Laurentian Lowlands southeast of Montreal. This site is owned and maintained privately by McGill University and the Monte Ste. Hilaire Nature Conservation Centre. The other is Waterton Lakes National Park. It was first put forward for designation as a biosphere reserve after Glacier National Park was so recognized. This served to continue the tradition of viewing these two areas as a single major landscape complex, a tradition maintained since their joint designation as an "International Peace Park" half a century ago.

I am a relatively recent newcomer to the Canadian national committee for MAB (Canada/MAB) so I am not familiar with all the reasons why more biosphere reserves were not established in Canada during the 1970s. Certainly there are excellent candidate areas in Canada, and a reading of some of the documents on file concerning Canada/MAB activities shows that a number of possibilities were raised and discussed from time to time. There appeared, however, to be two reasons why efforts to establish more biosphere reserves did not seem to enjoy high priority during this period.

One was that the Unesco/MAB's project itself, of which biosphere reserves are a part, was rather late in getting underway. By the time it did, the interest and attention of Canada/MAB was directed to other theme projects of interest during the 1970s. Almost all of these posed a difficult challenge. We had to consider how in Canada we could best develop the kinds of interdisciplinary and management oriented ecological research and environmental monitoring projects that expressed the ideals being fostered throughout the world by Unesco/MAB. The difficulties encountered in obtaining the necessary recognition, funding, and other support from the academic community, government agencies, and research funding bodies became a matter of continual concern. They also brought forth considerable effort and frustration among various Canada/MAB participants over the years; nevertheless some good projects did get done. I wish I could report that underlying problems with entrenched professional attitudes, institutional arrangements, and funding priorities have been sufficiently overcome to allow MAB and the ideals for which it stands to flourish in Canada during this second decade of the program. But in all honesty, I cannot.

The second reason was that activities consistent with some of the goals of MAB Project 8 were being pursued in Canada through an Associate Committee for Ecological Areas sponsored by the National Research Council. A large number of candidate ecological sites had been identified under the Conservation of Terrestrial Ecosystems project of the International Biological Programme (IBP-CT) during the 1960s. The associate committee, which continued until 1977, strove to obtain official recognition and protection for these areas in the provinces and territories. It should be noted in this regard that since British Columbia passed the first Ecological Reserves Act in 1971, eight of the ten provinces now have quite comparable statutes to protect important ecological sites. We view these to be major additions to the institutional arrangements through which some of the objectives of both IBP-CT and MAB Project 8 can be realized in Canada.

Canada/MAB started its second decade under new arrangements after the former ones were rather unceremoniously terminated in 1979. The secretariat responsibilities were picked up by the Canadian Commission for Unesco where they are now being supported on a year-to-year basis. The Canada/MAB committee itself was partly reconstituted. It was at this time in November 1980, that the question of biosphere reserves came up again. A small working group was convened to look into what could be done by working informally and with very little budget to help develop a system of biosphere reserves in Canada.

We are all aware that if only landscape features are considered, then Canada has a rich array of candidate biosphere reserves throughout the country. Many would already have a substantial "core" area protected under some park or equivalent reserve designation. However, we also have to try to determine whether any site that meets the biophysical criteria for a biosphere reserve is also set in a situation that is conducive to realizing the full potential inherent in the concept. This means at the very least that those who would have to be directly involved in a biosphere reserve and its activities must welcome and support the idea, otherwise a designation would likely be no more than on paper only.

From this basic perspective, the working group with a strong endorsement from Canada/MAB has been doing the following:

Preparing Information on Biosphere Reserves

We saw this as a first priority since few people in Canada know of biosphere reserves and the purposes they are meant to serve. In April 1982, Canada/MAB printed an illustrated brochure using a question and answer format for general distribution, especially in the two existing biosphere reserves. It also published Canada/MAB Report 15 on the "Nomination of Canadian Biosphere Reserves" to update earlier reports. The report briefly discusses the concept of biosphere reserves, indicates some of the implications of establishing and maintaining biosphere reserves, and presents the current Unesco/MAB guidelines for the information and documentation needed to nominate candidate areas.

Creation of a Biosphere Reserve Committee and Program of Activities at Waterton Lakes

The Waterton Lakes Biosphere Reserve designation was received in 1979 for the National Park. One way to look at this is that a magnificent core area has been recognized for a biosphere reserve that has yet to be fully developed. I believe this is comparable to many situations elsewhere at this time in the development of Unesco's international network of biosphere reserves.

The challenge then is how to work towards realizing the potential inherent in the concept of a biosphere reserve by bringing together under some informal cooperating arrangement the landowners and resource management interests from areas adjacent to the national park, viewed as the protected core area. The reason for doing this is to determine how some of the land use and resource management problems of interest to these other groups could be understood better by comparing the situation under relatively undisturbed conditions in the park with that in managed and utilized zones outside of it.

Over the past year or so, this possibility has been explored through informal meetings with ranchers, officials from provincial agencies dealing with regional planning and resource management interests, and people from universities and research institutions. Several special areas of common interest have been identified through these discussions and a Waterton Lakes Biosphere Reserve committee was established in March 1982, to pursue these questions further. Charley Russell, one of the co-chairmen of the group, has reported on their activities earlier in this symposium.

I can only add that Canada/MAB is pleased to see this initiative being taken. It could well lead to a good working model for biosphere reserves and this we recognize to be highly desirable for getting other people in Canada interested in the whole idea.

Nominations for New Biosphere Reserves

As noted earlier, there are a number of areas in Canada for which there would be little doubt about their suitability for recognition as biosphere reserves. Nevertheless given the importance that has to be placed on the acceptance and support among different organizations and groups who would have to be involved in maintaining a fully functioning biosphere reserve, the necessary time and care has to be taken for laying the groundwork of understanding and commitment for this. Our working group has taken quite a pragmatic approach to this. We try both to elicit and respond to interest expressed in the possibility of developing nomination submissions for candidate areas that appear to have all the prerequisites for being given biosphere reserve status.

At this time we are working informally with persons in the responsible administering agencies to consider nominations for three additional biosphere reserves. I mention these only to indicate what we are trying to do, and hasten to add that no official requests have been made as yet

to Canada/MAB to submit these to Unesco. The three areas we are looking into are: the Spatsizi Plateau in northern British Columbia, an area representing a rich variety of boreal and northern alpland ecosystems with major populations of large mammals; the Milk River Canyon grasslands in southeastern Alberta, an area of quite undisturbed mixed prairie grasslands; and the Long Point complex on the north shore of Lake Erie in Ontario, an area that is a superb example of the erosion deposit sand spit formation and associated habitats found in the lower Great Lakes.

Review of What is Known about the Two Biosphere Reserves

In looking ahead somewhat to the kinds of research and associated activities that might be fostered in biosphere reserves, we are now considering research reviews that would pull together what already is known about the two existing biosphere reserves as a necessary first step. Mont Ste. Hilaire has had such a review underway over the past several months, and we are exploring how a comparable review might be done for Waterton. There has been quite a lot of work done through Parks Canada in Waterton since the first bibliographic review was prepared by Bob Scafe in 1972.

Our assumption in doing this is that such reviews, together with the identification of resource management issues of concern to the local biosphere reserve committees, would be of help in outlining directions and priorities for research and monitoring activities based in the various component areas of the biosphere reserves. While this in itself does not address the difficulties in getting proper support for the work that should be done, it may be possible to elicit responses from individual research workers based in universities or government research institutions to work more closely with the local committees.

Adaptation and Refinement of the Udvardy-Classification of Biogeographic Provinces for Use at National and Subnational Levels

The working group has identified this as something to be considered although it has not initiated specific activities just yet. The Udvardy classification seems quite useful for the purposes it is meant to serve, namely a global framework to help guide the development of an international network of biosphere reserves. Nevertheless, before it could be used effectively as a planning and assessment framework for developing a system of biosphere reserves within countries, it would have to be adapted and refined at increasing levels of scale and detail. This would then allow for a more refined judgment about the "representational" features of any given biosphere reserve than is now possible through just noting which biogeographic province it is in.

We do see a lot of merit in the pragmatic approach to this question taken by our United States colleagues. They have addressed it by relying on the good judgment of a panel of experts who are knowledgeable about different aspects of the biogeography of a given biogeographic province. In fact, we have cooperated informally in one exploratory exercise to

review the possibilities for a biosphere reserve somewhere in the Sitkan Biogeographic Province, which includes Alaska and British Columbia.

In addition, however, we also believe that the considerable work that has gone on in Canada, especially over the past decade to develop different classifications of natural or ecological regions, often for purposes of planning for parks or ecological reserves, might be an especially useful experience to review. Some comparisons of the mix of criteria, operating scales, ease of use, and clarity of presentation of these different systems should yield insights on how we might consider adopting them or adapting them to mesh with the basic Udvardy classification scheme used by MAB.

Looking a little further ahead now, a few other possibilities might usefully be looked into. The first one, raised by the convening of this symposium, is that of informal cooperation between groups associated with U.S./MAB and Canada/MAB. We talked about this informally a year or so ago and could see two general directions to consider. One is the unique opportunity provided by having a shared biosphere reserve such as Glacier/Waterton. In our view, the direction and extent of mutual cooperation here must be decided by those directly involved with the two biosphere reserves.

The second opportunity is provided by the fact that 9 of 12 biogeographic provinces occurring in Canada also occur in the United States. This readily suggests that we might review our shared MAB Project 8 interests in each of these areas, partly to look into possibilities for new biosphere reserves, and partly to consider cooperation between biosphere reserve programs within these biogeographic provinces. The exploratory exercise mentioned earlier for the Sitkan is a first step in this direction. We are open to considering others, especially when we succeed in getting more biosphere reserves recognized in Canada.

Another avenue I think worth pursuing is to consider the extent to which, for any given biogeographic province, the existing systems of parks and equivalent reserves complement and strengthen the roles of biosphere reserves. In Canada as in the United States there are a number of agencies working at different levels of government as well as a number of private organizations who own and protect natural landscapes for various reasons. I believe that it is time to start viewing these as the basis for identifying some multi-institutional systems of protected areas for major natural regions. They should be reviewed to determine what else might be needed to round out such systems so that the full range of natural and man-made diversity deemed worthy of protection gets included among the areas under protective management.

I believe the MAB program could be used to develop useful definitions and guidelines for such multi-institutional systems. MAB recognizes the importance of cultural landscapes as well as the more natural ones and it has a global framework for defining natural regions in the Udvardy scheme. This line of endeavor would have to be related closely to whatever may be done to refine and adapt the Udvardy classification system for use at national and subnational levels.

Finally, the notion of integrated environmental monitoring related where possible to the Global Environmental Monitoring System (GEMS) has long been proposed as one function that biosphere reserves could support. I am aware of the state-of-the-art problems to be faced in the design of monitoring systems, especially any that are intended to detect subtle yet important changes occurring over a long period. Nevertheless this is a subject worth pursuing in the second decade of MAB.

In conclusion, then, I am cautiously optimistic about the possibilities of strengthening the Canadian presence in the international network of biosphere reserves. There seems little doubt that we will proceed slowly under the circumstances, but hopefully we will succeed in laying a good foundation for biosphere reserve activities as we go along. I am quite convinced that the MAB ideals give us the guidelines we need, and symposia such as this one give us the encouragement to persist.

BIOSPHERE RESERVE/OPPORTUNITIES FOR COOPERATION
A GLOBAL PERSPECTIVE

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For two days now we have heard about biosphere reserves from every possible point of view--from the general concept by Dr. Miller to the perspective of the rancher by Charley Russell. We have heard about reserves in the South Pacific, in Southeast Asia, in Europe, and elsewhere in North America. In essence you have had a global perspective and you don't need me. I am sure that you have made your own deductions about what works and what doesn't work.

With respect to the future, the concept is now 10 years old--not a long period in the implementation of a social invention, which is what the biosphere reserve is. From the little I will say, you will see that the future of the concept rests on what we do here. There is no "foreign magic" that is going to organize us and there are no "foreign dollars" that are going to keep us afloat. On the other hand, if our efforts achieve what we want, then the future of the concept is more assured. If we do not find the concept useful, then it should be laid to rest. The will to make the concept work depends on cooperation. In brief, thousands of local decisions will determine the global future. This will be the focus of my talk.

I have never prepared a paper on which I have deliberated as much about its relevance to the audience as this one. I have been deeply concerned because we are at the end of three days' deliberation about biosphere reserves in general and the Waterton/Glacier area specifically.

My task is to speak of the future when most of us are concerned about the present, to speak of the globe when most of us are concerned with a specific territory, to speak of cooperation when most of us have very specific tasks, and to speak on biosphere reserves when most of us have used up all of our reserves.

First of all, the future is going to come whether we do anything about it or not. The kind of future we have around Waterton/Glacier can be greatly influenced by our actions and inactions today. We can choose to continue the same route as we have followed in the past or we can choose a more innovative route.

I perceive the first route as one in which we do our own thing on our own territory, independent of the actions that take place around us. This is the route where the park superintendent doesn't know his neighbors or their concerns. This is the route where the local people never see the park superintendent--if they do think of him, its in the sense of another "fed" with a cushy job adding to the tax burden. If we do choose to follow this route, I doubt that we will be able to effectively tackle the issues that have been exposed during the past three days. We will not influence the future, it will unfold.

If we choose the innovative route, which I will call the biosphere route, we will have an opportunity to influence the future by some new approaches. Let's look at administrative innovation as one means of influencing the future.

First, we need to put the "biosphere" in perspective. It is an esoteric term, which for most of us generates a sense of irrelevance. What can we do to influence it? Or what impact does it have on us? The only thing we really need to remember is that as men and women we are each a part of the living organisms of the biosphere. Our actions have an impact on our local situations--on us. The sum total of these actions has a global impact.

When we think of the biosphere we tend to think of something happening out in space. Perhaps a concern for acid rain or CO₂ buildup is the image we conjure up. The point I wish to make is, in reality, we are dealing with the here and now. Perhaps we should call it the "locosphere" so that we give more emphasis to the local circumstances that we know we can influence.

When we think of the biosphere we think of some distant decision maker--perhaps in Unesco's offices in Paris or in a federal office in Washington or Ottawa. Without being facetious, you know as well as I do that decisions by bureaucrats at the top of the pyramid rarely bode well for the man on the ground. I would suggest that we perceive a hierarchy of decision-making with the federal government at the top, the provincial government in the middle and the individual at the bottom. To make a biosphere reserve work we need to reverse this--in effect to invert the pyramid (Figure 1).

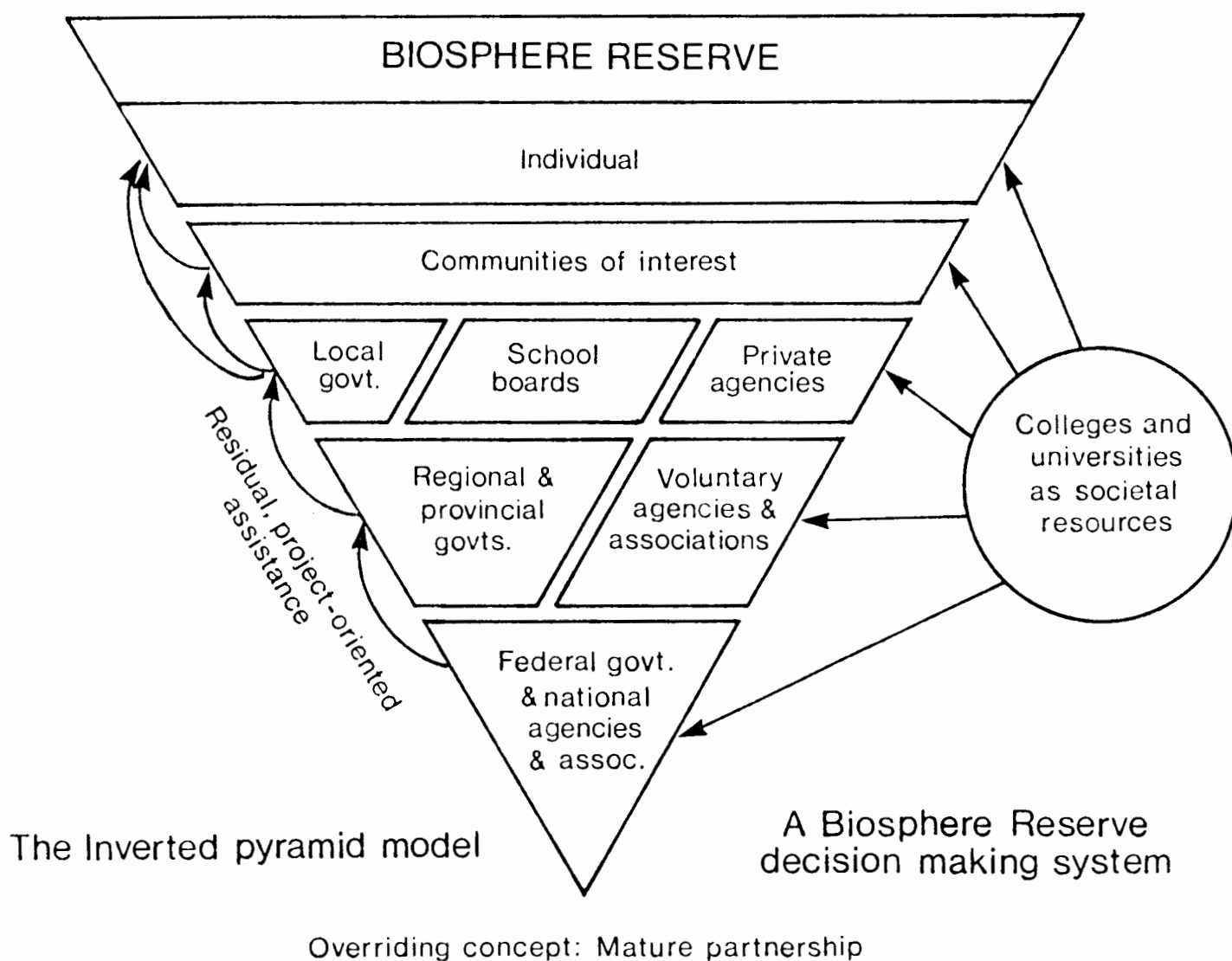
One approach to such an inversion of the decision pyramid described it as follows:

The system is designed to support and cherish the participant, operating at his or her own level. . . . Those services that cannot be provided by individuals or their communities then become the responsibility of local agencies. More specialized services come from the provincial governments--and finally, highly specialized residual services are provided by federal agencies. . . .

In looking at this model, we can see from the participation in this seminar that we have the ingredients to make it work. We have individual landowners, we have community representatives, we have colleagues from the universities, and we have provincial and federal representatives. From Parks Canada's point of view, we would like to see Waterton/Glacier work as a pilot project. The Canadian steering committee for Waterton jointly chaired by two of our ranching colleagues is a key step in this process.

In applying the recreation model to the biosphere reserve, we can see that we have a great range of interest from the federal government to the individual. The dominant place of the individual and the community illustrate the local focus of the decision process.

Figure 1. The Inverted Pyramid Model.



I would like to reinforce the local involvement aspect of the biosphere reserve in two additional ways. Dr. Ralph Slatyer, the former chairman of the MAB International Coordinating Committee, put it something like this. The key lies in research and training, rooted in the reality of priority problems as perceived at local and national levels. Unless an institution or an individual starts a project, so far as MAB is concerned nothing happens. In essence, the global system strictly speaking is an agglomeration of local projects. Without action at the local level there will be no action at the global level.

I look upon biosphere reserves as a new type of management and planning tool. The importance of the local involvement cannot be overstated and is in fact the most important element that distinguishes the biosphere reserve from the national park or national forest.

In a recent publication, "Growth Without Ecodisasters," Michael Royston described an idealized decision process as follows:

The global crisis has to be solved from the local village upwards, by building a political system which starts with the community and moves up to the region and then progresses up further to the national and international level--rather than being imposed from the central government or central capital downwards, so leading to alienation and frustration.

This statement describes the Swiss government in which the commune has a primary role and the federal government has a residual role as illustrated in the "inverted pyramid." The "biosphere reserve" thus provides an innovative administrative mechanism for looking at issues. It looks beyond the ranch, it looks beyond the park boundary, it looks beyond the province, and in Waterton/Glacier's case it looks beyond national frontiers. Cooperation is the key to dealing with issues of broad concern. Personal action remains the key to dealing with issues that are intrinsically a part of each individual operating unit.

From a global perspective a working biosphere reserve is a demonstration area. It can provide considerable guidance to others on how to tackle their problems. The Waterton/Glacier Biosphere Reserve provides a high degree of management complexity with private lands as well as public lands. A management structure that integrates all the concerned individuals in setting objectives would, in itself, be a formidable achievement. A program that achieves the stated objectives through joint action would be a major contribution to the global MAB program.

The future of the biosphere reserve program is literally in your hands. Each successful operation ensures the success of the program. Each failure reinforces the need for better approaches. The global perspective is the sum of all the local projects. Without your effort and cooperation there will be no global program.

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