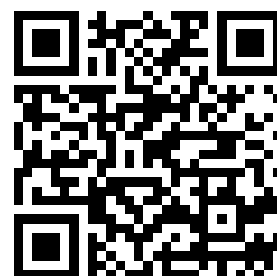

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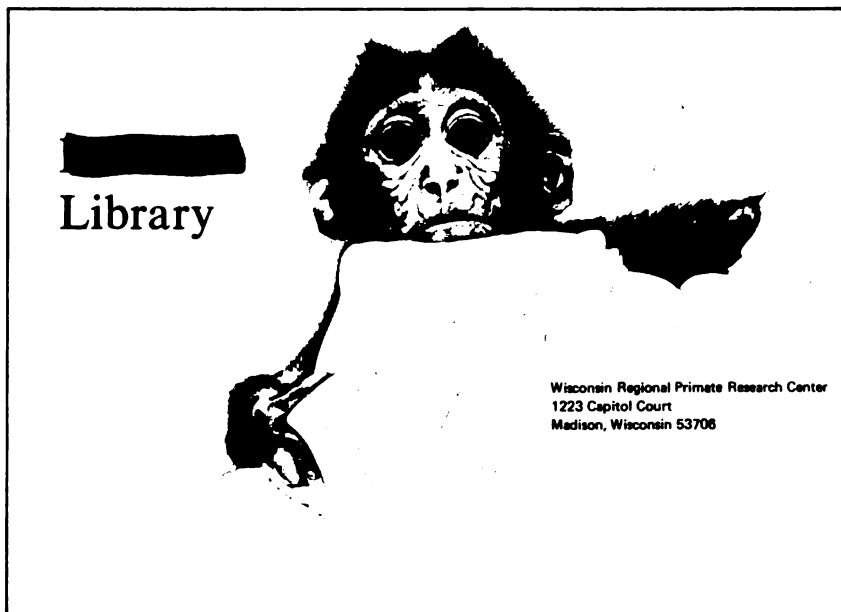


SECOND DRAFT
OF
A WORLD CONSERVATION STRATEGY

Prepared by the International Union for Conservation
and Natural Resources (IUCN)
with the financial assistance of
the United Nations Environment Programme (UNEP)
and the World Wildlife Fund (WWF)



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PREFACE

A World Conservation Strategy has been commissioned by the United Nations Environment Programme (UNEP), which together with the World Wildlife Fund (WWF) provided the financial support for its preparation. IUCN is grateful to both organizations, not only for this support but also for their cooperation and advice during the Strategy's preparation.

The goal of the Strategy is to achieve - as soon as possible and to the fullest possible extent - the conservation of the living natural resources on which human survival and wellbeing depend.

Achievement of this goal requires:

conservation organizations and individuals to spend much of their energies and funds on ensuring that fundamental requirements for conservation are met and only some of their energies and funds on emergencies and issues of the moment;

better and more widespread understanding of the concerns and relevance of conservation;

national development policies and priorities to favour sustainable developments that can provide a balanced combination of short- and long-term benefits as opposed to those developments that bring short-term benefits while precluding long-term ones.

The aims of this Strategy, therefore, are:

to identify the fundamental requirements for conservation;

to suggest how they might be met;

to identify those ecosystems and species of such importance and facing such grave problems that they require urgent measures either before or at the same time as the fundamental requirements are being met;

to provide a clear explanation of the concerns and relevance of conservation, together with suggestions on how to communicate this information;

and in general to promote conservation as an integral part of sustainable development.

The Strategy is intended to be read and implemented by governments, intergovernmental organizations, and international and national nongovernmental organizations both non-commercial and commercial.

The Strategy is also designed to help UNEP, FAO, UNESCO, and IUCN (all members of the Ecosystem Conservation Group), as well as WWF and other concerned organizations, to derive programmes from it which:

- consist of high priority projects;
- do not duplicate the programmes of other organizations;
- and can be implemented in the context of complementary activities by other bodies.

As such, the Strategy does not consist of lists of priority ecosystems and species or even of priority problems. Rather the emphasis is on recommending criteria for deciding priorities, together with priorities for general actions which can then be adapted to suit particular national and local conditions.

In a sense, A World Conservation Strategy will never be finished. It is meant to be an evolving document - to be regularly revised and improved with new knowledge, better understanding, changes of perception and values, and, it is hoped, as implementation of the Strategy reduces some problems and allows attention to be devoted to others.

A Sourcebook is being prepared to complement the Strategy, covering in greater detail three categories of subject: biomes and ecosystems; species; issues and measures. The Sourcebook for A World Conservation Strategy will be published in a series of volumes from the beginning of 1979 onwards. Preparation of the Sourcebook is expected to generate additional material for inclusion in the Strategy in subsequent revisions.

The problems posed by the destruction, degradation and depletion of living natural resources are many and complicated. The resources available to tackle them are small and priorities for their use are not always determined with sufficient care. There is a need to deal with the causes of many of these problems rather than with the symptoms. There are many competent, interested organizations with widely divergent aims, whose effect on the problems would be greater and longer lasting if they cooperated more along agreed lines. It is hoped that this Strategy will help governments, intergovernmental bodies, private organizations and individuals to cooperate with each other and jointly deploy the limited resources available to much greater effect. If this is done, then the prospects for conservation will be much enhanced.

D.J. Kuenen
President, IUCN

ACKNOWLEDGMENTS

This document has been prepared with the help of a great many individuals. A first draft was circulated to all the members and Commission members of IUCN, to members of the Ecosystem Conservation Group, to individuals associated with World Wildlife Fund, and to other concerned organizations and individuals. More than 140 responded with valuable criticisms and suggestions. Essentially, therefore, this World Conservation Strategy is a synthesis of their ideas and of the stock of shared and therefore unattributable ideas on which all authors draw.

Several people have been more than usually helpful, however, and their contributions are acknowledged with special gratitude. Duncan Poore, the senior consultant on the project, made useful comments on intermediate drafts as well as contributing many of the paragraphs on political commitment, transformed ecosystems, tropical rain forests, and drylands. Thomas B. Stoel, Jr., provided a number of the ideas and much of the inspiration for the section on development aid and technical assistance. Peter H. Sand contributed paragraphs on shared catchment areas. The analysis of representative samples of ecosystems and their protection was done by Harold K. Eidsvik; and Earl B. Baysinger helped with the section on species in international trade. Patricia J. Scharlin reminded us that the definition of conservation should have a time-frame. J.H. Koeman helped with the paragraphs on incidental kills caused by spraying campaigns. Michael Allaby, Chew Wee-Lek, John Kundaeli and Felipe Matos provided recommendations on tropical rain forests. Christopher Dunford, Robert M. Pyle, Maarten Bijleveld, Grenville Ll. Lucas and Hugh Synge, and Sidney Holt and Robert Allen provided recommendations on drylands, invertebrates, mountain systems, plants, and the seas, respectively. G. Carleton Ray helped to develop Duncan Poore's valuable distinction between original, modified and transformed ecosystems. The recommendations on the law of the sea come from the IUCN statement on Conservation and the New Law of the Sea prepared by Douglas M. Johnston. Thomas E. Lovejoy contributed his thoughts on the size and distribution of protected areas, and R. Michael Wright made the original recommendation for the establishment of agricultural conservation areas. Both Dr Lovejoy and Mr Wright fed a supply of thought-provoking papers thereby giving the author at least a chance of coping with the occupational hazard of the overloaded bureaucrat: to address tomorrow's problems with yesterday's data and the day before's ideas. Christine Prescott-Allen supplied paragraphs on education and protected areas, undertook the task of converting the Red Data Book into tabular form, and analyzed the threats to species. To all of these go warmest thanks.

A special mention must be made of the panel set up by the Council of IUCN to review the second draft of this Strategy: Ing. Mario A. Boza; Professor M. Kassas (Chairman); Dr Ashok Khosla; Dr F. Wayne King;

Dr G. Carleton Ray; together with representatives of UNEP (Ms Mona Björklund) and WWF (Mr Charles de Haes). The panel made so many constructive suggestions that in effect the present text is more a third than a second draft. The members' generous contribution of their time and energies proved indispensable.

Those members of staff who have been heavily involved in preparation and production of the Strategy also deserve thanks. The meticulousness of Dounia Morgan's translation of this draft into French and of Pierre Hunkeler's review of the translation led to improvements in the English original. Anette Herforth efficiently organized the typing and retyping of the drafts of the Strategy and of Sourcebook chapters; Margaret Smith typed an intermediate draft and she and Elaine Fisher thoroughly proofed this one; and Marguerite Jurgensen diligently organized the printing and binding. Geneviève Pichard and Françoise Dagon came to the aid of our hard-pressed secretaries by doing the final typing of the English and French editions respectively. Estelle Viguet took on even more of the work of the Membership and External Affairs Department during the two and a half months in which the author devoted himself to the Strategy. Lastly, I wish to acknowledge Robert Allen, who wrote and rewrote this draft, and to thank Christine, his wife, for sacrificing so many evenings and weekends.

David A. Munro
Director General, IUCN

SUMMARY OF RECOMMENDATIONS

GENERAL REQUIREMENTS FOR CONSERVATION

Political commitment

- 1-2. A commitment to conservation should be publicly made at the highest levels of each nation and province. The commitment should include an undertaking to develop a national (or provincial) conservation strategy and programmes for its implementation. Ideally, a commitment to conservation should also be written into each nation's constitution.
- 3-5. Politicians and government administrators should understand and support conservation. A great effort should be made to achieve this, by devising and propagating internally consistent arguments to show that sustainable development is impossible without conservation. Advantage should be taken of any circumstance in which politicians and governments may be convinced that it is in their interests to pursue policies of conservation.
6. Each nation and government should adopt a measure of economic growth and social progress that takes full account of the costs of destroying, degrading or depleting living natural resources and of the benefits of conserving them.

Better communication and application of existing knowledge

7. Every opportunity should be taken to promote an appreciation of conservation both through the media to the general public and by using the special opportunities provided by special interest groups.
- 8-9. A goal of conservation education should be that ecology be at least as well understood and as widely accepted by the lay person as is economics; and that conservation receive as intelligent media coverage as does energy now. School curricula should include conservation education, preferably not only as a separate subject but also as an intrinsic part of many other subjects.
10. Governments should delegate to NGOs much of the task of promoting support and understanding of conservation and help them to carry it out by commissioning NGOs to produce public information materials and by providing them with data.
11. NGOs should get to know and work with conservationist individuals and administrations in government, which need (and can use effectively) the public pressure and support generated by NGOs - especially when they are well-informed.
12. Administrators should not only be trained in conventional disciplines of administration but should also be knowledgeable about ecology, wildlife biology, and conservation in general. In turn, administrators

should be able to call upon cadres of experienced scientists, trained technicians and field personnel whether in government service or not. National or regional training centres and programmes should be set up to meet these needs.

13. Governments and national and international organizations should devise and launch programmes to promote understanding by local communities of the values and requirements of conservation and to train them in improved land-use practices.
- 14-15. Research should be conducted concurrently with the preparation of national and provincial conservation strategies, natural resource inventories and ecological capability assessments - which should be based on available knowledge and not deferred so that more knowledge can be accumulated. Strategies and assessments should be evolutionary, being modified from time to time in the light of new knowledge and changes in perceived needs, aspirations, and values.

Better planning

- 16-17. Every country and province should prepare its own conservation strategy which should influence and be a part of any national (or provincial) economic or development plan. Each strategy should identify critical areas of overlap with policies on human settlements, energy, mining, industry, water, agriculture, forestry, leisure, and so on, so that such policies can be modified well in advance.
18. Each strategy should estimate the investment of resources, describe the political decisions necessary to achieve the stated conservation aims, and identify the entities which possess the necessary resources and powers of decision. The strategy should propose a plan of action to bring about the required resource allocations and political decisions. The strategy should also provide policy guidance for dealing with other governments and with international organizations.
- 19-20. Each nation and province should prepare an inventory of key ecosystems and species, and of the ecosystems and species on which those ecosystems and species depend. An ecosystem capability assessment should then be conducted. The uses and values of each ecosystem-type should be assessed, and alternative uses, areas of potential multiple use and areas of conflict should be identified. Appropriate uses can then be allocated.
21. Given the increasing capacity of human societies for making irreversible changes to the environment, the allocation process should favour those uses that maintain the greatest number of future options.
22. Environmental impact assessments should be an essential and integral part of all planning for major actions, and should be carried out at the same time as engineering, economic and socio-political assessments.

23. Strategies, ecosystem capability assessments, policy decisions and environmental impact assessments, together with the scientific, economic and policy bases of such strategies, assessments and decisions, should be disclosed to the public, which should be given adequate time to influence them. Public involvement should be such that the public is able not only to influence the decision in question but also to cause refinement of the strategy or policy.

Better institutions

24. Governments should review the organization and funding of administrations with responsibilities for living natural resources, together with the legislative provisions governing actions affecting living natural resources and take the necessary steps - including changes in legislation - to ensure that they have the capability to carry out promptly and fully conservation strategies, natural resource inventories, ecosystem capability assessments, environmental impact assessments and any other measure required for the conservation of living natural resources.
- 25-26. The different administrations with responsibilities for living natural resources should have clear mandates and such mandates should specify conservation. There should be a permanent mechanism for joint consultation on, and coordination in, both the formulation and the implementation of policies. There should be independent representation of interests. Each administration should be enabled by statute to disclose and explain its positions to the public. Policies and decisions should be implemented.
27. Governments should ensure that conservation is adequately funded. In addition, they should allow conservation administrations to resort to independent means of raising funds, whenever the constitution does not preclude their doing this.
28. Whenever possible conservation legislation should follow and buttress improvement in public understanding and support. When this is impractical, a greater effort than usual must be made to ensure that the law is enforced and that the reasons for the law are understood.

More knowledge

- 29-30. Major gaps in knowledge should be identified and research programmes to close these gaps should be elaborated and implemented. Existing national and international programmes intended to close such gaps should be supported. At the same time the outcome of conservation strategies, natural resource inventories, ecosystem capability assessments and any other actions with effects on the environment should be monitored. The findings of such monitoring, together with the results of research, should be used to improve policies, strategies, assessments and other measures.

SPECIAL REQUIREMENTS: ECOSYSTEMS

31. In every country there should be a balance among original, modified and transformed ecosystems so that the fullest benefit may be derived from the special characteristics of each.

Original ecosystems and their protection

32. The following types of original ecosystem should be protected from transformation or modification: representative samples of the range of ecosystems in each country or province; centres of endemism and species-rich ecosystems; habitats of species threatened by habitat destruction or degradation.
- 33-34. Representative samples of the different kinds of ecosystem in each country should be protected. Only those uses that are compatible with the preservation of the ecosystem and its component communities of plants and animals should be permitted in such areas. National protected area programmes should be coordinated with international programmes, so that a complete network of protected representative samples of ecosystems may be established as soon as possible.
35. Each country should identify its centres of endemism and its species-rich ecosystems and ensure their preservation in protected areas as a matter of priority. In these areas preservation should have prior claim over other uses.
- 36-37. The habitats of threatened species should be protected. Each protected area should safeguard all the habitats (the feeding, breeding, nursery and resting areas) of the species concerned. Where this is clearly not possible - as in the case of migratory or wide-ranging animals - a network of protected areas should be established, the effect of which would be to safeguard all the habitats of the species concerned. Any external source of the nutrients and other essentials on which each habitat depends should also be protected or so managed as to assure an adequate supply of the essential concerned. Exploitation and other impacts (such as pollution) along migration routes should also be regulated.

Modified ecosystems: management and protection

38. Modified ecosystems should be managed sustainably. In many cases various management objectives can be combined in systems of multiple-use. For this to be done successfully, such objectives must be defined precisely and the compatibility of the various proposed uses both with each other and with the ecosystem carefully assessed.
- 39-41. The following ecosystems should be regarded as priority management areas; they may be modified provided that modification does not impair their key functions, but they should not be transformed: highly productive coastal and marine ecosystems; watershed forests and pastures. The following ecosystems may already be modified but should be preserved in their present state, whether modified or original: gene pools. In addition, modified areas within easy reach of human settlements should be set aside for recreation.

42. Highly productive coastal and marine ecosystems include offshore upwellings of nutrients and coastal wetlands and shallows. Use should be so regulated that their productivity is not reduced.
- 43-44. Agriculture, grazing and tree felling in watershed areas should be carefully regulated. Forest protection, reafforestation and watershed management should be given high priority by governments and by bilateral and multilateral aid agencies.
- 45-46. The wild relatives of cultivated plants and domesticated animals should be protected in special conservation areas. Locally domesticated varieties of cultivated plants and livestock should be husbanded in the ways they are now. For them it is necessary to set up agricultural conservation areas in regions where they are cultivated, and employ local farmers to act as farmer-wardens, preserving both the cultivar and the method of cultivation. Industries and other commercial enterprises based on, or regularly using, particular crops should be encouraged to sponsor conservation areas for the relevant gene pools.

Requirements for protected and priority management areas

47. The size, distribution and management of protected areas should be determined by the needs of the ecosystems and the plant and animal communities they are intended to protect. The necessary measures should be taken to safeguard the support systems of protected and priority management areas and to shelter the areas from harmful impacts.
48. Research should be continued into the questions of minimum critical size and optimum distribution of the protected areas required to safeguard a given number and composition of species.
49. Complementary sustainable development projects should be initiated in association with existing and proposed protected areas in order to take pressure off those areas. The projects should be sensitive to social impacts as well as environmental impacts.
50. Clear and simple field guides to the plants and animals that non-specialist visitors to the area are likely to see should be produced.
51. The local community should be involved in the protected area from the start - by being adequately represented on the management authority and by being given any employment or other economic opportunities associated with the protected area.
52. The special features of the protected area that may make it unique to the community and to the nation should be stressed, and people encouraged to regard the area as a source of local and national prestige.

53. The value of protected areas should be enhanced by using them to advance national scientific research, to build up a body of scientists with sound field experience, and to establish baselines so that changes elsewhere can be monitored.
54. Governments should adhere to the Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention).

Transformed ecosystems

- 55-56. Since the transformation of ecosystems is often difficult and expensive to reverse and may be irreversible, the allocation of ecosystems for transformation should be done with the greatest care. Particular attention should be paid to establishing the necessity of each proposed transformation and the suitability of the area for the proposed use compared with other possible uses. When assessing the possible effects of a proposed transformation it should be borne in mind that many effects may be delayed, displaced, or both.
57. Transformed ecosystems should be managed as efficiently as possible - consistent with reasonable ecological constraints - so that they will not occupy or affect a larger area than necessary. As far as possible new plantations should be on land already cleared.
58. Transformed ecosystems that are no longer used should either be converted to another use requiring transformation or they should be rehabilitated at least to the point where natural processes of restoration can take over rapidly.
59. Human settlements and other built environments should be so planned that they provide habitats for as great a variety of plants and animals as possible.
60. Demand should be reduced by eliminating waste, ensuring better distribution and avoiding unnecessary use. All economic activities should be conducted in ways compatible with sustaining the living resources on which all such activities ultimately depend.
61. Demand should be further reduced or at least should be stabilized by reducing or stabilizing human numbers and per capita consumption of energy, raw materials and other physical resources. Family planning programmes should be initiated or expanded.
62. The reduction or stabilization of per capita consumption is not, of course, a priority wherever effective demand is so low that the basic means of survival are denied people. Special efforts should be made to eliminate poverty in ways that by restoring and protecting the environment reduce the likelihood of poverty returning.
63. In every area, rich or poor, demand should be met in ways that do not harm people and are the least disruptive of their environment.

- 64-65. Particular efforts should be made both to conserve energy and to develop diversified power production systems. Development and use of solar energy and other benign forms of power generation should be greatly increased.

Ecosystems and subsistence peoples

66. Every effort should be made to identify those recent and surviving elements of subsistence and semi-subsistence cultures that enable them, wholly or partly, to have a sustainable relationship with their environment. This should be done before other measures are adopted to regulate impact on the environment. If additional or alternative measures prove necessary, the community concerned should participate in devising and implementing them.
67. Whenever a protected area is established a subsistence community need not necessarily be moved and should not be unless it wishes. Conversely, a subsistence community should not be kept in a protected area against its will.
68. Every effort should be made to document the environmental knowledge of subsistence and semi-subsistence peoples and to use it for the benefit of such peoples and the nation.

SPECIAL REQUIREMENTS: SPECIES

Minimum goals

- 69-72. The minimum goals of species conservation are:
- to prevent the extinction of any species;
 - to maintain enough viable populations of species of expected value as breeding material to safeguard the full range of variation in those species;
 - to ensure that all populations of species of expected value for harvesting can be restored to maximum sustainable yield (MSY) levels;
 - to restore all populations of species of current economic value to MSY levels and ensure harvesting thereafter is well within those levels;
 - to safeguard the ecosystem processes essential for the achievement of the above goals.

Criteria for deciding priorities

- 73-74. Adequate resources should be provided to tackle the problems of depleted populations of current value, threatened populations of expected value, and of all threatened species. A species of current economic value should be given priority attention if one or more of its populations is depleted. A species of expected economic value should be given priority attention if one or more of its populations is threatened. A species of potential value should be given priority attention if the species is threatened.

75. The criteria for deciding priorities within both the group of species of current value and the groups of species and varieties of expected value should be: value of resource; severity of problem.
76. Threatened species of current value should be given priority over those of expected value, which in turn should be given priority over those of potential value. Among species of potential value the criteria for deciding priorities should be: size of genetic loss; imminence of that loss.
77. Ways of making taxonomy more consistent and of improving its usefulness to conservation as well as its general information value should be explored by competent systematists and ecologists.
78. A distinction should be made between species that are threatened globally, nationally, and provincially. A species that is threatened globally should be given priority over one that is on a national list of threatened species but is considered secure elsewhere; and a species that is threatened nationally should be given priority over one that is threatened only at the provincial level.
79. Priority among species threatened at the same level should be determined by merging the two criteria of size and imminence of genetic loss on the basis of the following formulation: the greater the potential genetic loss the less imminent that loss need be to justify preventive action.
80. There should be very careful examination of prevailing and future pressures on the species concerned and of the measures necessary not only to achieve its conservation but also to sustain that achievement. Generally speaking, the higher priority the species the greater the proportion of available resources that is justified to be spent on conserving it.

Main species problems

- 81-82. Where a community already has effective harvesting regulations, these should be reinforced. Where there are no regulations or where traditional regulations have been rendered obsolete, the community should be helped to devise and enforce a set of effective regulations. These should include: restricting the times and places of harvesting and the total harvest; prohibiting or restricting the use of certain technologies; providing for habitat renewal; prohibiting or restricting commercial harvesting.
- 83-84. Should the overharvesting have become so acute that very severe regulation is needed, a great deal of time should be devoted to discussing the problem with the community; and an alternative food, fuel or fibre should be offered. Where demand has become excessive due to an increase in human numbers, family planning measures should be introduced or increased.

85. Where vegetation is being destroyed by cutting and stripping for fuel immediate measures should be taken to: restore the vegetation; establish plantations for firewood, which must be large enough to meet higher levels of demand than today's; provide alternative sources of firewood, to take pressure off the plantations and remaining vegetation; provide alternative sources of energy (other than firewood); stabilize and reduce human numbers.
86. The provision of alternative energy supplies should be a major development priority of governments and bilateral and multilateral aid agencies.
87. When traditional regulatory mechanisms (however well equipped to regulate subsistence demand) fail to cope with new demand generated by the cash economy, the problem should be discussed with the community, which should be helped to devise and enforce modified or additional regulations. Where very severe regulation is needed trade should be prohibited while allowing a limited harvest for subsistence only.
88. If a plant or animal is excessively harvested for international trade but is not on Appendix I or II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, then it should be placed on one of those Appendices or, if this is not warranted, on Appendix III.
89. Tree felling programmes should be matched by planting programmes of the species felled so that what is taken out is replaced.
90. Catches of fish, crustaceans and molluscs should be fixed at sustainable levels. Management objectives should be conservative and allow for error and ignorance. Research should be increased so that total allowable catches can be established with greater confidence of their sustainability.
91. The harvesting of plants and animals for the souvenir trade should be regulated so that it is sustainable. The size and dynamics of the trade should be investigated.
92. The following measures should also be taken:
 - Education. Understanding of and support for sustainable harvesting should be built up among both "producers" and consumers of living natural resources.
 - Monitoring. Harvest levels, trade, and response to regulations should be closely monitored, not only by governments but also by nongovernmental organizations.
 - Stabilization of trade and commodity prices. Some of the motivation to overharvest would disappear if prices could be guaranteed and fluctuations in demand reduced.

93. Given the extreme difficulty of eliminating introduced species, every effort should be made to prevent all introductions except those that can be proven harmless and over which complete control can be exercised. An intensive public education campaign should be directed at bodies responsible either for allowing or for promoting introductions. Governments should ensure that, by law, the onus of proof that an introduction will not be harmful and can be controlled, is on the introducer.
94. If the damage caused by a species that is being killed to protect crops, livestock or prey is imaginary or slight, an education campaign directed at the farmer, rancher or fisherman should be undertaken, backed up by legislation. If the damage is significant then a protection kill quota for the species being killed should be fixed; (the quota should be sustainable). Compensation for loss should be paid only exceptionally and as a last resort.
95. Where a species is threatened by loss or diminution of food supply, steps should be taken to manage the ecosystem or the prey species in ways such that they can support the affected species. The use of pesticides and other pollutants should be so restricted as to prevent harm to the feeding areas of threatened species.
96. An international workshop should be held to assess the dimensions of the marine incidental take problem and to recommend a cooperative programme of action by governments and international and national organizations.
- 97-99. The size and location of areas treated with insecticides in a single season should be chosen to avoid the extermination of local races of non-target species and to allow reoccupation by those species from adjacent untreated areas. Whenever possible spraying should be done on the ground rather than from the air. If aerial spraying is unavoidable it should be limited to areas that are relatively poor in non-target species, leaving more vulnerable areas to be sprayed from the ground. Since non-target species are more or less vulnerable to different insecticides, the impacts of different insecticides should be tested and the least harmful combination used.

SPECIAL REQUIREMENTS: ECOSYSTEMS AND SPECIES REQUIRING INTERNATIONAL COOPERATION

100. Every nation should recognize (and make appropriate provision in its national conservation strategy for) its responsibility to behave with particular restraint towards the following categories of living natural resource:
 - (a) ecosystems and species that occur outside national jurisdictions or within disputed jurisdictions;
 - (b) species that move between one national jurisdiction and another;
 - (c) ecosystems and species in one jurisdiction that depend on or are affected by events in another;
 - (d) species that are traded internationally.

The conservation of all these resources depends on international cooperation. Accordingly, nations should assist in the development of appropriate international treaties and other regimes or institutions both for regulating use of the resources themselves and for maintaining the habitats and processes on which the resources depend. They should also adhere to such treaties and implement them.

Ecosystems and species that occur outside national jurisdictions or within disputed jurisdictions

101. Ways of strengthening the existing regulatory bodies for tuna fishing and the desirability and feasibility of setting up a world body for the conservation of tuna should be explored.
102. Several weaknesses of the International Whaling Commission are listed. They should be remedied without delay.
103. The feasibility and implications of various possible international pelagic regimes should be investigated. Management of the pelagic realm should include the establishment of international conservation areas to protect the feeding grounds of whales, salmon, and so on, the spawning grounds of tuna, centres of endemism, and unique areas such as the Sargasso Sea.
- 104-105. Any regime for the exploitation of the living marine resources of the Southern Ocean should so regulate the krill fishery as to prevent: (a) irreversible changes to the populations of krill; (b) irreversible changes to the populations of the baleen whales and those seal, fish and bird species which feed on krill, as well as to the Southern Ocean ecosystem as a whole; (c) overcapitalization of krill fishing fleets. Attention should also be paid to the likely impact of a greatly expanded krill fishery on markets for such marine products as fish-meal, frozen shrimp and protein concentrates, as well as on markets for protein-rich feeds of terrestrial origin.
106. The Antarctic Treaty powers and nations fishing or intending to fish the Southern Ocean should exercise extreme restraint on catch levels until understanding of this uniquely productive ecosystem improves. All harvesting should be on an experimental basis as part of a scientific research programme to improve knowledge of krill and of the Southern Ocean as a whole. Current research efforts should be strongly supported.
107. Continued investigation into the possible environmental impacts of mining and oil exploitation in Antarctica are required. Meanwhile the feasibility of oil exploration and exploitation in particular should be approached with the utmost caution.

Species that move between one national jurisdiction and another

108. The international law of the sea should:
- provide the environmental safeguards essential for the seas to withstand the predicted impacts of current and prospective technology;
 - develop conservation duties and responsibilities of coastal states to match the enormous expansion of their rights and powers;
 - provide a coherent and comprehensive system of principles and criteria for the use and conservation of the seas' living resources;
 - provide for compensation to be paid for serious damage to a state's marine resources caused by another state's reckless treatment of its own marine environment;
 - provide adequate means of review and of avoiding and managing disputes.
109. The mandates of existing and new institutions for the management of marine resources should enable them to apply the principles listed on pages 49-50 - which they then should apply.
110. The nations concerned should fully support current initiatives to control pollution of shared seas and make every effort to conclude and implement appropriate conventions and protocols without delay.
111. The effectiveness of the existing regional agreements covering migratory species should be reviewed both to enable their implementation to be improved if necessary and to shed light on the provisions required of additional global and regional agreements.

Ecosystems and species in one jurisdiction that depend on or are affected by events in another

112. The conservation needs and problems of shared drainage basins should be reviewed, as a prelude to joint research and action plans by the riparian countries concerned.

Species that are traded internationally

113. As a matter of priority, nations that have not yet adhered to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) should do so. Those that have adhered should implement the Convention fully.
114. Multilateral and bilateral aid agencies should assist requesting governments to set up the scientific and management authorities that CITES requires - by providing both financial assistance and training. Governments lacking the financial or technical means to set up adequate scientific and management authorities should request such assistance.

115. A regular comparative analysis of the annual and biennial reports on national implementation of CITES should be undertaken by qualified international expert groups.
116. The feasibility and implications of an alternative to the present CITES' system of listing species should be explored.

URGENT MEASURES: HIGHEST PRIORITY ECOSYSTEMS AND SPECIES

Ecosystems and species in urgent need of better management

Ecosystems and species are considered in urgent need of better management if they are extremely vulnerable to mismanagement, are being mismanaged, but could yield considerable benefits if managed sustainably. Recommendations are made concerning the following:

- 117-125. Tropical rain and moist deciduous forests.
- 126-137. Drylands, tropical grasslands, and large herbivores.
138. Tundra.
139. Mountain systems.
- 140-141. Fresh waters (still and flowing waters, and wetlands) and freshwater fisheries.
- 142-145. Intertidal and neritic ecosystems and species; marine mammals, reptiles, fish, crustaceans and molluscs.
- 146-147. Ivory- and skin-yielding animals.

Ecosystems and species in urgent need of rescue

Ecosystems and species are considered in urgent need of rescue on the basis of the size and importance of the genetic loss were they to disappear and the imminence of that loss. Recommendations are made concerning the following:

- 148-158. Ecosystems in biogeographical provinces that are unrepresented or poorly represented in protected areas.
159. Ecosystems with many species threatened by habitat destruction.
- 160-161. Centres of genetic diversity for crops and commodities.
- 162-164. Highest priority threatened species.

IMPLEMENTATION OF THE STRATEGY

Governments and intergovernmental organizations

165. It is recommended that governments review the check-list of fundamental requirements for conservation (Appendix 4) and set target dates for satisfying those requirements not yet met. Intergovernmental organizations should be prepared to provide assistance on request to governments in meeting these requirements.
166. Those nations and agencies that provide development aid and technical assistance to others have a special responsibility to help the recipient nation ensure that such aid or assistance makes the best use of the living natural resources it is likely to affect.
- 167-168. If a national conservation strategy, living natural resource inventory, or ecosystem capability assessment, has not been carried out, aid agencies should regard it as a priority responsibility to encourage the government concerned to conduct the strategy, inventory or assessment, and provide, if requested, the necessary finance and technical assistance. Nations unable to carry out these measures due to a lack of financial or technical resources should request appropriate assistance from bilateral or multilateral agencies as a matter of the highest priority.
169. Model examples of national and provincial conservation strategies, living natural resource inventories and ecosystem capability assessments should be prepared and disseminated widely to governments.
170. In providing technical assistance and advice, international organizations should seek experts from the requesting country, or, if that is not possible, from elsewhere in the region concerned.
171. Intergovernmental organizations with more than one department or division working in the same country should make sure that the technical assistance and advice provided by each department or division are in harmony with each other according to a common programme that is consistent with the conservation of the country's living natural resources.
172. Bilateral and multilateral aid agencies should place sustainable development and the conservation of living natural resources high in their priorities. They should pay particular attention to the development and application of alternatives to techniques and technologies that are destructive of the environment or do not make the best use of living natural resources. Development projects should include adequate provision for safeguarding the environment and, if necessary, additional financial assistance should be made available so that such environmental provisions can be met.
173. It is recommended that there be greater coordination of action by intergovernmental organizations, using this Strategy as the basis of joint planning.

174. It is recommended that a conference of bilateral and multilateral aid and development agencies be convened on the implementation of this Strategy.

Nongovernmental organizations

175. NGOs should:
- (a) press for the implementation of the priorities of this Strategy, and promote public demand for their implementation;
 - (b) monitor the status of conservation in their country or province, the conservation administrations and activities of government, the implementation of conservation legislation, and the threats to conservation;
 - (c) alert the government and the public to the findings of such monitoring;
 - (d) conduct research on living natural resources and provide expert advice on the conservation needs and management methods that should be pursued;
 - (e) promote public understanding of and support for conservation;
 - (f) press government to safeguard the most important and threatened ecosystems and species; and
 - (g) if it becomes clear that government will not act in time, make use of the capacity of private bodies for prompt action to themselves safeguard such ecosystems and species.
176. NGOs should devote a much greater proportion of their efforts to influencing the activities of government - especially government expenditure on development, whether at home or abroad - and of business and industry. NGOs should determine those branches of government and industry that have the greatest impact on the environment and devise ways of influencing them.
177. NGOs and government should work with national and multinational commercial enterprises to agree codes of conduct for those enterprises with respect to living natural resources.
178. NGOs, the business community and governments should establish national and international awards and other forms of recognition for politicians and statesmen who advance conservation in their own countries or localities.
179. NGOs should review the check-list of fundamental requirements for conservation (Appendix 4), determine what requirements as yet not met in their own country are needed most urgently and could be most effectively promoted with the aid of a model example, and work with NGOs and governments in their own and in other countries to develop one that will be useful for other countries in similar circumstances.

General

180. Governmental and nongovernmental conservation organizations and individuals should spend most of their energies and funds on ensuring that the fundamental requirements for conservation (presented on pages 17-54) are met and only some of their energies and funds on emergencies and issues of the moment. Amongst the latter, priority should be given to the ecosystems and species mentioned on pages 55-68 - and highest priority should be given to those ecosystems which are priority candidates both for better management and for rescue.
181. Efforts to conserve ecosystems and species that are not of high priority but have great emotional appeal should be avoided, since they not only subtract from the total effort available for the conservation of high priority ecosystems and species but also damage the longer-term prospects of conservation by fostering the misleading impression that conservation is a sentimental indulgence.
182. Conservation organizations and individuals should concentrate on increasing understanding of conservation and on achieving the implementation of this Strategy. They should not attempt to tackle such related but separate problems as high human population levels and per capita consumption of energy and minerals, maldistribution of resources, inappropriate technology, or poverty; rather they should try to achieve greater understanding of the relevance and contribution of conservation to the solution of such problems among those organizations and individuals primarily concerned with them.
183. Policy briefs should be prepared to explain succinctly the contribution of living natural resource conservation to primary health care, rural development, and other policy areas. The briefs should be used to generate promotion of conservation by organizations and individuals concerned with those policy areas.

Monitoring and review

184. Constant effort - and constant encouragement - will be required to implement the priorities of this Strategy. IUCN or some other appropriate body should monitor and review implementation of the Strategy by regularly publishing brief progress reports from each country, together with descriptions of such model examples as may be devised, and the names and addresses of contact persons for further information. Regular reviews of progress should also be made by the Ecosystem Conservation Group. IUCN should publish a triennial report on progress, and the Strategy should be modified every three years in the light of new knowledge - and of results.

DEFINITIONS

Conservation. The management of human use of the biosphere, and of the ecosystems and species that compose it, so that they may yield the greatest sustainable benefit to present generations while maintaining their potential to meet the needs and aspirations of future generations. (See also pages 2-3.)

Preservation. The maintenance of an ecosystem or species in a particular state.

Biosphere. The part of the earth's crust, waters, and atmosphere where living organisms can subsist, together with those living organisms.

Ecosystem. Any system of plants and animals together with their environment. (See also pages 26-27.)

Original ecosystem. An ecosystem that is so little influenced by human activities that no intervention is required for its maintenance.

Modified ecosystem. An ecosystem whose original composition, structure and dynamics have been so altered by human activities that a degree of additional human intervention is required to maintain it in its present form and for ecosystem processes to continue at current rates.

Transformed ecosystem. An ecosystem that has been totally destroyed and replaced by inanimate structures or by monocultures or otherwise so altered that constant human intervention is required to maintain it.

Ecosystem process. A function mediated by an ecosystem (such as the transfer of energy, nutrients, and materials, or the provision of a habitat for reproduction or shelter).

Living resource. Any species or ecosystem.

Living natural resource. Any species or ecosystem that is not intensively farmed.

LAYOUT OF TEXT

Recommendations are numbered.

Recommendations and key statements begin at the left-hand margin.

Explanations are indented.

Readers wishing to read only the recommendations and key statements should omit the indented matter.

Readers wishing to read only the recommendations should read only the numbered paragraphs, beginning page 17.

OBJECTIVE, AIMS AND SCOPE

40% of the world's tropical rain forests - the richest environments on the planet - have been destroyed already. The rest are being felled and burned at the rate of 20 hectares a minute.

30 million km² (19% of the earth's land surface) are threatened with desertification. The world's drylands are being degraded at the rate of 44 hectares a minute.

Coastal wetlands and shallows - the support systems of two-thirds of the world's fisheries - are being degraded or destroyed by dredging, dumping and pollution just as fast.

More than a thousand vertebrate species and 25,000 plant species are threatened with extinction.

OBJECTIVE AND AIMS

Conservation and sustainable development

The chief impediment to sustainable development is lack of conservation.

Some of the obvious effects of this lack are: the reduction in fertility and often the outright destruction of vast areas of productive land; the depletion of major fisheries and the degradation of the ecosystems on which they depend; the staggering loss of species and varieties of plants and animals, many of which hold the key to high food yields, progress in the struggle against disease, and the generation of new products to meet human needs and raise the quality of life. Degradation and depletion on such a scale directly threatens the survival and wellbeing of many peoples and the stability of their governments.

In this World Conservation Strategy, conservation is defined as: the management of human use of the biosphere, and of the ecosystems and species that compose it, so that they may yield the greatest sustainable benefit to present generations while maintaining their potential to meet the needs and aspirations of future generations.

Conservation provides the means not only of avoiding further degradation and depletion of ecosystems and species but also of restoring those that have already been degraded or depleted, and still more importantly, of realizing the full value of this planet's unique and irreplaceable living resources.

Objective of the Strategy

The Strategy is intended to achieve - as soon as possible and to the fullest possible extent - the conservation of the living natural , resources on which human survival and wellbeing depend.

Aims of the Strategy

The fundamental requirements for the achievement of conservation are:

political commitment;
better communication and application of existing knowledge;
better planning;
better institutions;
more knowledge.

The aims of the Strategy are, therefore:

The satisfaction of these requirements throughout the world;
and
the identification and conservation of those ecosystems and species of such importance that they require urgent measures either before or at the same time as the fundamental requirements are being met.

SCOPE: THE CONSERVATION OF LIVING NATURAL RESOURCES

Conservation

Certain aspects of conservation as defined should be stressed:

1. People are the direct beneficiaries of conservation.

Conservation seeks to regulate human use of the environment so that human generations can benefit from the full potential of living natural resources to yield in quantity a great variety of goods and services (ecological, economic, emotional and recreational, ethical and cultural, scientific and intellectual). Conservation is therefore an integral part of sustainable development. Indeed without conservation, development is likely to be short-lived and unnecessarily costly.

2. Conservation operates in two time-frames. For present generations it seeks from living natural resources the fullest sustainable benefit. For future generations it seeks to maintain the potential of living natural resources so that they will be able to satisfy whatever may be those generations' needs and aspirations.

Since some at least of the needs and aspirations of the generations to come will probably be different from those of today's, the full variety of plants, animals and ecosystems must be retained.

3. The extinction of any species should be prevented.

There is nothing trivial about the extinction of a species: each extinction represents a profound loss for people. The potential uses of species are so unpredictable that it is sheer folly to allow a species to become extinct even if today so little is known about it that it appears to be useless.

4. The prevention of extinctions is not sufficient, however. A primary aim of conservation is to maintain ecosystem processes or functions, such as the predictable transfer of energy, nutrients and materials among organisms and their environments. Another aim is to maintain the populations of at least those species of current value at no lower than their maximum sustainable yield levels.

Many ecosystems and species not at risk are nevertheless misused and can and should be restored to and maintained in their optimum condition for only then can they yield the greatest sustainable benefit.

5. The protection of ecosystems or species is thus one essential aspect of a much wider endeavour: the planning and regulation of human use of resources.

On the quality of such planning and regulation rests the reconciliation of responsibilities to present generations with those to future generations.

6. While the focus of conservation is on living resources, it is also concerned with the interdependent non-living resources of water, soil, nutrients, and the atmosphere.

Living natural resources

This Strategy is largely concerned with the conservation of living natural resources: that is, of those species and ecosystems - the vast majority - that are not intensively farmed.

This slight narrowing of scope is necessary because living natural resources are particularly undervalued and poorly managed - yet they are crucial for human survival and wellbeing. Indeed, as will be shown in the following section, both the maintenance of and improvements in the productivity of intensively farmed resources depend in large measure on the conservation of uncultivated or extensively cultivated ones.

VALUES OF LIVING NATURAL RESOURCES

Many ecosystems and species are already known to be essential. All are potentially beneficial. One of the more important lessons to be learned from the examples which follow is that it is impossible to predict which species will be the next to become invaluable nor in what new way.

Ecological

A number of ecosystems and species which may appear useless, or at least dispensable, are critical to the health and maintenance of ecosystems and species of direct economic importance. Coastal wetlands and shallows are notable contributors to human welfare. So are watershed forests. The former are the nurseries, breeding areas, or major sources of nutrients for about two-thirds of the world's fisheries. The latter protect and provide resources for areas downstream (including areas a considerable distance away) by controlling water flow, preventing floods, erosion and the silting up of dams and canals, and - in the case of tropical cloud forests - intercepting water from clouds. Forests, whether watershed or not, also modify climate - especially microclimate - reducing the range of temperature variation, retaining a layer of cool moist air, and generally making local climates more equable. Many wild species play valuable, and often essential, roles in agriculture - as pollinators, as the predators and parasites of pests, as fixers of nitrogen, and so on. Those uncultivated ecosystems that provide the refuges, breeding sites and feeding grounds of both pollinators and the predators and parasites of pests contribute thereby to the productivity of cropland.

Economic

Food. People continue to depend to an unexpected degree on wild animals and plants for their food. More than 72 million tonnes of fish, crustaceans and molluscs were caught in 1976 - of which about 61 million tonnes were marine species and the rest freshwater (9.6 million tonnes) or diadromous (1.4 million tonnes). Some 36% of the world marine fish catch is turned into food for livestock. Roughly one-third of the world catch is traded internationally with an annual export value of more than \$8,000 million.

On average, fish and seafood account for 6% of the protein (17% of the animal protein) and 1% of the calories in the human diet. In the developed market economies fish and seafood

contribute 7% of the total protein supply and 12% of the animal protein supply. In the developing market economies they contribute 4% and 19% respectively; and in the centrally planned economies the respective contributions are 7% and 21%.

These figures both ignore the enormous importance of subsistence fisheries and conceal substantial differences between countries: a number depend quite heavily on marine sources of protein. The populations of 30 countries derive one-third or more of their animal protein supply from marine fish, crustaceans and molluscs; eight of them get more than half from these sources. In 36 countries the average annual per capita consumption of protein from the sea is 21 kg or more.

Whether or not they depend heavily on fish and fishery products for food, many countries do valuable trade in them and some rely on them for a significant proportion of their foreign exchange earnings. Eighteen countries (including five developing countries) each earn \$100 million or more a year in exports of fish and fishery products, and 17 countries each derive from them 3% or more of their export trade.

Fish and the other animals of the sea and fresh waters are not, of course, the only living natural resources that supply food. In many parts of the world, especially in the tropics, wild land mammals and birds are the principal source of meat. In Ghana, Zaire and other countries in west and central Africa, three-quarters of the animal protein comes from wild animals. Among the settlers along Brazil's Transamazon Highway, wild animals account for up to 20% of the total protein requirements.

The nutritional importance of wild animals and plants for large numbers of people is invariably underestimated (and often ignored), partly because some of the more frequently eaten plants and animals (for example, wild vetches, squirrels, porcupines and armadillos) seldom feature in the diets of nutritionists, but largely because these resources are harvested in areas far from the scrutiny of statisticians. This is unfortunate, for were the true nutritional value of wild plants and animals to be appreciated by politicians and administrators they might be less ready to allow the resource to be mismanaged or its habitats destroyed.

The importance of wild animals and plants as food is not confined to those consumed directly. The wild and semi-domesticated relatives of cultivated plants and animals are essential breeding material by which continued improvements in yields, nutritional quality, flavour, durability, pest and disease resistance, responsiveness to different soils and climates, and other qualities are achieved.

These qualities are rarely if ever permanent. Pests and diseases evolve new strains to overcome resistance; climates alter; soils vary; consumer demands change. Food-producers, therefore, cannot do without the reservoir of still-evolving possibilities available in the innumerable varieties of crop plants and domesticated animals and their wild relatives. The continued existence of wild and semi-wild varieties of rice, wheat, maize, sugarcane, tea, soybean, banana, coffee, cacao, tomato, potato, and all the other vital and valuable crop-plants is humanity's only insurance against their destruction by the equivalents for those crops of chestnut blight and Dutch elm disease.

It is not enough to keep these varieties ex situ, in seed banks and the like (although such storage, where possible, is also essential). Seed banks can fail - one of the largest collections of maize germ plasm in the world was lost from one bank when three refrigerator compressors broke down. The characteristics of plants kept in seed banks are frozen; plants (and animals) conserved in the wild can continue to evolve new strains. Finally, many crop plants cannot be stored in seed banks at all.

Lastly a number of locally consumed wild plants and animals could make a significant contribution to human food supply in other regions. For example, the San people of Botswana and Namibia eat two of the most protein-rich plants in the world: the mongongo nut (Ricinodendron rautanenii) and the tsi bean (Bauhinia esculenta). Both plants flourish in semi-arid regions, and the mongongo nut yields heavily. They might well help reduce the food problems of the Sahel. The US National Academy of Sciences has reported on 36 other underexploited tropical plant species with promising economic value, and doubtless there are many more.

Medicines and other drugs. The hoard of chemical compounds found in wild plants and animals is an indispensable source of medicines and other drugs - curare, cocaine and quinine to name but three. The chemical clues leading to the development of a great many synthetics - from aspirin to oral contraceptives - were derived from plants, and it is doubtful that many manufactured compounds would have been made without the leads provided by their natural prototypes.

More than 40% of the prescriptions written each year in the USA contain a drug of natural origin as sole active ingredient or as one of the main ones. In the USA alone the value of medicines from higher plants is estimated to be about \$3,000 million a year and rising.

Only a minute proportion of the world's plants and animals have been investigated for their value as drugs. A compound (ara-C) derived from the Caribbean sponge, Tethya crypta, is a powerful inhibitor of various cancers, including leukaemia. Another compound (ara-A) from the same species has proved effective against herpes encephalitis, providing a breakthrough in the treatment of diseases caused by viruses much as penicillin did in the treatment of diseases caused by bacteria. Compounds from other sponges, from corals, sea anemones, marine worms, molluscs, sea cucumbers and sea stars are likely to be useful in the treatment of various cancers, hypertension and cardiovascular disease, and already a number of these animals are valuable sources of antibiotics.

Other products. Forests have unquestioned importance for industry and commerce. The value of the annual world production of forest products exceeds \$115,500 million, and international trade is worth more than \$30,000 million. Thirty countries (eight of them developing countries) each earn more than \$100 million a year from exports of forest products - and five of these each earn more than \$1,000 million a year. In addition, industry depends on wild plants and animals for many fibres, resins, gums, dyes, skins, waxes and oils. Algin from brown seaweeds, for example, is used in paints, dyes, building materials (insulation products, sealing compounds, artificial wood), fire-extinguishing foams, paper products, oil drilling lubricants and coolants, cosmetics, shampoos, soaps and many other products.

Sperm whales are the source of a unique industrial oil, considered essential for automatic transmissions. Its importance may decline if recently discovered wild plant substitutes (especially the jojoba bean, Simmondsia chinensis) can be marketed successfully.

The Japanese insecticide Padan was developed from nereistoxin, a neurotoxin found in the marine polychaete worm Lumbrineris brevicirra. Padan is effective against such serious and widespread pests as Colorado beetle, Mexican bean beetle, cotton-boll weevil, rice-stem borer, cabbage butterfly, and diamond-back moth. It is also effective against strains of insects resistant to organophosphates and organochlorines.

Many of the huge array of industrial products derived from wild plants and animals are valuable because of their unique properties - properties that so far have proved impossible or unacceptably expensive to synthesize. All are also valuable for another reason: if they are exploited sustainably they will be available for use indefinitely.

Emotional and recreational

Living natural resources supply a multitude of emotional and recreational benefits. National parks and other protected areas attract growing numbers of visitors, both from elsewhere in the home country and from abroad. The beauty and behaviour of all kinds of plants and animals delight, inspire and instruct. The sounds, shapes, colours, scents, textures and tastes of the natural world continue to inspire musicians, architects, artists, designers, perfumers and cooks. Human achievements are the product of the human species' unrivalled imagination. For the imagination to grow, it must be stimulated frequently and must have access to repose - and the greatest source of stimulus and repose is the variety of other species and of the ecosystems of which they are part.

Ethical and cultural

The bond between people and the natural world is expressed by different cultures in many ways. Nations, provinces, communities and individuals often make symbols of plants and animals. Frequently the most popular landscapes are products of a synthesis of culture and nature - the mixed farmlands of Europe, for example - and people become very attached to places of great natural beauty with important historical or other cultural associations. Many people also feel a strong sense of stewardship towards the natural world. Indeed a growing body of opinion believes that ethical arguments in favour of conservation are paramount and that plants and animals have an intrinsic right to survival which should not be denied them.

Scientific and intellectual

There are estimated to be between 5 million and 10 million different species of plants and animals in the world, of which only about 1.6 million have been named and still fewer have been described. Relatively few can be said to be known completely. These species, and the communities they form, are living laboratories. Unmodified ecosystems are essential both for an understanding of fundamental problems of ecology and evolution and as baselines for monitoring changes to other ecosystems together with the consequences of such changes. Many of the most significant advances in a great many scientific and intellectual fields have come from study of (apparently insignificant) animals and plants. Understanding of human genetics has depended on understanding the genetics of horseshoe crabs (Limulus) and of Drosophila

fruit flies. Developmental and reproductive biology began with the study of sea-urchin eggs. The development of sonar and echolocation stemmed from the study of the use of sound for navigation and hunting by bats. Some species of whales and dolphins are cerebrally as highly developed as humans. These species may provide science with its only opportunity (short of the arrival of visitors from outer space) of studying advanced non-human intelligences.

Indeed it is impossible to predict what species or ecosystems will provide yet another key to scientific progress. Three species to have received public attention recently have been as diverse as the black bear (studies of which have already led to an improved high-protein, low-fluid diet for patients with kidney failure); the octopus (as an aid to understanding the process of aging); and Umbilicosphaera, a minute planktonic coccolith, which concentrates uranium 10,000-fold and could be a clue to a way of cleaning up radioactive spills.

Costs and benefits

Living natural resources cost nothing to make and little to take, but when destroyed some are extremely expensive to replace and others are irreplaceable. It is not difficult to put monetary values on those plants and animals and their products that are traded - and these values are considerable. Other living resources, however, benefit the economy and the rest of human life in ways whose value is virtually impossible to quantify even though it is often much greater. Few of the essential ecosystem processes or of the species and varieties of indirect but nonetheless critical economic importance lend themselves to cost-benefit analysis, but this is a measure not of their lack of value but of the lack of sophistication of cost-benefit analysis.

Despite the unquestionable contribution of such resources to human survival and wellbeing, it is difficult to evaluate in monetary terms a species that is the founder of a pharmaceutical industry or a variety that has increased the yield and disease resistance of a major food-crop like rice. It is even more difficult to evaluate those species and varieties with the potential - as yet uncalled on - to perform these vital services.

A similar difficulty is experienced with watershed forests or with coastal ecosystems that are the nurseries and nutrient suppliers of fisheries. Indeed because the goods and services supplied by these areas are free they are invariably undervalued and unaccounted for. Yet the decline in extent and abundance of such areas is followed by reduced

yields and rising costs. The species and ecosystems providing the kinds of ecological and scientific benefits described earlier at least save money every time they give those free services and often provide services that could not be bought at any price.

The loss of a variety, a species or an ecosystem that yields an economic, ecological or scientific benefit is a cost to society. Sometimes and in some countries the cost will go unnoticed or will be easily absorbed. At other times, people may be faced with great expense - to regain control over erosion, for example. Many human communities do not have the money to replace free goods and services once lost - so they starve or migrate to overcrowded cities. Only a tiny minority of the human species is in the luxurious position of being able to pass up free goods and services - and even this minority should appreciate the consequences of a staple crop (like wheat) being wiped out for want of a wild relative of that crop; or a human disease still untreatable thanks to the destruction of some pharmaceutical cornucopia of a cloud forest or a coral reef.

There are of course opportunity costs in conserving living resources - the costs incurred by a society when a beneficial use of a resource is denied it. But these should not be exaggerated: only in certain well-defined cases is protection of the species or ecosystem the only use permitted. In most cases, it is possible to use living resources in a variety of sustainable ways while still maintaining their potential for other uses.

The main problem of the costs and benefits of conservation is that they are distributed unequally. Most of the costs of clearing a watershed forest may be felt by farmers and city-dwellers downstream (as when villages are flooded or a city's reservoir silts up); most of the benefits may be felt by a timber company whose earnings go elsewhere. A fishing community may lose its livelihood when coastal wetlands are filled in for agriculture or are polluted by neighbouring towns and industries. The costs of safeguarding the wild varieties of a plant may be felt in one continent (where the plant originated but is economically unimportant) while the benefits are felt in another continent (where the plant is a major cash-crop).

The difficulties of quantifying and of allocating both the benefits of living natural resources and the costs incurred by their destruction, degradation or depletion cannot be side-stepped. They bring out the crucial fact that living natural resources cannot be entrusted to the market-place. The benefits they confer can be

retained only by controlling use of the resources through the same social and political institutions that order the rest of civilized behaviour. If unregulated market forces are allowed to dominate or if institutions for planning and managing uses are weak or ill-informed, then the problems facing living natural resources will become intractable and the resources' exceptional economic and social values will be dissipated.

PROBLEMS OF LIVING NATURAL RESOURCES

The degradation and destruction of ecosystems and the depletion of species is proceeding at such a rate and on such a scale that it directly threatens the survival and wellbeing of many peoples and the stability of their governments.

One of the most serious problems is the reduction in fertility, and often the outright loss, of productive land. In the USA alone 10,000 km² of arable land are usurped each year by industry and urbanization. At current rates, the world will lose about one-third of its arable land between now and the end of the century - a period in which the human population will continue rapidly to increase. Desertification will shortly have half the world's land surface within its grip.

Some 43% of the earth's land surface is already desert or semi-desert. A further 19% (30 million km²) is threatened with desertification. The world's drylands are being degraded at a rate of 58,250 km² a year. The annual loss (in terms of lost income and excluding social costs) has been valued at \$1,283 million. Due to badly regulated irrigation, large areas are sterilized by salt and alkali. Over even larger areas - as a result of deforestation, overgrazing and poor farming practices - soil is stripped from the land to clog rivers and canals, fill up reservoirs and kill coral reefs. To a considerable extent the major crop failures caused by droughts or floods in recent years (particularly in the Indian sub-continent and in Africa's Sahel) are not so much natural disasters as cultural disasters - in large measure the result of deforestation and stripping of vegetation.

More than 40% (6.6 million km²) of the world's tropical rain forests and tropical moist deciduous forests have disappeared already. The remainder is being felled or cleared at a conservatively estimated rate of 110,000 km² a year (1.2% of what is left), or 20 hectares a minute. Tropical forests are not uniform, however; nor is their rate of disappearance. The most valuable, and the richest in species, are the lowland rain forests - and these are being destroyed at a much faster

rate. Some, like the lowland forests of Malaysia, Indonesia and the Philippines, are believed unlikely to survive beyond the turn of the century. The magnitude of this loss - quite without precedent in evolution - can be surmised from the fact that as many as half of the world's land species live only in tropical rain forests. Apart from this loss of irreplaceable resources, such destruction could have a considerable impact on climate by, for example, increasing the carbon dioxide content of the atmosphere and by changing the albedo (ratio of light reflected by the planet to that received by it).

Ecosystems can be grouped into three categories according to how much they have been influenced by people: modified, transformed, or original. Modified ecosystems are those whose original structure and dynamics have been altered by human intervention. Transformed ecosystems are those that have been totally destroyed and replaced by inanimate structures or by such artificial ecosystems as plantations. Original ecosystems are those that have not been transformed or modified. All are necessary for human survival and wellbeing; but the transformation and modification of ecosystems must be done highly selectively, and modified ecosystems must be managed in a sustainable manner. There is abundant evidence that neither of these principles has been observed consistently by any country - with the result that large parts of the world (especially tropical forests, tundra, rangelands, mid-mountain forests and pastures, fresh waters and coastal waters) face persistent management problems.

Another set of problems with serious consequences for human survival and wellbeing is that of extinctions. Many varieties of crop-plants have already disappeared for ever and many more are in danger of following them. A number of varieties of rice, maize, sorghum, millet, yam and cotton, for example, are almost extinct. The centres where wheat, barley, chickpeas and lentils originated face an emergency. All over the world the centres of origin of crop-plants are disappearing - ironically, for example, the last remaining forests in western Ethiopia, a centre of wild coffee, are being cleared for coffee plantations. Indeed, it is astonishing how little appreciated is the world's dependence on a few centres of diversity for the continued viability of its major crop-plants. These centres - of which the most important are central and South America, West Asia and South East Asia - are rapidly being modified and urgent measures are required to ensure that no more of their vital stores of genetic wealth is destroyed.

In addition to crop-plant varieties, unprecedented numbers of species are threatened with extinction. More than 1,000 fish, amphibian, reptile, bird and mammal species, and some 25,000 plant species are endangered or vulnerable. Unfortunately,

this is bound to be an underestimate because it does not take account of the inevitable losses of invertebrate and small vertebrate species whose habitats are being eliminated in their entirety.

The food-production capacities of both land and sea are being heavily reduced not only by ecosystem degradation and destruction and the extinction of varieties and species but also by overexploitation to the extent that yields are driven well below their potential maximum for long periods. At least 25 of the most valuable fisheries are seriously depleted. Many more fisheries are now so fully exploited that they can be expected to become depleted within a decade or so, due to the effects of exploitation either alone or in combination with those of pollution and habitat destruction.

The consequences of such overexploitation can be illustrated from the northwest Atlantic, where cod catches are still only a third of their estimated potential due to overfishing in the late 1960s and where the total catch has declined from 4.3 million tonnes in 1970 to 3.5 million tonnes in 1976 despite increased capelin and mackerel catches. It can no longer be assumed that depleted stocks will recover to their full potential, because: the spawning fishes and young fry may continue to be caught by industrial fisheries (which take fish for conversion to animal feed); ecosystem dynamics can change and another species may take over because the depleted species can no longer compete effectively with it; and habitats essential for spawning or as nurseries may be degraded or destroyed.

Lastly, there is one category of problem about which not enough is known but which could have profound consequences for the whole of humanity - namely, those human activities which might confront the "outer limits" of biological and physical systems and by causing irreversible changes to them render human survival precarious or impossible. These problems include: the release to the atmosphere of increasing amounts of carbon dioxide due to the burning of fossil fuels and the destruction of forests, with possibly critical effects on climate; the effect of fluorocarbons and other chemicals on the ozone layer, which by reducing the screening of ultraviolet radiation could have a severe impact on a great many species, including people. Neither the extent nor the exact consequences of such problems are known. But because their effects on climate and the environment may be irreversible it is vital that they be fully researched and that in the meantime the problems be reduced as far as possible.

The four sets of problem (loss of productive land, extinction of species and varieties, overexploitation, and possibly irreversible changes to the environment) outlined above are the products of two linked conditions: level of demand and means of supply.

The level of demand on living natural resources is a function of human numbers and per capita consumption. The means of supply (or the way demand is met) is determined by the location and timing of different uses, the technologies used, market structures, and the distribution of resources within and among countries.

Each of the conditions and the factors within each condition influence each other. Greater economic security and better living conditions can encourage people to have smaller families. Rapidly rising populations can undermine efforts to grow food and improve health. The relative importance of each of the conditions and factors vary from circumstance to circumstance. A large number of people with very low per capita consumption of resources can destroy the basis of its livelihood by converting forests into fuel and clearing slopes too steep for cultivation. A much smaller number of people can be no less destructive if their consumption of resources is high or if they misallocate uses by, for example, building on prime agricultural land.

All living natural resource problems and indeed all socio-environmental problems are caused by inappropriate levels of demand or inappropriate means of supply or - more commonly - both.

Human activities need to be so managed that both the level of demand and the means of supply, at any given time and place, are compatible with the conservation of the resources on which such activities depend. For this to occur there must be:

- political commitment;
- better communication and application of existing knowledge;
- better planning;
- better institutions;
- more knowledge.

All of the above are required to change attitudes and practices relating to:

- human population levels and densities;
- per capita consumption of energy and other resources;
- the distribution of resources within and among countries;
- the design, manufacture and application of technology;
- the location and timing of different uses;
- the measurement of social and economic achievement;
- market structures.

Some factors will be the dominant causes of some of the problems covered by this Strategy. When this is the case, they will be specifically addressed. But the understandable tendency of many people to simplify matters and focus exclusively on a particular problem, cause or solution should be resisted. There is no single problem, no single cause, no single solution. There are multiplicities

of problems and causes, all interrelated - and the only way to deal with them is through a multiplicity of measures, themselves interrelated, directed at a common end: conservation - for human survival and wellbeing and for the sustainable development of the world's rich yet vulnerable heritage of natural resources.

THE STRATEGY: PRIORITIES FOR ACTION

GENERAL REQUIREMENTS FOR CONSERVATION

Political commitment

1. A commitment to conservation should be publicly made at the highest levels of each nation and province - by the Head of State and by the head of government. The commitment should include an undertaking to develop a national (or provincial) conservation strategy and programmes for its implementation.
2. Ideally, a commitment to conservation should also be written into each nation's constitution.
3. Politicians and government administrators should understand and support conservation. A great effort should be made to achieve this understanding and support.

Although most governments make some provision for conservation, very few seem to regard it as a major policy concern. This is probably because the arguments for conservation are often misunderstood or misrepresented and even when understood are accorded low priority. Conservation is misunderstood because it is widely thought to be anti-growth and anti-development - positions that are anathema to most politicians. Also conservation is considered to be the special pleading of pressure groups with limited and specialized interests. There is sufficient truth in both these views for it to be easy for those opposed to conservation to make capital out of them.

4. A great effort should be made to devise and propagate internally consistent arguments to show that sustainable development is impossible without conservation. These arguments should also distinguish the quite legitimate claims of different special interest groups so that political judgements may be made about where the balance of advantage lies.

It is unwise to conceal the fact that there are many circumstances where conservation is a matter of choice, where the conservation of one resource is in conflict with that of another, and where no answer is absolutely right. Equally there are certain kinds of development, essentially those that are not sustainable, that are in sharp conflict with conservation. This should be openly admitted. The case for conservation is compelling enough.

Yet, even when national and provincial leaders and politicians do understand the arguments, they often have more pressing preoccupations. Although a number of these preoccupations may be due to past lack of conservation, and although present lack of conservation may well cause still greater political

difficulties, the benefits of conservation action taken now seldom occur in time to influence the results of the next election.

5. Advantage should be taken of any of those circumstances in which politicians and governments may be convinced that it is in their interests to pursue policies of conservation, namely:
 - (a) when pro-conservation decisions are evidently the most profitable within the time-frame of their concern;
 - (b) when pro-conservation decisions are an effective way of achieving other policy objectives;
 - (c) if the leaders are personally convinced that conservation policies are the right course to pursue;
 - (d) if the electorate is so convinced and makes it clear that it will vote for those policies;
 - (e) if influential groups within the country are educated in and committed to conservation policies.

When politicians and governments use narrow monetary indices to measure social and economic achievement, conservation policies often appear unprofitable and their benefits obscure. If economic growth is looked on simply as growth of gross national product (GNP), and growth of GNP is then made an overriding national goal, then the costs of adverse impacts on living natural resources may either be ignored or, worse, appear as benefits, and a great many social and economic values may be discarded. Conservation benefits are more easily accounted for if a broader measure of economic progress is used - one that reflects the full range of a society's values.

6. Each nation and government should adopt a measure of economic growth and social progress that takes full account of the costs of destroying, degrading or depleting living natural resources and of the benefits of conserving them.

Better communication and application of existing knowledge

Communication

Public support and understanding is the base of the pyramid of governmental commitment. Relatively little can be achieved, and few achievements will last, while the values and requirements of living natural resources remain poorly communicated.

7. Every opportunity should be taken to promote an appreciation of conservation both through the media to the general public and by using the special opportunities provided by special interest groups:

the business community (chambers of commerce, industrial associations), professional organizations, trades unions, youth groups, and other clubs and societies. Of the various arguments for conservation - aesthetic, cultural, economic, ethical, scientific, survival - clearly those that are most compelling for the audience addressed should be used.

8. A goal of conservation education should be that ecology be at least as well understood and as widely accepted by the lay person as is economics; and that conservation receives as intelligent media coverage as does energy now. School curricula should include conservation education, preferably not only as a separate subject but also as an intrinsic part of many other subjects.
9. One priority is the production of clear, succinct information materials/booklets on the importance and problems of various groups of species and ecosystems, which can then be adapted to meet the needs of different interest groups in different countries. Another is to take full educational advantage of conservation areas located near (within day-trip distance of) big cities, by producing clear and simple field guides to the plants and animals non-specialist visitors are likely to see (see also page 31). A third priority is to publicize model examples of successful conservation and sustainable development.
10. Nongovernmental organizations (NGOs) provide a most effective means of promoting public support for and understanding of conservation. Governments can strengthen NGOs, without compromising either themselves or the NGOs, by commissioning them to produce public information materials and by providing data (and if necessary technical assistance). Indeed, much of the task of promoting support and understanding could sensibly be delegated to NGOs (which need not and should not be inhibited by the same constraints as are governments).
11. For their part, NGOs should be aware that governments are not homogeneous. However monolithic a government might seem, within it there are conservationist individuals and administrations which need (and can use effectively) the public pressure and support generated by NGOs - especially when they are well-informed. NGOs should get to know and work with these individuals and administrations.

Training

A large body of trained, knowledgeable individuals is vital.

12. Administrators should be trained not only in conventional disciplines of administration (management, planning, economics, and so on), but should also be knowledgeable about ecology, wildlife biology, and conservation in general. In turn, administrators should be able to

call upon cadres of experienced scientists, trained technicians and field personnel whether in government service or not. National or regional training centres and programmes should be set up to meet these needs.

13. Governments and national and international organizations should devise and launch programmes to promote understanding by local communities of the values and requirements of conservation and to train them in improved land-use practices.

Application

Although there will always be a need for more knowledge, it is most important that the considerable body of knowledge that already exists be used.

14. The preparation of national and provincial conservation strategies, natural resource inventories and ecological capability assessments should be based on available knowledge and should not be deferred so that more knowledge can be accumulated.
15. Research needs should be identified and met concurrently with the preparation of policies, strategies, plans, inventories and assessments, all of which should be evolutionary in nature, being modified from time to time in the light of new knowledge and changes in perceived needs, aspirations, and values.

Better planning

The planning requirements for conservation are:

- (a) national and provincial conservation strategies;
- (b) resource inventories and ecosystem capability assessments, with allocation of uses according to these assessments;
- (c) environmental impact assessments;
- (d) public disclosure and debate.

National and provincial conservation strategies

16. Every country and province should prepare its own conservation strategy which should influence and be a part of any national (or provincial) economic or development plan. Each strategy should indicate: areas of multiple-use or with potential for multiple-use and what those uses might be; areas of actual or potential conflict of use and the requirements for resolving or avoiding such conflicts; priority ecosystems and species and the requirements for their conservation; how both sets of requirements could be met; and guidelines for planning and management.

17. The strategy should identify critical areas of overlap with policies on human settlements, energy, mining, industry, water, agriculture, forestry, leisure, and so on, so that such policies can be modified well in advance. If this is done, many resource conflicts could be avoided and others resolved without disrupting the economy.

Examples: In many countries, developed and developing, prime agricultural land is being lost to urbanization, industry, and physical infrastructure (roads, airports, etc.). Often, the land so lost is replaced by converting less productive, marginal land to agriculture. Thus the pressure of agriculture on more sensitive lands can be a function of urban policy and the extent to which it is careless of the loss of good farmland.

Policies concerning the extraction of fuels and minerals should recognize that non-renewable resource industries fluctuate sharply, with a characteristic sequence of boom and bust, providing high rewards and attracting immigration of labour at first, followed by a severe decline which often leaves an artificially enlarged community destitute and unable to support itself. By contrast, renewable resource industries fluctuate less (with the possible exception of important commodities such as coffee, cocoa); and although their initial yields are lower they have longer (indeed for all practical purposes indefinite) lifetimes if properly managed. An unplanned or a planned but disproportionate emphasis on the development of non-renewable resource industries generally precludes the development of the full potential of renewable resource industries; but the latter does not preclude the orderly, balanced development of the former.

18. The strategy should estimate the investment of resources, describe the political decisions necessary to achieve the stated conservation aims, and identify the entities which possess the necessary resources and powers of decision. The strategy should propose a plan of action to bring about the required resource allocations and political decisions. The strategy should also provide policy guidance for dealing with other governments and with international organizations especially with respect to:

- (a) ecosystems and species that occur in areas beyond national jurisdictions or within disputed jurisdictions;
- (b) species that move between one national jurisdiction and another;
- (c) ecosystems and species in one jurisdiction that depend on or are affected by events in another;
- (d) species that are traded internationally.

Specific guidance should be given concerning international agreements, and the giving and receipt of aid and technical assistance. Consistent positions should be developed for the governing bodies of UN and

other intergovernmental organizations on which the government sits.

Inventories and ecosystem capability assessments

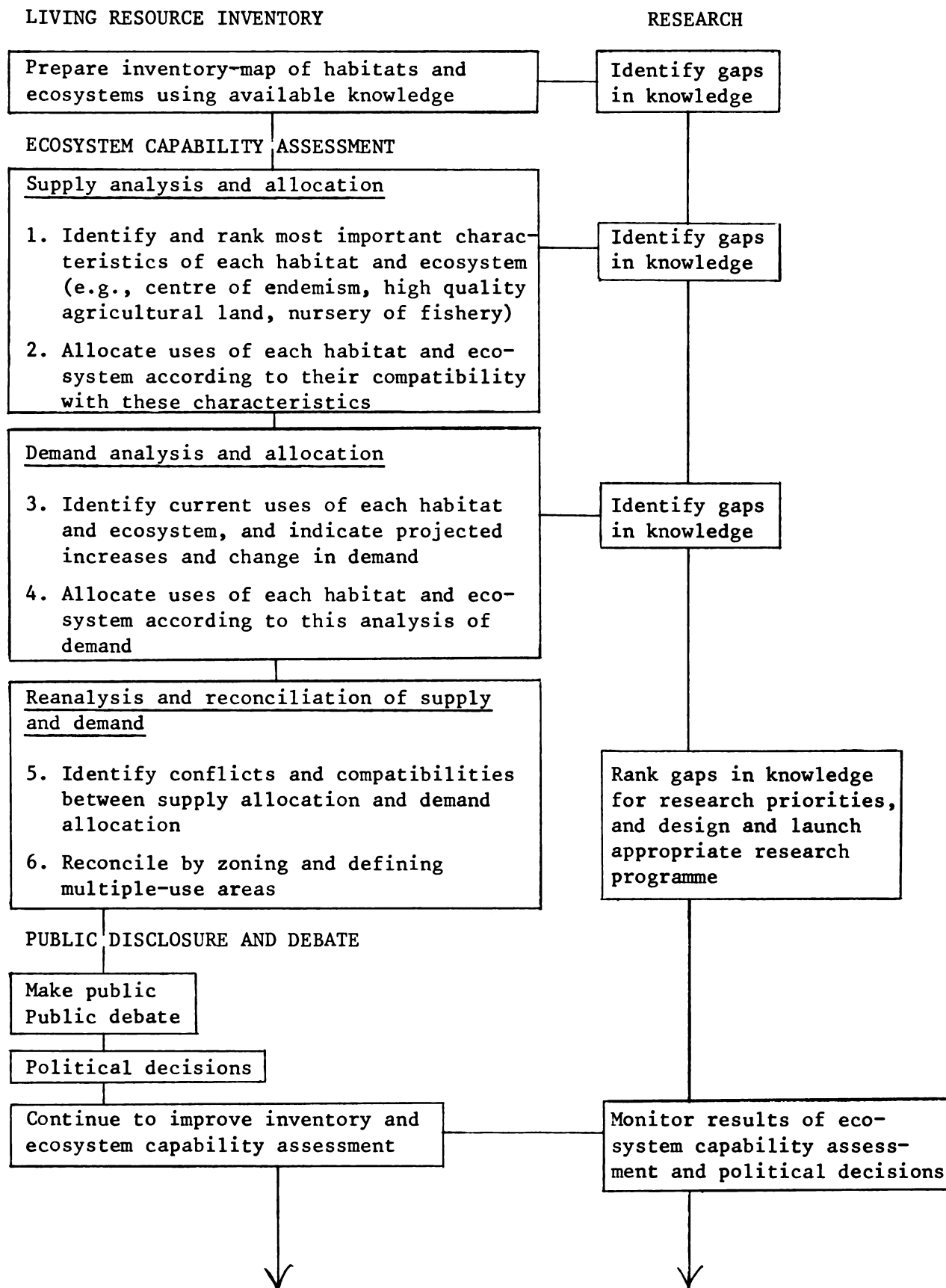
19. The first essential of planning is to know what is there. Each nation or province should prepare an inventory of key ecosystems (of great economic importance or cultural importance, representative ecosystems, unique ecosystems, centres of diversity, highly productive ecosystems, critical habitats, habitats of threatened species) and of key species (of great economic or cultural value, endemic and threatened species), together with the ecosystems and species on which they depend.
20. The second essential is to establish the most appropriate use for each of the ecosystems, or types of ecosystem, of the land, fresh waters, and the sea. The uses and values of each should be assessed, and alternative uses, areas of potential multiple use and areas of conflict should be identified. Those areas which should be protected as crucial for conservation (that is, those for which no other use but protection can be envisaged - centres of diversity, unique ecosystems, critical habitats of threatened species, for example) should be identified as such first. Next should come priority management areas (areas that may be modified provided that modification will not impair their key function - for example, watershed protection forests; highly productive coastal wetlands and shallows) - with an indication of compatible uses - and areas that are best suited for food production. Then should come areas that are best suited for sustained yield forestry. All ecosystems - or, in the first instance, types of ecosystems - should be classified by the constraints on use that should be applied to them. Appropriate uses can then be allocated. A procedure is illustrated in Figure 1 (page 23).
21. Given the increasing capacity of human societies for making irreversible changes to the environment, the allocation process should favour those uses that maintain the greatest number of future options.

Environmental impact assessments

An environmental impact assessment is an activity designed to identify, predict, interpret and communicate information about the impact of an action (any engineering project, legislative proposal, policy, programme or operation with environmental implications) on human health and wellbeing (including the wellbeing of ecosystems on which human survival depends).

It is essential that developments are so located and regulated that adverse environmental impacts are avoided as far as possible and any proposed are at acceptable levels. The most reliable and economically least disruptive way of achieving this is by good planning, principally through ecosystem capability assessments and allocation of uses according to those assessments.

Figure 1. A procedure for ecosystem capability assessments



There are occasions, however, when an incompatible development - one that does not make the most appropriate use of the ecosystem concerned - is unavoidable or is claimed to be unavoidable. In such cases, an environmental impact assessment is essential in order to determine the likely extent and manner of ecosystem disruption and whether they are acceptable to the community.

In addition, environmental impact assessments provide valuable safeguards against planning gaps, and are a necessary supplement to planning, especially in respect of major developments. Plans and capability assessments are never so infallible as to be sufficient in themselves (some new uses, for example, may not be predicted and therefore not taken into account); environmental impact assessments can provide some insurance against planning failure.

22. Environmental impact assessments should be an essential and integral part of all planning for major actions, and should be carried out at the same time as engineering, economic and socio-political assessments.

Public disclosure and debate

Public disclosure and debate is both a safeguard against poorly considered decisions and a valuable means of educating the public on the importance and problems of conservation.

23. Strategies, plans, ecosystem capability assessments, policy decisions and environmental impact assessments, together with the scientific, economic and policy bases of such strategies, assessments and decisions, should be disclosed to the public, which should be given adequate time to influence them. Public involvement should be such that the public is able not only to influence the decision in question but also to cause refinement of the (overall) strategy or policy.

Better institutions

24. Governments should review the organization and funding of administrations with responsibilities for living natural resources, together with the legislative provisions governing actions affecting living natural resources and take the necessary steps - including changes in legislation - to ensure that they have the capability to carry out promptly and fully conservation strategies, natural resource inventories, ecosystem capability assessments, environmental impact assessments and any other measure required for the conservation of living natural resources.

Organization

In many countries, conservation administrations are split between different government departments; and each administration

is often a relatively minor component of the department it is in. Thus responsibility for fisheries, other wildlife, and protected areas is often separated - even though, for example, it would greatly aid the conservation of coastal wetlands and shallows if arguments from all three standpoints could be combined. The consequences of such division vary from country to country. In some countries, conservation arguments are fragmented and positions weakened - especially if the conservation administrations lack the power to make even minority statements so that their views are submerged in the official positions of the larger administrations of which they are part.

In other countries, however, the consequences are positive; the presence of a conservation administration within a number of different government departments means that conservation arguments and positions are brought to bear in many more policy areas than they would be if lumped in one single department.

25. Each country should judge for itself whether or not it is better to have conservation divided but diffused throughout government or brought together in a single department.
26. Whatever the conclusion, there are a few general principles which should be borne in mind:
 - (a) The different administrations with responsibilities for living natural resources should have clear mandates and such mandates should specify conservation.
 - (b) There should be a permanent mechanism for joint consultation on and coordination in both the formulation and the implementation of policies.
 - (c) There should be independent representation of interests. The detailed pursuit of different objectives of living natural resource management can be in conflict (exploitation versus protection, for example). Each administration should be enabled by statute to disclose and explain its positions to the public.
 - (d) Policies and decisions should be implemented.

Finance

The financial resources necessary for conservation will vary greatly from country to country. They are likely to be relatively modest - compared with the needs of education, energy, social security, and (apparently) military security - and to be not unreasonable when measured against even the short-term returns attributable to conservation investment - from fisheries, forest products, subsistence from wildlife, tourism, and so on.

27. Governments should ensure that conservation is adequately funded. In addition, they should allow conservation administrations to resort to independent means of raising funds, whenever the constitution does not preclude their doing this.

Legislation

28. Whenever possible conservation legislation should follow and buttress improvement in public understanding and support. When this is impractical, a greater effort than usual must be made to ensure that the law is enforced and that the reasons for the law are understood. Effective implementation of the law is needed at all times, for obvious reasons - but also because to allow otherwise puts the law into contempt and permits administrators and politicians a quite unjustified complacency.

More knowledge

The preparation of conservation strategies, natural resource inventories and ecosystem capability assessments will reveal gaps in knowledge.

29. Major gaps in knowledge should be identified and research programmes to close these gaps should be elaborated and implemented. Existing national and international programmes intended to close such gaps should be supported.
30. At the same time the outcome of conservation strategies, natural resource inventories, ecosystem capability assessments and any other actions with effects (whether positive or negative) on the environment should be monitored. The findings of such monitoring, together with the results of research, should be used to improve policies, strategies, assessments and other measures.

SPECIAL REQUIREMENTS: ECOSYSTEMS

Ecosystems are systems of plants and animals together with their environment. The living and non-living components are functionally linked, although the boundary of each ecosystem is generally an abstraction intended to assist study of the ecosystem in question. Thus an entire catchment area, a watershed forest and a decaying tree are all ecosystems. What matters is the functional organization of ecosystems since it is this that confers on ecosystems their key characteristics of predictability, resilience and self-regulation.

Human activities tend to reduce these characteristics, and the more they do so the more work (capital, energy, labour) is required to maintain the ecosystems concerned or the ecosystems that replace them. Depending on the nature and timing of the changes induced by human activities, some ecosystem processes (the flow of energy, the recycling of nutrients, and reproduction and mortality are examples of ecosystem processes) may be speeded or slowed, increased or diminished, or ended altogether.

In this Strategy three types of ecosystem are recognized depending on the extent to which they have been influenced by human activities:

- (a) original ecosystems are those so little influenced by human activities that no intervention is required for their maintenance;
- (b) modified ecosystems are those whose original composition, structure and dynamics have been so altered by human activities that a degree of additional human intervention is required to maintain them in their present form and for ecosystem processes to continue at current rates;
- (c) transformed ecosystems are those that have been totally destroyed and replaced by inanimate structures or by monocultures or otherwise so altered that constant human intervention is required to maintain them.

31. In every country there should be a balance among original, modified and transformed ecosystems so that the fullest benefit may be derived from the special characteristics of each.

Original ecosystems and their protection

32. The following types of original ecosystem should be protected from transformation and modification:
- representative samples of the range of ecosystems in each country or province;
 - centres of endemism and species-rich ecosystems;
 - habitats of species threatened by habitat destruction or degradation.

Representative samples of ecosystems

33. Representative samples of the different kinds of ecosystem in each country should be protected so that the range of variation in nature is preserved. Only those uses that are compatible with the preservation of the ecosystem and its component communities of plants and animals should be permitted in areas protected for this purpose.

34. Each country should review its existing system of protected areas and ascertain the extent to which the different kinds of ecosystem in each biogeographical province are protected. Biogeographical provinces with no protected areas should be given priority, followed by provinces in which few of the ecosystem-types are represented in protected areas. Attention should be paid to the adequacy of protection of each area. Global biogeographical classifications should be used together with more detailed national or regional classifications derived from them. National protected area programmes should be coordinated with international programmes, particularly the biosphere reserves programme of UNESCO's MAB 8 project and the initiatives of IUCN's Commission on National Parks and Protected Areas, so that a complete network of protected representative samples of ecosystems may be established as soon as possible.

Centres of endemism and species-rich ecosystems

35. Each country should identify its centres of endemism and its species-rich ecosystems (particularly those that are unique) and ensure their preservation in protected areas as a matter of priority. In these areas preservation should have prior claim over other uses.

Habitats of species threatened by habitat destruction or degradation

More plant and animal species are threatened by habitat destruction or degradation than by any other problem. Habitat destruction and degradation includes: replacement of the entire habitat by settlements and other human constructions, by cropland, grazing land and plantations, and by mines and quarries; the effects of dams (blocking of spawning migrations, drowning of habitat, alteration of chemical or thermal conditions); drainage, channelization and flood control; chemical nutrient and solid waste pollution (domestic, agricultural, industrial, mining); over-extraction of water (for domestic, agricultural and industrial purposes); removal of materials (such as vegetation, gravel and stones) for timber, fuel, construction and so on; overgrazing; erosion and its by-effects (such as siltation); and destruction/degradation by introduced species (for example, goats).

36. The habitats of threatened species should be protected. Each protected area should safeguard all the habitats (the feeding, breeding, nursery and resting areas) of the species concerned. Where this is clearly not possible - as in the case of migratory or wide-ranging animals - a network of protected areas should be established the effect of which would be to safeguard all the habitats of the species concerned. If the species migrates or ranges from one national jurisdiction to others, bilateral and multilateral agreements should be made as appropriate to set up the required network.

37. Not only should habitat be protected but any external source of the nutrients and other essentials on which each habitat depends should also be protected or so managed as to assure an adequate supply of the essential concerned. Exploitation and other impacts (such as pollution) along migration routes should also be regulated.

Modified ecosystems: management and protection

38. Modified ecosystems should be managed sustainably. In many cases various management objectives can be combined in systems of multiple-use. For this to be done successfully, such objectives must be defined precisely and the compatibility of the various proposed uses both with each other and with the ecosystem carefully assessed.
39. The following ecosystems should be regarded as priority management areas; they may be modified provided that modification does not impair their key functions, but they should not be transformed:
- highly productive coastal and marine ecosystems;
 - watershed forests and pastures.
40. The following ecosystems may already be modified but should be preserved in their present state, whether modified or original:
- gene pools.
41. In addition, modified areas within easy reach of human settlements should be set aside for recreation.

Highly productive coastal and marine ecosystems

42. Highly productive coastal and marine ecosystems include offshore upwellings of nutrients and coastal wetlands (mangroves, saltmarshes, lagoons, estuaries) and shallows. They support valuable fisheries as well as large numbers of sea and shore birds and rich invertebrate communities. It is not necessary to protect such ecosystems absolutely (this is seldom possible anyway) - but use should be so regulated that their productivity is not reduced.

Watershed forests and pastures

43. To maintain the productivity of watershed forests and pastures and ensure that they continue to protect areas downstream both from siltation and floods and other sharp fluctuations in streamflow, agriculture, grazing and tree felling in watershed areas should be carefully regulated.
44. Forest protection, reforestation and watershed management should be given high priority by governments and by bilateral and multilateral aid agencies.

Gene pools

45. The wild relatives of cultivated plants and domesticated animals should be protected in special conservation areas. Primitive varieties of cultivated plants and domesticated animals should be husbanded in the ways they are now. For them it is necessary to set up agricultural conservation areas in regions where they are cultivated, and employ local farmers to act as farmer-wardens, preserving both the cultivar and the method of cultivation.
46. Industries and other commercial enterprises based on, or regularly using, particular crops should be encouraged to sponsor conservation areas for the relevant gene pools.

Requirements for protected and priority management areasSize and distribution

47. The size, distribution and management of protected areas should be determined by the needs of the ecosystems and the plant and animal communities they are intended to protect. The necessary measures should be taken to safeguard the support systems of protected and priority management areas and to shelter the areas from harmful impacts: these measures should include the establishment of buffer zones where special restraints on use may be applied.
48. Research should be continued into the questions of minimum critical size and optimum distribution of the protected areas required to safeguard a given number and composition of species. Much better understanding is needed of: the phenomena of species loss from areas below the minimum critical size and of species recruitment - both through immigration from other areas and through changes in the gene pool remaining within the refuge; the genetic problems of very small populations; and obligate relationships with other species (for example, pollinators and seed dispersers).

Security

Protected and priority management areas of all kinds are likely to come under increasing pressure. This pressure may more easily be avoided or resisted if complementary sustainable development projects take place in the neighbourhood of each area and if the neighbourhood's investment in each area is high. Investment can be increased by making each area a centre of education, involvement, prestige and research.

49. Development. Complementary sustainable development projects should be initiated in association with existing and proposed protected areas in order to take pressure off those areas. The projects should be sensitive to social impacts as well as environmental impacts.

50. Education. Clear and simple field guides to the plants and animals non-specialist visitors to the area are likely to see should be produced; besides aids to identification, the field guides should contain concise items of interesting information (for example, on behaviour and on uses and values) concerning the species covered. At the same time the function of the protected area as a bank of living resources should briefly be explained. Production of these guides - which should be attractive, so that they will be read and kept - should begin with the protected areas that are most visited and nearest the larger centres of population.
51. Involvement. To foster local support and understanding, the local community should be involved in the protected area from the start - by being adequately represented on the management authority and by being given any employment or other economic opportunities associated with the protected area.
52. Prestige. The special features of the protected area that may make it unique to the community and to the nation should be stressed, and people encouraged to regard the area as a source of local and national prestige.
53. Research. The value of protected areas can and should be enhanced by using them to advance national scientific research, to build up a body of scientists with sound field experience, and to establish baselines so that changes elsewhere can be monitored. Given the provision of mobile accommodation and laboratories, scientists could make greater use of protected areas without the need for establishing and maintaining permanent biological stations. The presence of researchers, especially in the more remote areas, can have a valuable by-effect by deterring poachers and squatters.

World Heritage Convention

54. Governments should adhere to the Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention) if they have not already done so. They should recognize their obligation to provide adequate funds to safeguard world heritage sites.

Transformed ecosystems

55. Since the transformation of ecosystems is often difficult and expensive to reverse and may even be irreversible, the allocation of ecosystems for transformation should be done with the greatest care. Particular attention should be paid to establishing the necessity of each proposed transformation and the suitability of the area for the proposed use compared with other possible uses.

56. When assessing the possible effects of a proposed transformation it should be borne in mind that many effects may be delayed, displaced, or both.
57. Transformed ecosystems (especially human settlements, and monocultural and other highly specialized farms and plantations) should be managed as efficiently as possible - consistent with reasonable ecological constraints - so that they will not occupy or affect a larger area than necessary. As far as possible new plantations should be on land already cleared.
58. Transformed ecosystems that are no longer used (abandoned mines, for example) should either be converted to another use requiring transformation or they should be rehabilitated at least to the point where natural processes of restoration can take over rapidly.
59. Human settlements and other built environments should be so planned that they provide habitats for as great a variety of plants and animals as possible.

This will not only increase the wellbeing of urban dwellers (the majority of people) but will also reduce some of the harmful impacts of built environments on living natural resources.

Transformation and the level of demand

There is a direct relationship between pressure for transformation and level of demand.

60. Demand should be reduced by eliminating waste, ensuring better distribution and avoiding unnecessary use. All economic activities should be conducted in ways compatible with sustaining the living resources on which all such activities ultimately depend.
61. Demand should be further reduced or at least should be stabilized by reducing or stabilizing human numbers and per capita consumption of energy, raw materials and other physical resources. Family planning programmes should be initiated or expanded.
62. The reduction or stabilization of per capita consumption is not, of course, a priority wherever effective demand is so low that the basic means of survival are denied people. Poverty and environmental degradation often form a vicious circle, the one increasing the other. Special efforts should be made to eliminate poverty in ways that by restoring and protecting the environment reduce the likelihood of poverty returning.
63. In every area, rich or poor, demand should be met in ways that do not harm people and are the least disruptive of their environment.

64. Particular efforts should be made both to conserve energy and to develop diversified power production systems.

Few forms of energy supply are benign in all circumstances. Nuclear energy is potentially highly destructive, bringing with it problems of waste disposal, the security of plutonium, and the safeguarding of decommissioned power plants. Fossil fuels have brought the problems of CO₂ increase, strip mining, oil spills, and the degradation by acid rain of many freshwater areas in northern Europe and North America. Hydroelectric power can block the spawning migrations of fishes, alter or destroy the habitats of many species and drown the habitats of many others.

65. Development and use of solar energy and other benign forms of power generation should be greatly increased.

Ecosystems and subsistence peoples

Subsistence and semi-subsistence (part subsistence, part cash) peoples often have a profound and detailed knowledge of the ecosystems and species with which they are in contact and effective ways of ensuring they are used sustainably. Even when a people is clearly destroying a part of its environment it should not be assumed that all of that people's knowledge has disappeared or all of its ways of regulating use have atrophied. Such assumptions tend to be self-fulfilling - with the result that a subsistence society with a prospect of developing harmoniously with its environment is more readily transformed into a poor cash society, hostile to attempts to regulate use and predisposed to degrade the environment still more severely.

66. Every effort should be made to identify those recent and surviving elements of subsistence and semi-subsistence cultures that enable (or enabled) them, wholly or partly, to have a sustainable relationship with their environment. This should be done before other measures are adopted to regulate impact on the environment. If additional or alternative measures prove necessary, the community concerned should participate in devising and implementing them.

Depending on the environmental relationship of the society and on the function of the protected area, a subsistence society may be compatible with a protected area.

67. Whenever a protected area is established a subsistence community need not necessarily be moved and should not be unless it wishes. Conversely a subsistence community should not be kept in a protected area against its will.

The knowledge that subsistence and semi-subsistence peoples have of their environment is a valuable resource.

68. Every effort should be made to document the environmental knowledge of subsistence and semi-subsistence peoples and to use it for the benefit of such peoples and the nation.

SPECIAL REQUIREMENTS: SPECIES

This section deals with three questions:

1. What are the minimum goals of species conservation?
2. What are the criteria for determining priorities in species conservation?
3. How should the main problems of species conservation be tackled?

Minimum goals

69. The minimum goals of species conservation are:

to prevent the extinction of any species;
 to maintain enough viable populations of species of expected value as breeding material to safeguard the full range of variation in those species;
 to ensure that all populations of species of expected value for harvesting can be restored to maximum sustainable yield (MSY) levels;
 to restore all populations of species of current economic value to MSY levels and ensure harvesting thereafter is well within those levels;
 to safeguard the ecosystem processes essential for the achievement of the above goals.

The minimum goals of species conservation are determined by the value placed on the species concerned. For this purpose species may be divided into three groups: of current economic value; of expected economic value; of potential economic value. This classification in no way excludes or underestimates other values. Scientific values are catered for largely by meeting the same minimum goal as for potential economic value. The minimum goals with respect to aesthetic, cultural and ethical values vary considerably, not only between countries but also among different interest groups within countries. Where the species is of general and widespread aesthetic and cultural value, and people wish to come into regular contact with it, the minimum goal clearly must be to maintain the species in sufficient numbers for such contact to occur. It is not likely that aesthetic and cultural values would conflict with economic ones; rather they can be considered additional factors which should be taken into account when deciding what the minimum conservation goal for each species should be.

- 70a. Species of current economic value are those species that yield a direct and immediate economic return to people or are important for subsistence - together with the ecosystems and species on which they depend. The minimum goals should be to restore the populations

of all such species to at least maximum sustainable yield levels, to ensure that harvesting is such that the populations do not fall below those levels (to allow for error and ignorance), and to safeguard the ecosystem processes on which the species depend (including breeding, feeding and resting areas).

- 70b. When more than one species is being harvested at a time (as with a multi-species fishery) these goals require correspondingly greater knowledge of the systems affected and therefore harvest levels should be set with still greater caution and monitored still more closely.
71. Species of expected economic value are either those related to cultivated plants and domesticated animals or those that could be harvested once their economic potential has been demonstrated. The minimum goal depends on the type of species. If the species is a wild or semi-domesticated relative or variety of a cultivated species, and its value is as a source of breeding material, then the minimum goal should be to maintain viable populations representing the full range of variation within each species. If the species is one that could be harvested, once its economic potential has been found satisfactory (for example, certain trees or fish), then ideally the minimum goals for species of current economic value should apply, and at the very least populations should not be allowed to fall below levels from which recovery to maximum sustainable yield levels would be problematical.
72. Species of potential economic value include all other species, since (as noted on pages 4-9) it is impossible to predict which species currently unknown, or known but assumed to be without value, will prove eventually to be useful or even indispensable. The minimum goal for the conservation of all these species should be to ensure their survival by maintaining a sufficient number of viable populations of each, within the ecosystems of which they are part, to provide adequate insurance against disasters.

Criteria for deciding priorities

73. Adequate resources should be provided to tackle the problems of depleted populations of current value, threatened populations of expected value, and of all threatened species.

It would be extremely shortsighted to concentrate on species of current value to the exclusion of the others, and foolish to concentrate on the most threatened species to the exclusion of unthreatened but misused species of great economic value.

The extent to which a species problem demands a high priority response depends on the value accorded the affected species and therefore on the minimum conservation goal. Species of current or likely value need not be threatened to require

high priority action. Indeed by definition those in the category of expected value as breeding material will not be threatened since often they will be wild varieties of cultivated species. Similarly, a species in the category of current economic value, however numerous, need only be excessively harvested, to justify high priority action. If a species in this category is threatened, however, then it should be accorded greater priority than it might otherwise. The relationship between the immediacy of the value of a species (and hence the minimum conservation goal) and the degree of problem to be tackled is shown in Figure 2.

Figure 2.

————— degree of problem —————>

Value and minimum goal	POPULATIONS DEPLETED	POPULATIONS THREATENED	SPECIES THREATENED
<u>Current</u> restore populations to MSY levels; ensure harvesting thereafter is well within those levels; safeguard essential ecosystem processes	populations reduced or declining but not threatened	populations severely reduced or threatened but species not threatened	species threatened
<u>Expected, for harvesting</u> ensure populations can be restored to MSY levels			
<u>Expected, as breeding material</u> maintain enough viable populations to safeguard full range of variation			
<u>Potential</u> safeguard enough viable populations to ensure survival of the species			

74. A species of current economic value should be given priority attention if one or more of its populations is depleted. A species of expected economic value should be given priority attention if one or more of its populations is threatened. A species of potential value should be given priority attention if the species is threatened.
75. The criteria for deciding priorities within both the group of species of current value and the groups of species and varieties of expected value should be: value of resource; severity of problem.

Criteria for deciding priorities among threatened species

76. Threatened species of current value should be given priority over those of expected value, which in turn should be given priority over those of potential value. Among species of potential value the criteria for deciding priorities should be: size of genetic loss; imminence of that loss.

Size of genetic loss. Clearly the loss of a family is greater than the loss of a subspecies. Other things being equal, a threatened order should be given priority over a threatened family, a family over a genus, a genus over a species, and a species over a subspecies. This is because, ideally at least, different positions in the taxonomic hierarchy reflect greater or lesser degrees of genetic difference, and hence difference in such variables as behaviour, physiology, chemistry and ecology.

Monotypic families or genera should receive priority over polytypic ones, since - theoretically - the smaller the family or genus the greater should be the gap between the nearest related family or genus.

Although the degree of difference (the gap) between genera and between species within genera varies both within and among classes, the current taxonomic hierarchy provides the only convenient rule of thumb for determining the relative size of a potential loss of genetic material.

The method is by no means free of anomalies, but these reflect the wider problem of modern taxonomy as an information retrieval system.

77. Ways of making taxonomy more consistent and of improving its usefulness to conservation as well as its general information value should be explored by competent systematists and ecologists.
78. A distinction should be made between species that are threatened globally, nationally, and provincially. A species that is threatened globally (is an IUCN Red Data Book species or equivalent) should be given priority over one that is on a national list of threatened species but is considered secure elsewhere; and a species that is threatened nationally should be given priority over one that is

threatened only at the provincial level.

This does not mean that species threatened only at national or provincial levels are unworthy of attention. On the contrary, by protecting such species valuable intraspecific variation (genetic variation within the species) may be safeguarded. Such species, however, should not be given priority over globally threatened ones.

Imminence of loss. IUCN distinguishes three levels of threat -

endangered: in danger of extinction; survival unlikely if the causal factors (threats) continue operating.

vulnerable: not yet endangered, but likely to be if the causal factors (threats) continue operating.

rare: world population is small and "at risk" but not yet endangered or vulnerable; (by implication this refers to taxa with so restricted a world range that it would be possible to endanger them or even make them extinct by, for example, a sudden change in land use in one area).

There is also a fourth category,

indeterminate: indeterminate taxa are suspected of belonging to one of the three categories above but there is insufficient information to assign them to the correct one.

Other things being equal, an endangered species should be given priority over a vulnerable one, a vulnerable over a rare, a rare over an indeterminate one, and an indeterminate species over one that even if it is declining is considered insufficiently threatened to qualify for any one of the four categories.

Imminence of threat, however, is partly a function of the state of knowledge of a species. Species not known to be threatened but with highly restricted distributions should therefore be closely monitored - with particular attention being paid to higher taxa (orders, families, genera) with restricted distributions.

79. Merging the two criteria. Priority should be determined by merging the two criteria on the basis of the following formulation: the greater the potential genetic loss the less imminent that loss need be to justify preventive action. This is illustrated in Figure 3. Furthermore endangered species within a top priority family (for example) should be tackled before vulnerable species in that family.

Figure 3. Formulation for determining priority

————— Imminence of loss —————→

	Indeterminate	Rare	Vulnerable	Endangered
Order	7	3	2	1
Family	11	8	5	4
Genus	13	12	9	6
Species	16	15	14	10

↑
size
|
of
|
loss
|

stippled area = highest priority
 hatched area = intermediate priority
 unshaded area = lower priority
 numbers indicate suggested order of priority

80. There should be very careful examination of prevailing and future pressures on the species concerned and of the measures necessary not only to achieve its conservation but also to sustain that achievement. Generally speaking, the higher priority the species (in terms both of size of potential genetic loss and of the imminence of that loss), the greater the proportion of available resources that is justified to be spent on conserving it.

Main species problems

The main species problems are (in order of world importance):

habitat degradation and destruction;
 overexploitation;
 effects of introduced species;
 killing to protect crops, livestock and prey;
 loss, diminution or contamination of food supply;
 incidental take.

Habitat degradation and destruction

This problem has already been treated on pages 28-29.

Overexploitation

Problems of overexploitation vary depending on the intensiveness with which the species concerned are harvested and the extent to which they or their products are traded. There are several types of exploitation:

1. Subsistence harvesting without trade. Here is meant the harvesting of those plants and animals that meet a subsistence need (whether for food, fuel, or fibre) in areas where demand for them is as yet little influenced by the cash economy.

Harvests are normally sustainable - except when:

- (a) demand becomes excessive due to an increase in human numbers;
- (b) a more efficient, or a less efficient but more destructive, harvesting technology has been introduced (e.g. shotguns, nylon nets);
- (c) external factors (habitat destruction, commercial harvest of the target species) have reduced the harvested species to an "artificially" low level.

- 81. Where a community already has effective harvesting regulations, these should be reinforced. Where there are no regulations or where one of the factors (a) to (c) has rendered traditional regulations obsolete the community should be helped to devise and enforce a set of effective regulations.
- 82. Regulations should include: restricting the times and places of harvesting and the total harvest; prohibiting or restricting the use of certain technologies; providing for habitat renewal; prohibiting or restricting commercial harvesting.
- 83. Should the overharvesting have become so acute that very severe regulation is needed (including an outright ban of months or years on harvesting) then there are likely to be real problems of enforcement. A great deal of time should be devoted to discussing the problem with the community; and an alternative food, fuel or fibre should be offered.
- 84. Where demand has become excessive due to an increase in human numbers, family planning measures should be introduced or increased.
- 85. Where vegetation is being destroyed by cutting and stripping for fuel immediate measures should be taken to:
 - restore the vegetation;
 - establish plantations for firewood, which must be large enough to meet higher levels of demand than today's (there is a direct relationship between human population size and level of demand);

provide alternative sources of firewood, to take pressure off the plantations and remaining vegetation;

provide alternative sources of energy (other than firewood).

Note: if these other sources are successful, the need for alternative sources of firewood and for the more extensive plantations may become less acute;

stabilize and reduce human numbers.

86. The provision of alternative energy supplies (solar, wind, biogas, and so on) should be a major development priority of governments and bilateral and multilateral aid agencies.

2. Subsistence harvesting with national trade. Here is meant the harvesting of those plants and animals that meet a subsistence need but are also traded for cash. Harvests can become excessive under any one or combination of conditions (a) to (c) above and also when

(d) traditional regulatory mechanisms, however well equipped to regulate subsistence demand, fail to cope with the new demand generated by the cash economy.

87. Where this is the case, the problem should be discussed with the community, which should be helped to devise and enforce modified or additional regulations. Because much of the demand is generated outside the community, however, greater supervision and enforcement by government will be needed. Where very severe regulation is needed trade should be prohibited while allowing a limited harvest for subsistence only.

3. Subsistence harvesting with international trade. Harvests can become excessive under any one or combination of conditions (a) to (d). In the case of (d), failure of existing regulatory mechanisms is even more likely because of the relatively high cash rewards for supplying international demand. The provisions of 2 apply. In addition:

88. If the plant or animal in question is not already on Appendix I or II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, then it should be placed on one of those Appendices or, if this is not warranted, on Appendix III.

4. Commercial harvesting. Special consideration has been given to subsistence harvesting because the direct dependence on wild animals and plants and correspondingly high cultural attachment to them characteristic of subsistence communities require special provisions. In the case of commercial harvesting the need for consultation with the industry concerned is as high as it is with the subsistence community; but generally an industry is capable of a more flexible response to improved regulation.

Despite its inherently greater responsiveness to regulation, commercial harvesting is often excessive. Of special concern

are harvests of the commercially more important wild plants and animals, principally trees, fish, crustaceans and molluscs, and of attractive and bizarre plants and animals for the souvenir trade.

89. Tree felling programmes should be matched by planting programmes of the species felled so that what is taken out is replaced.
90. Catches of fish, crustaceans and molluscs should be fixed at sustainable levels. Management objectives should be conservative and allow for error and ignorance. Research should be increased so that total allowable catches can be established with greater confidence of their sustainability.
91. The harvesting of plants and animals for the souvenir trade should be regulated so that it is sustainable. The size and dynamics of the trade should be investigated.

5. International trade. Provisions for the regulation of international trade are given on page 54.

92. Additional measures. In addition to those mentioned above, the following measures should be taken:

Education. Understanding of and support for sustainable harvesting should be built up among both "producers" and consumers of living natural resources; this is especially necessary with respect to those resources that are harvested commercially and/or enter international trade.

Monitoring. Harvest levels, trade, and response to regulations should be closely monitored, not only by governments but also by nongovernmental organizations (NGOs). NGOs with monitoring experience could provide a useful service to other NGOs (especially in other countries or provinces) by helping them to set up their own monitoring systems.

Stabilization of trade and commodity prices. Overexploitation is partly a function of market uncertainty. Some of the motivation to overharvest would disappear if prices could be guaranteed and fluctuations in demand reduced.

Effects of introduced species

Introduced species can have adverse effects on native species in one or more of the following ways: genetic "swamping" due to hybridization; competition for space or food; predation; habitat destruction or degradation. The elimination of most introduced species is virtually impossible and therefore should be attempted only as a last resort - for example, when an endangered species clearly will not survive unless the introduced species is destroyed. Of course, by no means all introductions have been harmful. Crop plants are an obvious example of highly

beneficial ones. Nevertheless, the problems caused by harmful introductions can be so severe and intractable that only those introductions over which absolute control can be had should be permitted.

93. Given the extreme difficulty of eliminating introduced species, every effort should be made to prevent all introductions except those that can be proven to be harmless and over which complete control can be exercised. An intensive public education campaign should be directed at the pet trade and consumers, government agricultural, wildlife and fisheries administrations, and at other bodies responsible either for allowing or for promoting introductions. Of all conservation problems at the species level, introductions are probably the most underestimated; and such an education campaign should be given high priority. Governments should ensure that, by law, the onus of proof that an introduction will not be harmful and can be controlled, is on the introducer. A proposed introduction should be the subject of an environmental impact assessment, including a full enquiry on the likely and possible ecological effects. When examining the issue of control, it should be borne in mind that many species are capable of changing their behaviour when placed in new situations. The normally anadromous Pacific salmon Oncorhynchus ceased to be so when introduced to the Great Lakes (North America).

Killing to protect crops, livestock and prey

Many species are being depleted because they are killed to protect crops, livestock or prey (for example, fish) whether or not the harm they do is real or imagined, and if real, slight or significant.

94. Research may be necessary to determine the extent of the damage, if any. If the damage is imaginary or slight, an education campaign directed at the farmer, rancher or fisherman should be undertaken, backed up by legislation. If the damage is significant then a protection kill quota for the species being killed should be fixed; (the quota should be sustainable). Compensation for loss should be paid (to farmers, ranchers, fishermen) only exceptionally and as a last resort (since its availability tends to increase claims of loss or damage) when it is clear that an increase in the protection kill quota would threaten the species concerned but significant losses are still being suffered.

Loss, diminution or contamination of food supply

The loss or diminution of the food supply particularly affects predatory species, as well as many specialized invertebrates, and often indicates that humans are subjecting ecosystems and prey species to heavy pressure. Contamination of food supply is usually by pesticides but occasionally also by other pollutants.

95. Where a species is threatened by loss or diminution of food supply, steps should be taken to manage the ecosystem or the prey species in ways such that they can support the affected species. Where a species is threatened by contamination of food supply by pesticides and other pollutants the use of such contaminants should be restricted by law whenever they could harm the feeding areas of affected species. Users of pesticides should be educated to choose and apply them with greater care, and codes of conduct governing the release of pollutants to the environment should be drawn up with farmers and industry.

Incidental take

Incidental take is the accidental capture and killing of non-target animals in the course of hunting or fishing for other species. All types of gear and fishing techniques are involved: purse seines, shrimp trawls, deepwater trawls, gill-nets (fixed and drift), anti-shark nets, long lines, traps, and dynamite. Incidental take is highly destructive. In the northeast Atlantic heavy inroads have been made on herring, whiting and haddock stocks by industrial fisheries for sprat and Norway pout which annually take tens of thousands of immatures of non-target species. Globally, shrimp fisheries are estimated to kill at least 3-4 million tons of fish a year. The Atlantic ridley turtle has been reduced almost to extinction by incidental take by the Gulf of Mexico shrimp fishery, while in other parts of the world loggerhead and green turtles are seriously affected. Salmon gill-net fisheries in the north Atlantic and north Pacific destroy hundreds of thousands of seabirds every year. The Japanese salmon fishery takes incidentally about 20,000 Dall's porpoise a year, and in 1976 the eastern Pacific tuna fishery took almost 144,000 dolphins (though this take is now being sharply reduced).

The USA is making a concerted effort to tackle aspects of the marine incidental take problem (by developing improved gear and techniques for tuna fishing so as to reduce dolphin deaths; and by devising improved shrimp trawls to exclude turtles). Since the problem is global, many more countries should be making similar efforts.

96. An international workshop should be held to assess the dimensions of the marine incidental take problem and to recommend a cooperative programme of action by governments and international and national organizations to research, develop and adopt ways of reducing incidental take and of making full use of such incidental catches that it is impossible to prevent.

Spraying campaigns to control pests and diseases often kill huge numbers of non-target land and freshwater animals. Some at least of this killing is avoidable and should be avoided. Incidental take is also a problem of freshwater fisheries (in India, for example, gill nets in rivers are a serious threat

to gharials - Gavialis gangeticus).

97. The size and location of the areas treated with insecticides in a single season should be chosen to avoid the extermination of local races of non-target species and to allow reoccupation by those species from adjacent untreated areas.
98. Whenever possible spraying should be done on the ground rather than from the air, since groundspraying is more discriminating. If aerial spraying is unavoidable it should be limited to areas that are relatively poor in non-target species, leaving more vulnerable areas (such as gallery forests, woodland with dense undergrowth, and swamps) to be sprayed from the ground.
99. Since non-target species are more or less vulnerable to different insecticides, the impacts of different insecticides should be tested (if not known) and the least harmful combination used.

SPECIAL REQUIREMENTS: ECOSYSTEMS AND SPECIES REQUIRING INTERNATIONAL COOPERATION

100. Every nation should recognize (and make appropriate provision in its national conservation strategy for) its responsibility to behave with particular restraint towards the following categories of living natural resource:
 - (a) ecosystems and species that occur outside national jurisdictions or within disputed jurisdictions;
 - (b) species that move between one national jurisdiction and another;
 - (c) ecosystems and species in one jurisdiction that depend on or are affected by events in another;
 - (d) species that are traded internationally.

The conservation of all these resources depends on international cooperation. Accordingly, nations should assist in the development of appropriate international treaties and other regimes or institutions both for regulating use of the resources themselves and for maintaining the habitats and processes on which the resources depend. They should also adhere to such treaties and implement them.

Ecosystems and species that occur outside national jurisdictions or within disputed jurisdictions

This category includes:

the pelagic and deep benthic realms;
Antarctica and the Southern Ocean.

The pelagic and deep benthic realms

These are defined as the area of open sea together with the sea floor beyond the continental shelf and beyond national (200 nautical mile) "exclusive economic zones" (EEZs), assuming that every coastal state adopts them. Ocean trenches are not included since all of them would be, wholly or largely, within one EEZ or another.

Currently the most important living natural resources of the pelagic realm are tuna (and tuna-like fishes) and whales. By and large tuna fisheries could and should be much better regulated. Fishing for tuna in the east central Pacific is regulated by the Inter-American Tropical Tuna Commission (I-ATTC) and in the Atlantic by the International Commission for the Conservation of Atlantic Tunas (ICCAT). There is no organization set up specifically to regulate tuna fisheries in either of the other important tuna regions: the Indian Ocean, and the west central Pacific. A world regulatory body has been proposed.

I-ATTC does not include all nations fishing for tuna in its region, cannot enforce the quotas and closed seasons it sets on behalf of its members, is vulnerable to commercial pressures, and does not disclose its data or assumptions (which are therefore immune from public and scientific scrutiny).

101. Ways of strengthening the existing regulatory bodies and the desirability and feasibility of setting up a world body for the conservation (sustainable exploitation) of tuna should be explored.

Whaling is regulated by the International Whaling Commission (IWC) under the International Convention for the Regulation of Whaling (now being revised). Six whaling nations (Chile, Republic of Korea, Peru, Portugal, Somalia and Spain) do not belong to the IWC.

102. The conservation record of the IWC is poor. The main weaknesses that should be remedied without delay are:

- (a) failure to take adequate account of the effects of changes in ecosystems on whales and of whaling on ecosystems, with the result that harvesting potential has been exaggerated and the capacity of depleted populations for recovery overestimated;

- (b) failure to take adequate account of the effects of changes in one whale stock on other stocks, with similar results;
- (c) inadequate collection of data on the state and practices of national whaling industries and on their operating methods, with the result that regulations are made in ignorance of some crucial variables (such as accurate catch per unit of effort data) and such conservation that is achieved is done at the risk of needless economic harm (thus provoking unnecessary resistance by the industry);
- (d) the right of a nation to disregard quotas and other regulations simply by giving notice of its decision to do so;
- (e) the use of models of populations and of the effects of harvesting on populations that are not only based on inadequate data but also inadequately reflect such data that are available, with the result that population estimates are probably too high and the effects of harvesting on populations underestimated;
- (f) inadequate research on whales and on the ecosystems of which they are part;
- (g) inadequate evaluation of the results of research, partly because the data are not made available promptly (if at all).

The IWC is concerned only with the baleen whales and with sperm whales and a few other toothed whales. The dolphins taken incidentally on the high seas (largely by tuna fisheries and largely in the east central Pacific and east central Atlantic) have no body to fix quotas.

Similarly there is no control of impacts on the other resources of the pelagic realm. With use of the seas intensifying, it is highly desirable that the exploitation of the pelagic realm be better regulated, preferably not by the further extension of national jurisdictions but by the establishment of an international regime. The proposals of the Third UN Conference on the Law of the Sea provide a useful basis for this.

103. The feasibility and implications of various possible international pelagic regimes should be investigated. Management should include the establishment of international conservation areas to protect the pelagic feeding grounds of whales, salmon, and so on, the spawning grounds of tuna, centres of endemism, and unique areas such as the Sargasso Sea. One or two pilot international conservation areas could be invaluable training grounds for nations and their peoples in the exercise of international responsibility of the world's heritage of living natural resources. Policing of the conservation areas could be by the international scientific community, which could conduct regular research cruises to them - the scientific value of an area being an important criterion for choosing it as a pilot.

Antarctica and the Southern Ocean

This area is defined as all land and sea south of the Antarctic Convergence (the well-defined line where the cold surface waters of the Southern Ocean sink beneath the warmer waters of the cold-temperate Atlantic, Indian and Pacific Oceans - roughly along latitude 50°S in the Atlantic and Indian Oceans and 60°S in the Pacific). Much of this area - that is the entire area south of 60°S latitude except for the "high seas" - is under the nominal control of the 13 parties to the Antarctic Treaty.

Under the Antarctic Treaty, Antarctica may be used only for peaceful non-exploitative purposes - principally scientific research. Conservation of the living natural resources of the land is provided for by the "Agreed Measures for the Conservation of Antarctic Fauna and Flora", which are excellent but have not yet been ratified. Monitoring of the state of conservation, and scientific advice on conservation, is provided by the Scientific Committee on Antarctic Research (SCAR) of the International Council of Scientific Unions.

The treaty powers, however, have decided that it is time they exploited the area's considerable resources. The potential of krill (Euphausia superba) is currently attracting a great deal of interest: it is said that the catch could rise from about 50,000 tonnes in 1977/1978 to 60 million tonnes or more. A regime for the harvesting of the living resources of the sea is being negotiated, and is expected to be followed by a regime for mining and oil exploitation.

At present the only convention covering the conservation of living resources in the Southern Ocean (apart from the International Convention for the Regulation of Whaling) is the Convention for the Conservation of Antarctic Seals. Exploitation of fish, molluscs and crustaceans is entirely unregulated - so the draft Convention on the Conservation of Antarctic Marine Living Resources currently being negotiated by the Antarctic Treaty powers could fill a serious gap.

104. Any regime for the exploitation of the living marine resources of the Southern Ocean should so regulate the krill fishery as to prevent
- (a) irreversible changes to the populations of krill;
 - (b) irreversible changes to the populations of the baleen whales and those seal, fish and bird species which feed on krill, as well as to the Southern Ocean ecosystem as a whole;
 - (c) Overcapitalization of krill fishing fleets, which could have severe impacts on fisheries outside the Southern Ocean,

due to the need to redeploy the krill fleets during the long Antarctic winter.

105. Attention should also be paid to the likely impact of a greatly expanded krill fishery on markets for such marine products as fishmeal, frozen shrimp and protein concentrates, as well as on markets for protein-rich feeds of terrestrial origin.
106. The Antarctic Treaty powers and nations fishing or intending to fish the Southern Ocean should exercise extreme restraint on catch levels until understanding of this uniquely productive ecosystem improves. All harvesting should be on an experimental basis as part of a scientific research programme to improve knowledge of krill and of the Southern Ocean as a whole. Current research efforts should be strongly supported.*
107. Continued investigation into the possible environmental impacts of mining and oil exploitation are required. Meanwhile, since oil degrades extremely slowly in conditions such as those of Antarctica and since operating hazards are very high, the feasibility of oil exploration and exploitation in particular should be approached with the utmost caution.

Species that move between one national jurisdiction and another

This category includes species that move regularly between one national jurisdiction and another, and therefore over which nations have partial (rather than temporary) jurisdiction. The economically most valuable living natural resources in this group are fish, crustaceans and molluscs; but issues concerning migratory birds, insects and other animals are also important. Discussion will be divided therefore between the new law of the sea, marine resource management authorities, and general problems of migratory species.

UNCLOS and the new law of the sea

The new law of the sea emerging from the Third UN Conference

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- * Many of the ecological problems are being studied by: the SCAR/SCOR (Scientific Committee on Oceanic Research) Group of Specialists on Living Resources of the Southern Ocean under its "Biological Investigation of Marine Antarctic Systems and Stocks" (BIOMASS) programme; the IOC International Coordination Group for the Southern Ocean; the FAO (including its Advisory Committee on Marine Resources Research), particularly under the UNDP/FAO Southern Ocean Fisheries Survey Programme; the IWC; and IUCN. Some of the economic problems are being investigated by the International Institute for Environment and Development (IIED) in conjunction with IUCN.

on the Law of the Sea (UNCLOS III) and from the unilateral decisions of coastal states is overwhelmingly influenced by the strong desire of almost all the coastal states to win sovereign rights and jurisdiction over the marine resources and environment within 200 nautical miles of their shores. The advent of the Exclusive Economic Zone (EEZ) is of enormous historic and practical importance because it marks a significant setback for the concept of the seas as the heritage of all humanity and the resource of all nations.

Despite the greatly expanded powers over marine resources conferred on states by adoption of EEZs, however, UNCLOS III has not defined corresponding responsibilities to safeguard and manage scientifically the living resources within each EEZ. Yet the resources of one EEZ are seldom independent of other EEZs.

Indeed, in the draft text being considered by UNCLOS III, the provisions for conservation and management of living resources are most unsatisfactory. As the present text stands, for example, coastal states would continue to be legally free to overexploit species and to destroy the habitats on which they depend. This means that the fisheries of one country could be damaged with impunity by another either by overfishing or by degrading or destroying their breeding, nursery or feeding grounds.

108. The international law of the sea should:

provide the environmental safeguards essential for the seas to withstand the predicted impacts of current and prospective technology;

develop conservation duties and responsibilities of coastal states to match the enormous expansion of their rights and powers;

provide a coherent and comprehensive system of principles and criteria for the use and conservation of the seas' living resources;

provide for compensation to be paid for serious damage to a state's marine resources caused by another state's reckless treatment of its own marine environment.

provide adequate means of avoiding and managing disputes and of reviewing the text.

Marine resource management authorities

The conservation of most marine living resources will depend on the improvement of existing, and development of new, bilateral and regional management arrangements, and the strengthening of such international scientific research bodies as the

International Council for Exploration of the Seas (ICES).

International agreements covering four regional fisheries commissions (International Baltic Sea Fishery Commission, International Commission for the Northwest Atlantic Fisheries, Northeast Atlantic Fisheries Commission, and International North Pacific Fisheries Commission) are being revised or renegotiated following extensions of the jurisdictions of coastal states. The roles of other regional fisheries commissions are likely also to be changed radically.

Even if the regional fisheries commissions were not to be modified substantially, it would be necessary to set up new or much altered institutions in order both to take advantage of the new powers of the coastal states and to ensure that the living resources concerned are managed as ecological rather than as political units. There should be a very strong incentive for countries to safeguard the coastal wetlands and other critical marine habitats in their jurisdiction, now that they are also likely to control the fisheries which are supported by those habitats.

109. The mandates of the required institutions for the management of marine resources should enable them to apply the following principles - which then should be applied:
- (a) the area for which the institution is responsible should be, as far as possible, an ecological whole: for example, a biogeographical province or sub-province, or an area served by one or more entire catchments;
 - (b) since ecological wholes must be, to varying extents, arbitrarily defined, and therefore there will be exchanges of nutrients and movements of species between one institution's area and another's, there should be close cooperation between the institutions concerned;
 - (c) there should also be close cooperation between the institution and the authorities responsible for contiguous areas of the land, since impacts on freshwater systems and on coastal habitats greatly affect marine living resources;
 - (d) the institution should be responsible not only for fixing catch levels and closed seasons but also for ensuring the integrity of the habitats on which the marine living resources depend, ensuring that sufficient protection is accorded to coastal wetlands and shallows and other critical marine habitats for their role in maintaining key marine populations and processes to continue;
 - (e) full account should be taken of the effects of changes in ecosystems on the harvested species and of changes in catch levels on ecosystems;

- (f) catch levels should be sustainable and should allow for error, uncertainty and ignorance;
- (g) the institution should be empowered to enforce the catch levels and closed seasons it fixes;
- (h) all decisions should be based on the best available scientific information, whether or not the information comes from scientists of the nations concerned;
- (i) the institution should encourage and facilitate research on the marine living resources of its area (especially on target species and the ecosystems of which they are part);
- (j) the institution should make public the data available to it, the scientific advice it receives, and the assumptions behind its decisions, so that it is open to public and scientific scrutiny.

In addition to the establishment of institutions to manage shared marine living resources, there is a pressing need for joint action to control pollution, especially of shared seas.

In some regions action has already been taken: witness the Convention on the Protection of the Marine Environment of the Baltic Sea Area; the Convention for the Protection of the Mediterranean Sea against Pollution; and the Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution. The latter two conventions are among a number of initiatives by the United Nations Environment Programme (UNEP) and cooperating governments directed at the sustainable development of regional sea areas: the Mediterranean, the Gulf, the Red Sea (with ALECSO), the Caribbean (with ECLA), West Africa, and the Malacca Straits.

110. The nations concerned should fully support these initiatives and make every effort to conclude and implement appropriate conventions and protocols without delay.

General problems of migratory species

These include migratory birds and insects and other wide-ranging land animals. International agreements are required to protect the breeding, feeding, resting and (in the case of birds) moulting areas of such animals - especially threatened species - and to regulate harvesting and such other impacts as pollution. A global Migratory Species Convention is being prepared by the Federal Republic of Germany. This will need to be supplemented by regional agreements, some of which exist already (for example: the Agreement on Conservation of Polar Bears; the Convention for the Protection of Migratory Birds between Canada and USA, later supplemented by a similar treaty between the United States and Mexico; the US-Japan Convention for the Protection of Migratory Birds and their Environment and Birds

in Danger of Extinction; the Japan-USSR Convention for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment; and the Japan-Australia Convention for the Protection of Migratory Birds) and others of which are in preparation (for example, the Convention on Conservation of Wildlife and Natural Habitats being prepared by the Council of Europe).

111. The effectiveness of the existing regional agreements covering migratory species should be reviewed both to enable their implementation to be improved if necessary and to shed light on the provisions required of additional agreements (global and regional). The review should also consider what other regional agreements are necessary.

Ecosystems and species in one jurisdiction that depend on or are affected by events in another

This category includes the species and ecosystems of shared catchment areas. There are more than 200 first-order international drainage basins (that is, water basins or catchment areas shared by two or more states and communicating directly with the sea or inland lakes): 64 in Africa, 60 in the Americas, 45 in Europe and 40 in Asia. Joint use of watercourses has always depended on co-operation between the riparian states and some of the oldest international organizations were created to manage river navigation on the Rhine and the Danube.

Yet the use of international inland waters has steadily expanded beyond the scope of navigation. New industrial, urban and agricultural demands on water quantity have risen more or less simultaneously with a dramatic decline in water quality in most international basins. Forest clearance, hydro-electric installations, irrigation and water supply works, and pollution by one country can rob another of water, increase its costs of making water suitable for different uses, and destroy, degrade or deplete its valuable ecosystems and species.

Failure to reconcile the competing interests of upstream and downstream users has generated considerable political friction in Europe, in Latin America and on the Indian subcontinent. Where traditional interstate basin commissions exist, they are often ill-adapted to the new challenge of water conservation and integrated environmental management. There have been some notable regional improvements - such as the Danube fisheries conservation agreement, the Great Lakes water quality agreement, the Rhine salinity and chemical pollution agreements, and developments in the Mekong Basin Commission, the Lake Chad Basin Commission, and the Senegal River Development Organization.

112. In order to evaluate these experiences, with a view to their adaptation

to other regions, an appropriate international organization should undertake a review of the conservation needs and problems of shared drainage basins, as a prelude to joint research and action plans by the riparian countries concerned, possibly along the lines of UNEP's regional seas programmes.

Species that are traded internationally

International trade in food (primarily fish and fish products), fur and leather (especially otters, cats, crocodilians, snakes), live animals (for the pet and aquarium trades, the biomedical industry, menageries, and zoos), live plants, timber, ivory, shells, and wild animal- or plant-derived aphrodisiacs, exotic medicines, perfumes, gums, resins, oils, pharmaceuticals, and souvenirs for tourists, is exerting a heavy and increasing impact on species and ecosystems. The most promising way of regulating this trade is through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

113. As a matter of priority, nations that have not yet adhered to CITES should do so; and those that have adhered should implement the Convention fully.
114. Multilateral and bilateral aid agencies should assist requesting governments to set up the scientific and management authorities that CITES requires - by providing both financial assistance and training. Governments lacking the financial or technical means to set up adequate scientific and management authorities should request such assistance.
115. One of the potentially most useful innovations introduced by CITES is its system of annual and biennial reports on national implementation, which has only just begun to become operational. In order to make optimal use of the valuable information so provided, a regular comparative analysis of these reports should be undertaken by qualified international expert groups.

Certain improvements of CITES itself are also needed. At present, marine fish, molluscs and crustaceans are inadequately represented. If the species in these groups that require monitoring were to be placed on Appendix II, CITES would pose great difficulties of implementation. Already the present length of the CITES' appendices is causing some governments some difficulty.

116. An alternative to the present CITES' system, which might be more practical, would be simply to monitor trade in all wild plant and animal species, except for those on either of two lists:
 - (a) species in which trade is severely restricted;
 - (b) species in which trade is entirely unrestricted (and unmonitored).

The feasibility and implications of this alternative should be explored.

URGENT MEASURES: HIGHEST PRIORITY ECOSYSTEMS AND SPECIES

Certain ecosystems and species require urgent measures either before or at the same time as the requirements set out in the three previous sections are being met. They fall into one or both of two groups:

ecosystems and species in urgent need of better management;
ecosystems and species in urgent need of rescue.

Ecosystems and species are considered in urgent need of better management if they are extremely vulnerable to mismanagement, are being mismanaged, but could yield considerable benefits if managed sustainably.

Ecosystems and species are considered in urgent need of rescue on the basis of the size and importance of the genetic loss were they to disappear and the imminence of that loss.

Ecosystems and species in urgent need of better management

The ecosystems and species in urgent need of better management are listed here (in no particular order) together with their main management problems.

ecosystem/species

tropical rain and moist deciduous forests

drylands, tropical grasslands, and large herbivores

tundra

mountain systems

fresh waters (still and flowing waters, and wetlands) and freshwater fisheries

management problems

unsustainable exploitation for timber and other produce; uncontrolled settlement and expansion of shifting agriculture

loss of vegetation; unsustainable exploitation of pasture; replacement of native large herbivores by livestock

insufficiently controlled expansion of mining and oil exploitation

unsustainable exploitation of watershed forests and pastures

insufficiently controlled pollution, development of hydropower, irrigation projects and other transformations; unsustainable exploitation of fisheries

intertidal and neritic ecosystems
and species; marine mammals,
reptiles, fish, crustaceans and
molluscs

degradation and destruction
of highly productive
wetlands and shallows
and other critical
habitats; unsustainable
exploitation, especially
of whales, turtles and
fish

ivory and skinyielding animals

unsustainable exploitation

The following recommendations are taken from the relevant chapters of the Sourcebook for a World Conservation Strategy. As chapters are added to the Sourcebook, recommendations on those of the above ecosystems and species for which few or no recommendations are made here will be included in the Strategy.

Tropical rain and moist deciduous forests

117. Countries with tropical rain forest or tropical moist deciduous forest should, if they have not already done so, adopt procedures for the comprehensive planning of the use of resources. These should take full account of environmental considerations and should include, at the earliest possible stage, a full range of protective measures to safeguard the various values of tropical rain forest and moist deciduous forest and their species.
118. The FAO/UNEP programme for the monitoring of the cover of various types of tropical rain forest and moist deciduous forest should be continued and expanded into other parts of the world where critical changes are taking place.
119. Suitable case studies designed to demonstrate the economic and other benefits to be derived from well-planned and zoned multipurpose use of tropical rain forests for the production of timber and other forest produce, wildlife management, recreation, scientific use, and so on, should be made.
120. Efforts should be continued: to develop new means of using tropical woods and other forest produce; to reduce waste and incidental destruction during exploitation; to stabilize markets in tropical timbers; to develop plantations to meet forthcoming world needs for wood products; and to develop timber processing industries in tropical rain forest countries.
121. Well-designed and strategically located managed production forests should be designated to meet immediate needs for raw materials and

to serve as model examples for the development of neighbouring areas.

122. A code of conduct should be drawn up jointly by the forestry departments of the main tropical rain forest countries and representatives of the international timber trade to govern the granting of concessions and the conduct of all extraction operations.
123. Appropriate knowledge and techniques of shifting and other small-scale cultivators in tropical rain forest regions should be combined with the results of modern research to establish systems of agrisilviculture which mimic the structure and dynamics of tropical rain forest successions and retain soil structure and fertility.
124. Appreciation of the natural heritage of tropical rain forest should be increased by developing imaginative methods of interpretation suited to the local cultures in rain forest countries and to the possible development of a discriminating tourism.
125. Research should be continued and intensified: on the management of the tropical rain forest and moist deciduous forest on a sustainable basis; on tropical land use systems; on the further development of innovative methods of management such as agrisilviculture; and on the best distribution and management of areas of rain forest to maintain their genetic potential; on potential goods and services that can be provided by the tropical rain forest on a sustainable basis; and on tropical soils. This research should be based on the existing multilateral initiatives of FAO, UNEP, UNESCO (in its MAB 1 Programme) and IUFRO, and on such bilateral initiatives as the Brazil-Venezuela joint programme.

Drylands, tropical grasslands, and large herbivores

126. Some sort of insurance should be provided for pastoralists (traditional and commercial) against the risk of unpredictable drought. Such insurance might take the form of reserves of food and animal feed, market price supports for livestock during drought, and liberal credits for purchase of breeding stock after drought.
127. If soil and vegetation are to be restored, they must be given a respite from intensive use. This requires integrated local plans: for reduction of livestock numbers (possibly through price supports that encourage sale to market); for increased efficiency of food production on nearby irrigated and rainfed farms; for employment of local people in replanting and reseedling schemes; and for provision of alternative settlement areas and alternative sources of water and fuel and other services (health, education, job training, and so on).
128. The full understanding and participation of local people in the formulation and implementation of these plans is crucial for success. The problem of persuading local people to participate willingly is made easier if they can be shown the successful results of earlier

projects. For this reason, the areas most likely to respond to rehabilitation should be given priority and used as demonstration projects.

129. Any proposals to replace natural vegetation with rainfed or irrigated crops should be carefully assessed. Such projects should be properly planned and designed for their purpose. This can be provided for by the comprehensive evaluation of land capability.
130. The decision to revegetate with non-native species should be taken with care. Often the same result may be obtained as rapidly and more cheaply by allowing the recovery of the native vegetation or encouraging it artificially. But where the native vegetation is of no particular intrinsic worth and the objective (for example the fixing of mobile eroding soil or the provision of a quick supply of wood or fodder) can best be secured with non-native species, this should be encouraged. Apart from its main purpose, it will help to relieve pressures on other, neighbouring areas.
131. The search for new species or varieties of plant adapted to dry land conditions should be intensified and imaginative use should be made of them. These may be for pasture, fodder, soil fixation or as cash crops. Botanic gardens should develop regional programmes to grow and maintain dryland endangered species for possible reintroduction when circumstances permit.
132. The ever-increasing demand for new food-producing land should not be further accelerated by needless loss of the best farm land to non-agricultural uses. Dryland towns and cities have commonly grown up beside rivers on the best irrigable land. This trend should be stopped as soon as possible by land-use regulation. Urban development can usually be redirected into the drier lands nearby.
133. The development and distribution of solar cookers should be considered a high priority and should, if necessary, be promoted and subsidized by governments. Ideally three measures could be combined: revegetation, local construction of such cookers and their widespread use. Whenever overcollecting for firewood is among the primary causes of loss of vegetation, provision of alternative sources of fuel for local people is mandatory.
134. Plans should be made to develop fisheries and fish-farming in close association with irrigation schemes, preferably using local species rather than exotic ones. Serious problems, leading in some instances to the extinction of local species, have been caused by the introduction of exotic fish species in the southwestern United States. Great care should be taken to ensure fisheries and fish farms are not damaged by pesticide residues or by high concentrations of ions (from irrigation effluent).
135. There are certain activities which are already well under way which

should be encouraged and expanded:

- * (a) Promotion of schemes for rehabilitation of natural vegetation, including the selection of prime areas for demonstration projects such as the UNEP/UNESCO integrated Project on Arid Lands, and similar work in Iran. Enlightened programmes such as these should be encouraged and expanded and the results of them should be monitored, widely publicized and used for demonstration. Particular encouragement should be given to schemes that reflect concern for biological diversity.
 - * (b) Identification and promotion of prime areas for protection, including support for the UNESCO/UNEP project to establish a comprehensive series of Biosphere Reserves in arid and semi-arid regions.
 - (c) Encouragement and support of research in the ecosystems of arid and semi-arid lands with the object of improving systems of management to restore the potential of these lands and enable them to be used in a sustainable manner.
 - (d) Support and strengthening of FAO programmes for exploration and conservation of wild varieties and primitive cultivars of economically important dryland species.
136. For all dryland areas which are being developed or rehabilitated for crop, livestock, or wood production or for mining, tourism, and other non-agricultural uses, conservationists should be able to assess project proposals and make their assessments known to would-be funding and implementing organizations. The nations concerned should develop a process for assessing development project proposals for their consistency with the requirements called for by the World Conservation Strategy. Such an assessment should become a standard criterion, along with other political economic and social criteria, for acceptance, rejection, or modification of project proposals by funding agencies.
137. In Africa, the potential of wild herbivores for subsistence and commercial use should be given priority attention. There are three

* In countries where centuries of intensive human use have devastated the vegetation of large areas of dryland, there is much to rehabilitate but little left to preserve in the unexploited state. Emphasis should be on rehabilitation in areas of high human and animal population densities. Because of the high densities, the supply of alternative food, fuel, and employment is difficult but mandatory. These areas are marked on The World Map of Desertification (A/CONF.74/2). In other countries, the emphasis should be on protecting some of the many remaining unexploited areas. Then there are still other countries which have both large areas of degraded dryland and large areas which have yet to be intensively exploited. Emphasis in these should be on both rehabilitation and protection.

priority actions:

- (a) Assessment of current and potential ecological impacts of trypanosomiasis control in Africa, including consideration of new developments in control techniques.
- (b) Assessment of social and economic potential of game ranching in Africa, looking at commercial harvesting, subsistence harvesting, and domestication options, as well as at market potential for products.
- (c) Preservation of addax and oryx as wild populations and as captive populations in reserves recommended by IUCN.

Tundra

138. Norway's proposal, made at the UN Conference on the Human Environment in 1972, to host an international conference on Arctic conservation should be followed up.

The 1977 UN Conference on Desertification demonstrated the value of using an international conference to launch a coordinated programme of information gathering and stimulation of action, leading to a conference to produce a detailed international action plan to be carried out by identified institutions. An analysis is urgently needed of current and projected industrial activities and their likely impact on tundra and ice environments, together with an agreed plan for regulating those activities to conserve the living resources of those environments.

Mountain systems

139. Sustainable development programmes should be set up to make the fullest possible use of the forests and pastures of mountain areas while maintaining their role of watershed protection. Bilateral and multilateral sources of financial and technical assistance should work with governments and local communities to devise and implement model examples of such programmes, which should be culturally as well as environmentally compatible.

Fresh waters and freshwater fisheries

Freshwater fisheries are declining in many parts of the world largely due to pollution and environmental degradation caused by dams, irrigation or land reclamation. In addition, many fisheries are yielding less than their potential because of poor management.

140. The requirements of freshwater fisheries should be fully considered in the general planning of inland water use.
141. Given the universality of the problems facing fresh waters it is recommended that there be an international review of those problems, leading to a world conference and an international action plan.

Intertidal and neritic ecosystems and species; marine mammals, reptiles, fish, crustaceans and molluscs

Recommendations 39 and 42 (on highly productive coastal and marine ecosystems), 90 (on commercial harvesting), 96 (on incidental take), 101-102 (on tuna-fishing and on whaling), 104-107 (on the Southern Ocean), 108 (on the law of the sea), 109 (on marine resource management authorities), and 110 (on controlling pollution especially of shared seas) all apply. The following are also priorities:

142. Every coastal state should map its critical marine habitats to show the main feeding, resting, breeding and nursery areas of the marine mammals, reptiles, fish, crustaceans and molluscs that live or pass through its jurisdiction, together with the areas that supply such areas with nutrients and other essentials. The maps should show the dynamic nature of the processes involved, indicating (where known) the rough timing and periodicity of these processes and the extent to which feeding and breeding areas have been observed to change (with variations in current, and so on). Other maps should show present and projected demand on the ecosystems and species concerned so that compatibilities and conflicts may be revealed and decisions made accordingly.
143. The recommendations of the Working Party on Marine Mammals of the FAO Advisory Committee on Marine Resources Research should be implemented without delay. UNEP and FAO should make this a high priority activity within their programme following up on the FAO/UNEP Scientific Consultation on Marine Mammals.
144. Efforts to develop management methods that reflect the special continuities and divisions of the seas should be intensified. This is a particularly important priority with respect to the coastal zone and to multi-species fisheries. The coastal zone and its hinterland should be managed as an ecological whole embracing both the offshore area it influences and the drainage basin that supplies it. Model examples of appropriate management methods should be devised and promoted.
145. The values and problems of marine living resources should be intensively publicized.

Ivory- and skin-yielding animals

146. Populations of animals exploited for their ivory or skin should be restored to at least their maximum sustainable yield levels. Harvesting should be so regulated that the populations do not fall below those levels and the ecosystem processes on which the species depend should be safeguarded.
147. Study and analysis of international trade in ivory and skins should be intensified so that a comprehensive programme for regulating that trade can be implemented.

Ecosystems and species in urgent need of rescue

The ecosystems in urgent need of rescue are: ecosystems in biogeographical provinces that are unrepresented or poorly represented in protected areas, especially centres of endemism and species-rich ecosystems; ecosystems with many species threatened by habitat destruction; and centres of genetic diversity for crops and commodities. The species in urgent need of rescue are those designated as highest priority according to the formulation given on pages 38-39.

Ecosystems in biogeographical provinces that are unrepresented or poorly represented in protected areas

Appendix 1 lists 56 terrestrial biogeographical provinces that are highest priority for the establishment and reinforcement of protected areas to safeguard representative samples of the ecosystems within them.

148. Representative samples of the ecosystems in these provinces should be given protection as soon as possible. In addition, all the other provinces need to be examined for the quality of their coverage. In many of them only a small proportion of ecosystem-types are covered by protected areas, and many of those that are covered are given inadequate protection. Special attention should be paid to centres of endemism within each province and to areas of exceptionally high diversity - notably lowland forests (those below 300 meters in tropical rain forests), tropical and subtropical cloud forests, and isolated mountains.
149. IUCN's Commission on National Parks and Protected Areas (CNPPA) is embarking on a full review of the coverage of terrestrial biogeographical provinces in protected areas. Until this review has been completed the protection status of these provinces will not be adequately known and this component of the Strategy will remain much vaguer than it should be. The review, therefore, is of great and urgent importance and should be completed as soon as possible.
150. Similar reviews should be done for azonal provinces (still and flowing fresh waters; caves and cave systems) and for those of the sea. Meanwhile it should be noted that very few azonal and marine ecosystems are protected. Most provinces are probably either unrepresented or underrepresented in protected areas. It is expected, therefore, that many azonal and marine ecosystems will be given higher priority than all but a few of the terrestrial ecosystems listed above.

The following additional recommendations for the protection of ecosystems in tropical rain and moist deciduous forests and in dryland regions are taken from the Sourcebook for a World Conservation Strategy.

151. Information on tropical rain forest ecosystems and species that are declining and on centres of endemism and diversity should be assembled nationally and regionally in order to develop soundly based plans for ecosystem and genetic conservation based on the best scientific information.
152. A model for the conservation, both in situ and ex situ of economic species of tree in the tropical forest should be developed. The model should be based on the task force set up by IUCN for conservation of the Dipterocarpaceae, and on the work already carried out on the genus Agathis by FAO/UNEP and the UK Overseas Development Ministry.
153. A programme should be launched involving regional cooperation and possibly a world conference, to ensure that, within the next five years, a complete sample of rain forest and moist deciduous forest ecosystems is adequately safeguarded in all the countries in which they occur. This should include cooperation between existing country programmes for protected areas and the international efforts being made by UNESCO in its Biosphere Reserve Programme, UNEP and IUCN.
154. With respect to the protection of tropical rain forest ecosystems, priority should be given to:
- (a) The preservation of representative samples of tropical rain forest and monsoon forest on small oceanic islands in the Indian Ocean and South Pacific, and on small islands in Malesia and the Caribbean.
 - (b) The protection of the East African cloud forests.
 - (c) The preservation of samples of the coastal forests of eastern Brazil and the forests of Amazonia selected with special reference to the habitat of primate species.
 - (d) The preservation of samples of the forests of Madagascar with special reference to the requirements of threatened primates and birds.
 - (e) The preservation of samples of the forests of the Western Ghats in India and of south western Sri Lanka.
 - (f) Selection and safeguarding of areas for preservation of representative samples of rain forest ecosystems in Sumatra, Kalimantan and West Irian.
 - (g) Selection and safeguarding of sites in the peat forests and limestone forests of South East Asia.
 - (h) Development of guidelines for the economic use of heath forest, and safeguarding of representative samples in South East Asia and in Amazonia.
 - (i) Surveys in Himalayas (Nepal, Bhutan), Thailand, Malaysia, Indonesia and Papua New Guinea:
 - to assess the importance of the mid-montane forests;
 - identify threats and conservation problems;

develop conservation action.

Drylands. Full understanding of the best ways to make sustainable use of drylands will only come when the ecology of the natural ecosystems are much more fully understood - in particular their productivity, competition between species, water relations, nutrient requirements and the dynamics of the natural communities. The provision of representative series of ecosystems for scientific study in which the processes in natural ecosystems can be compared with those that have been modified or transformed in various ways is very important.

155. Because of their inherent high productivity, the role that they play in the hydrology of drylands, their importance for migratory birds and their characteristic flora and fauna, the protection of wetlands within the semi-arid and arid regions should be assured. The value of such wetlands for fisheries should also be stressed.
156. In selecting areas for protection special attention should be paid to centres of endemism and to local variations in the flora and fauna. There are, for example, many highly specialized plant and animal forms in the driest regions. Protected areas in the hyperarid regions should not be neglected even though these ecosystems may not seem to be under present threat. Changes due to mining, to the generation of solar energy, or to the discovery of new aquifers, could arise very rapidly.
157. The most valuable reserves in drylands are likely to contain wide expanses of the characteristic ecosystems of flat or gently undulating land, combined with areas of different topography and drainage. Such areas will give refuge to animals in times of stress and will enable plants and animals to respond more readily to periods of dry years or other fluctuations in climate. Communities that should be included are marshes, salt flats with intermittent water, watercourses, and isolated ranges of hills and mountains.
158. The setting up of protected areas is much more likely to be successful if it is combined with measures to improve rapidly the condition of local peoples, such as pasture development or the establishment of fuel wood plantations. Every effort should be made to explain why areas are being protected and to enlist local understanding and support. The protection of a large number of relatively small areas is especially valuable in drylands to reveal what species are present, to provide for seed production and to demonstrate ecological recovery. Demonstrations of the benefits of restoring the full natural cover and productivity of the vegetation may be necessary to persuade local people that a relaxation of pressure on grazing lands is essential.

Ecosystems with many species threatened by habitat destruction

Ecosystem-types with concentrations of plant species threatened by habitat destruction are: tropical rain forests, evergreen sclerophyllous forests (Mediterranean-type), warm deserts and semi-deserts (drylands), islands, and freshwater wetlands. Those with concentrations of invertebrate species threatened by habitat destruction are: tropical rain forests, temperate broadleaf forests, temperate grasslands, mountain systems, islands, freshwater wetlands, and caves. Ecosystem-types with concentrations of vertebrate species threatened by habitat destruction are: tropical rain forests, tropical dry and deciduous forests, warm deserts and semi-deserts (drylands), islands, and fresh waters (still and flowing, and including wetlands).

159. The habitats of threatened species within the above ecosystems should receive protection as a matter of priority.

Centres of genetic diversity for crops and commodities

160. Recommendations 45 and 46 should be implemented. Preliminary priorities for crops only are indicated in Appendix 2. Inventories of existing protected areas should be made to determine what relatives of crops, commodities and livestock are already adequately protected.
161. The International Board for Plant Genetic Resources (IBPGR), the International Union of Forest Research Organizations (IUFRO), FAO, UNEP, UNESCO, IUCN, and other concerned national and international organizations should work out a common programme of mutually supportive in situ and ex situ preservation of both the wild relatives and the locally domesticated varieties or breeds of crops, commodities and livestock.

Highest priority threatened species

162. The formulation given on pages 38 and 39 has been used to determine the highest priority threatened species of vertebrate. These species are listed in Appendix 3. The conservation problems of these species should be addressed urgently and before those of other threatened vertebrates.

Not enough is known about threatened plants and invertebrates for equivalent lists to be prepared for those groups. Among plants, however, the following may be considered as priorities:

Cycads: Central America, Caribbean, tropical East and South Africa, South Asia, Australia and Papua New Guinea.

Orchids: cosmopolitan (a very large family).

Cacti: with one exception, confined to the Western Hemisphere, centred on Mexico and southern USA.

Other succulents: in particular, species of Euphorbia, Aloe (especially in southern Africa), Pachypodium, Asclepiadaceae.

Tree-ferns: especially in the tropics.

Palms: widespread in tropics and subtropics, but also reaching Europe (2 species), and southern Australia.

- 163a. Priorities for action include adherence to and implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) by nations that have not yet done so; support for strong national legislations where needed; and support for a full study by the IUCN Threatened Plants Committee (TPC) of the plant groups covered by CITES, making use both of data on trade already available from countries that have ratified CITES and of field knowledge of threatened plants in relevant countries, so that detailed recommendations on the inclusion/exclusion of named groups in the CITES Appendices and on national needs for protection can be made. Encouragement should be given to large scale commercial propagation of such species to reduce their value to collectors and take pressure off wild populations.
- 163b. The following are priority actions for threatened plant conservation:
- (a) Basic research. A prime requirement is encouragement by governments of basic research on the taxonomy and distribution of the plants within their boundaries.
 - (b) Information-gathering.
 - (c) Project formulation. Even where the data on threatened plants are available very few projects have so far been formulated and proposed for funding by governments and international organizations.
 - (d) Education. In the long-term, the single most important limiting factor on plant conservation is lack of public awareness of the problem. Education should be based more on the value and importance of plants themselves than exclusively on the problems of threatened species. The production of illustrated field guides and popular books on plants is a priority.
164. In particular, highest priority should be given to:
- (a) Preparation of lists of rare and threatened plants and of reports on centres of endemism in -
 - i. Caribbean and South America (a TPC project is being implemented);
 - ii. Tropical Africa (where the primary requirement is a report on centres of endemism and the extent to which they are included in national parks);
 - iii. Europe (biennial revision of the Council of Europe's list);
 - iv. South East Asia (where the requirement is a report on centres of endemism, with emphasis on genera of

potentially economic plants);

- v. Malay Peninsula (list plus report on centres of endemism and the extent to which they are included in protected areas);
- vi. Australia (revision, enlargement and updating of list by Specht et al, 1974);
- vii. Pacific Islands (preliminary studies for a list are needed);
- viii. Arctic (list).

(b) Species studies on -

- i. Palms (completion of TPC Palm Group's list of rare and threatened palms, and assessment of important sites for protection);
- ii. Orchids (gathering of field information on threatened species and combining it with data on traded genera from CITES statistics).

(c) Protection and related projects in -

- i. Europe (project and action plan formulation, coordination of national efforts, and production of Red Data Bulletins);
- ii. Mediterranean (conservation field surveys of North African centres of endemism to establish areas suitable for reserves; report on sand-dune floras, with indications of extent, threats to sites, and floristic analysis; assessment of possibility of including threatened plant sites on Greek islands with proposed monk seal reserves; study of the potential of protecting the sites of rare species through planning controls rather than reserves);
- iii. Canary Islands (protection and reintroduction of endangered species);
- iv. Madeira (protection of laurel forests);
- v. Mascarene Islands (studies of suitable sites for reserves, especially in Réunion, and establishment of cultivated stocks of endangered species in local botanic gardens);
- vi. Henderson Island (near Pitcairn, Pacific - protect entire island as a reserve).

(d) Botanic gardens -

- i. Expansion of current TPC project on locating threatened species in cultivation into a full conservation information service for botanic gardens;

- ii. Establishment in east Mediterranean of seed-bank facilities for Mediterranean floras.

(e) Legislation -

- i. studies of national legislations;
- ii. rationalization of CITES Appendices.

(f) Education -

- i. Popular book on threatened plants;
- ii. Information materials (for schools, local groups, decision-makers).

IMPLEMENTATION OF THE STRATEGY

This Strategy is meant to be implemented. It is hoped that the Strategy will be followed, as far as possible in its entirety, by all governments and by all organizations with interests in living natural resources. Few if any national or international organizations will be equipped to carry out all the priority actions, but it is hoped that each will do as it is able. The UN bodies with primary responsibilities in the field of living natural resources - UNEP, FAO, UNESCO, WHO, WMO, IMCO - and the multilateral and bilateral aid agencies are in particularly good positions to implement certain of the priorities and to assist governments to undertake many of the remainder.

For its part, IUCN is expected to identify those priorities for which it can assume responsibility within its triennial programme; and World Wildlife Fund has announced that its conservation programme will also follow the Strategy. NGOs (nongovernmental organizations) have a vital role in ensuring the implementation of this Strategy. Strong pressure groups acting within their own countries but with international coordination - combining the efforts of both governments and NGOs - are likely to provide the most effective response to the resurgence of shortsighted nationalism among some governments and the consequent semi-paralysis of intergovernmental law and institutions.

GOVERNMENTS AND INTERGOVERNMENTAL ORGANIZATIONS

165. It is recommended that governments review the check-list of fundamental requirements for conservation (Appendix 4) and set target dates for satisfying those requirements not yet met. Intergovernmental organizations should be prepared to provide assistance on request to governments in meeting these requirements.

Development aid and technical assistance

166. Those nations and agencies that provide development aid and technical assistance to others have a special responsibility to help the recipient nation ensure that such aid or assistance makes the best use of the living natural resources it is likely to affect, and should make sure that:
- (a) the proposed development is in harmony with the recipient country's national conservation strategy and ecosystem

capability assessment (if they exist);

- (b) the proposed development is the most appropriate response to the capabilities of the ecosystems concerned;
- (c) as far as possible the potential of the ecosystems concerned is retained; and
- (d) an environmental impact assessment is carried out.

167. If a national conservation strategy, living natural resource inventory, or ecosystem capability assessment, has not been carried out, aid agencies should regard it as a priority responsibility to:
- encourage the government concerned to conduct the strategy, inventory or assessment (or all three if none has been attempted); and
 - provide, if requested, the necessary finance and technical assistance.
168. Nations unable to carry out a conservation strategy, natural resource inventory, ecosystem capability assessment, or environmental impact assessments due to a lack of financial or technical resources should request financial aid and/or technical assistance from bilateral or multilateral agencies as a matter of the highest priority.
169. Model examples of national and provincial conservation strategies should be prepared and disseminated widely to governments. International organizations could help greatly in this. Model examples of living natural resource inventories and ecosystem capability assessments should also be prepared and made available to governments.
170. In providing technical assistance and advice, international organizations (whether global or regional) should seek experts from the requesting country, or, if that is not possible, from elsewhere in the region concerned. In this way, formulation of the advice or assistance will benefit from local knowledge; and the experts themselves will benefit by having their national standing enhanced and their international experience increased.
171. Intergovernmental organizations with more than one department or division working in the same country should make sure that the technical assistance and advice provided by each department or division are in harmony with each other according to a common programme that is consistent with the conservation of the country's living natural resources.
172. Bilateral and multilateral aid agencies should place sustainable development and the conservation of living natural resources high in their priorities. They should pay particular attention to the development and application of alternatives to techniques and technologies that are destructive of the environment or do not make the best use of living natural resources. Development projects

should include adequate provision for safeguarding the environment and, if necessary, additional financial assistance should be made available so that such environmental provisions can be met.

173. It is recommended that there be greater coordination of action by intergovernmental organizations, along the lines of the Ecosystem Conservation Group (ECG) formed by UNEP, FAO, UNESCO and IUCN, and using this Strategy as the basis of joint planning.
174. It is recommended that a conference of bilateral and multilateral aid and development agencies be convened on the implementation of this Strategy. Among the matters that should be considered are: the need for international machinery for review and improvement of environmental impact assessments, especially those carried out for bilateral and multilateral aid projects; and the need for internationally approved standards for monitoring the general state of the environment using agreed indicators, such as: extent of forest cover; silt load of rivers; proportion of endemic species not threatened. International organizations should be encouraged to begin or continue monitoring such indicators; the work of FAO/UNEP in monitoring forest cover is a good example.

NONGOVERNMENTAL ORGANIZATIONS

Nongovernmental organizations (NGOs) are a vital force for the achievement of conservation in general and the implementation of this Strategy in particular.

175. NGOs should:
- (a) press for the implementation of the priorities of this Strategy, and promote public demand for their implementation;
 - (b) monitor the status of conservation in their country or province, the conservation administrations and activities of government, the implementation of conservation legislation, and the threats to conservation;
 - (c) alert the government and the public to the findings of such monitoring;
 - (d) conduct research on living natural resources and (when requested by government) provide expert advice on the conservation needs and management methods that should be pursued;
 - (e) promote public understanding of and support for conservation;
 - (f) press government to safeguard the most important and threatened ecosystems and species; and
 - (g) if it becomes clear that government will not act in time,

make use of the capacity of private bodies for prompt action to themselves safeguard such ecosystems and species.

A large proportion of the meagre resources available to conservation organizations can be spent most effectively in influencing the allocation of the much larger sums spent on development by national and international aid agencies. An example is the recent successful intervention by US nongovernmental organizations concerning the policies of the US Agency for International Development (AID), which annually spends some \$17,000 million in developing countries. The US NGOs have: first, seen to it that AID makes environmental impact assessments before undertaking any environmentally significant activities; second, persuaded the Congress to add "environment and natural resources" to the areas in which AID is statutorily required to spend its money; third, helped persuade AID's Asia Bureau to make forest protection one of its highest priorities; and fourth, persuaded a Congressional committee to direct AID to prepare "environmental profiles" of all the countries in which AID operates. All this was achieved for a total cost of \$30,000.

176. NGOs should devote a much greater proportion of their efforts to influencing the activities of government - especially government expenditure on development, whether at home or abroad - and of business and industry. NGOs should determine those branches of government and industry that have the greatest impact on the environment and devise ways of influencing them.
177. NGOs and government should work with national and multinational commercial enterprises to agree codes of conduct for those enterprises with respect to living natural resources.

Moral support for conservation progress

Public opinion on conservation often ranges from indifference to hostility, and politicians in a number of countries sometimes take considerable political risks when they promote conservation. National and international expressions of support for, and praise of, conservation progress are therefore extremely important.

178. NGOs, the business community and governments should establish national and international awards and other forms of recognition for politicians and statesmen who advance conservation in their own countries or localities.

Awards to politicians and statesmen have more leverage and potential for generating further advances than awards to conservationists for past achievements (however valuable those achievements and however great the desire to give them

recognition). The effect of the major existing conservation awards would be greatly enhanced if awarded in this way.

Devising and promoting model examples of conservation action

179. Model examples of how to satisfy the fundamental requirements for conservation are needed to show governments what is needed and how it can be achieved. NGOs with appropriate expertise can perform a valuable service by devising and promoting such model examples. NGOs should review the check-list of fundamental requirements for conservation (Appendix 4), determine what requirements as yet not met in their own country are needed most urgently and could be most effectively promoted with the aid of a model example, and work with NGOs and governments in their own and other countries to develop a model example that will be useful not only for their own country but also for others in similar circumstances.

GENERAL

180. Governmental and nongovernmental conservation organizations and individuals should spend most of their energies and funds on ensuring that the fundamental requirements for conservation (presented on pages 17-54) are met and only some of their energies and funds on emergencies and issues of the moment. Amongst the latter, priority should be given to the ecosystems and species mentioned on pages 55-68 - and highest priority should be given to those ecosystems which are priority candidates both for better management and for rescue. Table 1 shows that the ecosystem groups requiring action on the greatest number of fronts are: tropical rain forests; tropical dry or deciduous forests; evergreen sclerophyllous forests (Mediterranean-type ecosystems); warm deserts and semi-deserts (drylands); islands; fresh waters; and intertidal and neritic ecosystems. Attention should be paid to these ecosystems first. It should be noted, however, that review of the status of fresh water, intertidal and neritic ecosystems is likely to reveal several that should be accorded an even higher priority than at present.
181. Efforts to conserve ecosystems and species that are not of high priority but have great emotional appeal are sometimes undertaken to raise money and recruit people to the cause of conservation. As far as possible this tactic should be avoided, since such efforts not only subtract from the total available for the conservation of high priority ecosystems and species (many of which are also very attractive) but also damage the longer-term prospects of conservation by fostering the misleading impression that conservation is a sentimental indulgence.
182. The concerns and relevance of conservation are not well understood. Conservation organizations and individuals should concentrate on increasing understanding of conservation and on achieving the implementation of this Strategy. Although conservation is impeded by

Table 1. Highest priority ecosystems

	HMP	HRP				
		RS	GP	CTS		
				V	I	P
LAND						
Tropical rain forests	x	18*	x	x	x	x
Subtropical and temperate rain forests		2*				
Temperate needleleaf forests						
Tropical dry or deciduous forests	x	8*	x	x		
Temperate broadleaf forests		2*			x	
Evergreen sclerophyllous forests		2*	x			x
Warm deserts and semideserts	x	2*	x	x		x
Cold-winter deserts and semideserts		1*				
Tundra and barren arctic desert	x	4*				
Tropical grasslands	x	2*				
Temperate grasslands		2*			x	
Mountain systems	x				x	
Islands		13*		x	x	x
FRESH WATERS						
Lentic (lakes, ponds)	x	x		x		
Lotic (rivers, streams, springs)	x	x		x		
Wetlands (bogs, marshes, swamps)		x		x	x	x
CAVES						
		?			x	
SEA						
Intertidal and neritic	x	x	x			
Pelagic and deep benthic		x				

Column headings: HMP - Highest Management Priority
 HRP - Highest Rescue Priority
 RS - Representative Samples
 GP - Gene Pools
 CTS - Concentrations of Threatened Species
 V - Vertebrates
 I - Invertebrates
 P - Plants

* number of biogeographical provinces that are unrepresented or underrepresented in protected areas.

high human population levels and densities, high per capita consumption of energy and minerals, maldistribution of resources, inappropriate technology, and poverty, conservationists should not devote themselves to these problems. Rather they should attempt to achieve greater understanding of the relevance and contribution of conservation to the solution of such problems among those organizations and individuals primarily concerned with them. In addition, conservationists should take advantage of the opportunity provided by any advance in dealing with such problems to increase support for conservation.

Example. The concept of primary health care (health care that is accessible, acceptable and affordable) is rapidly gaining ground. Primary health care in developing countries reduces emphasis on western-trained specialists and branded drugs from international pharmaceutical companies and increases emphasis on traditional medicine and locally grown remedies. The greater the development of primary health care, therefore, the more immediate will be the benefits of a country's conserving its genetic resources. Conservationists should ensure that the proponents of primary health care are fully aware of this.

183. Policy briefs should be prepared to explain succinctly the contribution of living natural resource conservation to primary health care, rural development, and other policy areas. The briefs should be used to generate promotion of conservation by organizations and individuals concerned with those policy areas.

MONITORING AND REVIEW

184. Constant effort - and constant encouragement - will be required to implement the priorities of this Strategy. IUCN or some other appropriate body should monitor and review implementation of the Strategy by regularly publishing brief progress reports from each country, together with descriptions of such model examples as may be devised, and the names and addresses of contact persons for further information. Regular reviews of progress should also be made by the Ecosystem Conservation Group (UNEP, FAO, UNESCO, IUCN). IUCN should publish a triennial report on progress, and the Strategy should be modified every three years in the light of new knowledge - and of results.

APPENDIX 1

Highest priorities for the protection of representative samples of ecosystems, centres of endemism, and areas of high diversity

A review of the UN List of National Parks and Equivalent Reserves, the World Directory of National Parks and Other Protected Areas and IUCN's files indicates that of the 193 terrestrial biogeographic provinces listed in Udvardy (1975), 26 have no (or only one or two) protected areas. They are:

Tropical rain forests

4.6.1. South Chinese rain forest

Tropical dry or deciduous forests (including monsoon forests)

6.3.4. Northern coastal (Australia)

8.13.4. Sinaloa (Mexico)

8.15.4. Yucatecan (Mexico)

Temperate broad-leaf forests

2.7.5. Kamchatkan (USSR)

2.12.5. Pannonian (Hungary, Yugoslavia)

Warm deserts and semi-deserts

1.10.7. Tamaulipan (Mexico)

2.18.7. Sahara

Cold-winter deserts and semi-deserts

2.23.8. Tibetan

Tundra

1.13.9. Alaskan tundra

1.14.9. Canadian tundra

1.15.9. Arctic archipelago (Canada)

1.16.9. Greenland tundra

Tropical grasslands

6.11.10. Northern savanna (Australia)

6.12.10. Northern grasslands (Australia)

Temperate grasslands

1.18.11. Grasslands (USA, Canada)

2.28.11. Atlas steppe (Morocco, Algeria, Tunisia, Libya)

Island systems

3.23.13. Ascension and St. Helena Islands (S. Atlantic)

4.17.13. Laccadives Islands (W. Indian Ocean)

4.18.13. Maldives and Chagos Islands (W. Indian Ocean)

4.19.13. Cocos-Keeling and Christmas Islands (E. Indian Ocean)

- 4.20.13. Andaman and Nicobar Islands (E. Indian Ocean)
- 8.42.13. Revilla Gigedo Island (E. Pacific)
- 8.43.13. Cocos Island (E. Pacific)
- 8.45.13. Fernando de Noronja Island (W. Atlantic)
- 8.46.13. South Trinidade Island (W. Atlantic)

Representative samples of the ecosystems in these provinces should be given protection as soon as possible. In addition, all the other provinces need to be examined for the quality of their coverage. In many of them only a small proportion of ecosystem-types are covered by protected areas, and many of those that are covered are given inadequate protection. Special attention should be paid to centres of endemism within each province and to areas of exceptionally high diversity - notably lowland forests (those below 300 meters in tropical rain forests), tropical and subtropical cloud forests, and isolated mountains. These remarks apply with particular force to the following provinces of unusual species richness:

Tropical rain forests

- 3.2.1. Congo rain forest
- 3.3.1. Malagasy rain forest (Madagascar)
- 4.7.1. Malayan rain forest
- 4.21.12. Sumatra
- 4.22.12. Java
- 4.23.12. Lesser Sunda Islands
- 4.24.12. Celebes
- 4.25.12. Borneo
- 4.26.12. Philippines
- 5.1.13. Papuan (Irian Jaya, Papua New Guinea, Solomon Islands)
- 8.1.1. Campechean (Mexico)
- 8.2.1. Panamanian
- 8.3.1. Colombian coastal
- 8.4.1. Guyanan
- 8.5.1. Amazonian
- 8.6.1. Madeiran (Brazil)
- 8.7.1. Serra do Mar (Brazil)

Subtropical and temperate rain forests

- 8.8.2. Brazilian rain forest
- 8.9.2. Brazilian planalto

Tropical dry or deciduous forests (including monsoon forests)

- 3.9.4. Malagasy woodland/savanna
- 3.10.4. Malagasy thorn forest
- 8.14.4. Guerreran (Mexico)
- 8.16.4. Central American
- 8.21.4. Gran Chaco (Paraguay)

Evergreen sclerophyllous forests

3.11.6. Cape sclerophyll (South Africa)

6.4.6. Western sclerophyll (Australia)

Island systems

3.25.13. Mascarene Islands (Mauritius, Réunion)

5.3.13. Hawaiian

5.6.13. New Caledonian

3.39.13. Cuban

IUCN's Commission on National Parks and Protected Areas (CNPPA) is embarking on a full review of the coverage of terrestrial biogeographical provinces in protected areas. Until this review has been completed the protection status of these provinces will not be adequately known and this component of the Strategy will remain much vaguer than it should be. The review, therefore, is of great and urgent importance.

Similar reviews should be done for azonal provinces (still and flowing fresh waters; caves and cave systems) and for those of the sea. Meanwhile it should be noted that very few azonal and marine ecosystems are protected. Most provinces are probably either unrepresented or underrepresented in protected areas. It is expected, therefore, that many azonal and marine ecosystems will be given higher priority than all but a few of the terrestrial ecosystems listed above.

APPENDIX 2Protection of centres of genetic diversity: preliminary priorities
for crops

Wheat, rice, sorghums, millets, barley

Beans (Phaseolus), soya, groundnut, pea, cowpea (Vigna)

Potato, cassava, sweet potato, yam

Banana, temperate, subtropical and tropical fruits

Sugarcane

Cotton, coffee, cacao, rubber

Forage species

Cucurbits

Source: UNEP (1976)

APPENDIX 3Highest priority threatened speciesVulnerable orders

SIRENIA (Sea cows)

DUGONGIDAE (Dugongs)

Dugong dugon (dugong) V

TRICHECHIDAE (Manatees)

Trichechus inunguis (Amazonian manatee) ETrichechus manatus (Caribbean manatee) VTrichechus senegalensis (West African manatee) V

PROBOSCIDEA (Elephants)

ELEPHANTIDAE (Elephants)

Elephas maximus (Asian elephant) VLoxodonta africana (African elephant) VEndangered families

DERMOCHELYIDAE (Leathery sea turtles)

Dermochelys coriacea (leathery turtle) E

GAVIALIDAE (Gavials)

Gavialis gangeticus (Indian gavial, gharial) E

RHYNOCHETIDAE (Kagus)

Rhynchoceros jubatus (kagu) E

THYLACINIDAE (Thylacines)

Thylacinus cynocephalus (thylacine) E

DAUBENTONIIDAE (Aye-ayes)

Daubentonia madagascariensis (aye-aye) EVulnerable families

CHELONIIDAE (Sea turtles)

Eretmochelys imbricata (hawksbill turtle) ELepidochelys kempii (Atlantic ridley turtle) ELepidochelys olivacea (olive turtle, Pacific ridley) ECaretta caretta (loggerhead turtle) VChelonia mydas (green turtle) EChelonia depressa (flatback green turtle) R

CROCODYLIDAE (Crocodiles)

<u>Osteolaemus tetraspis</u> (dwarf crocodile)	E
<u>Tomistoma schlegelii</u> (false gavia)	E
<u>Crocodylus acutus</u> (American crocodile)	E
<u>Crocodylus cataphractus</u> (African slender-snouted crocodile)	E
<u>Crocodylus intermedius</u> (Orinoco crocodile)	E
<u>Crocodylus moreletii</u> (Morelet's crocodile)	E
<u>Crocodylus niloticus</u> (Nile crocodile)	E
<u>Crocodylus rhombifer</u> (Cuban crocodile)	E
<u>Crocodylus siamensis</u> (Siamese crocodile)	E
<u>Crocodylus johnsoni</u> (Australian freshwater crocodile)	V
<u>Crocodylus palustris</u> (marsh crocodile)	V
<u>Crocodylus porosus</u> (estuarine crocodile)	V
<u>Crocodylus novaeguineae</u> (New Guinean and Philippine crocodiles)	I

ATRICHORNITHIDAE (Scrub-birds)

<u>Atrichornis clamosus</u> (noisy scrub-bird)	E
<u>Atrichornis rufescens</u> (rufous scrub-bird)	R

SOLENODONTIDAE (Solenodons)

<u>Solenodon paradoxus</u> (Haitian solenodon)	E
<u>Atopogale cubana</u> (Cuban solenodon)	R

PONGIDAE (Great apes)

<u>Pongo pygmaeus</u> (orang-utan)	E
<u>Gorilla gorilla</u> (gorilla)	V
<u>Pan troglodytes</u> (chimpanzee)	V
<u>Pan paniscus</u> (pygmy chimpanzee)	V

Endangered genera - fish all E

<u>Moapa coriacea</u> (Moapa dace)
<u>Oreodaimon quathlambae</u> (Maluti minnow)
<u>Plagopterus argentissimus</u> (woundfin)
<u>Prietella phreatophila</u> (Mexican blindcat)
<u>Speoplatyrhinus poulsoni</u> (Alabama cavefish)
<u>Campbellolebias brucei</u> (Santa Catarina sabrefin)
<u>Empetrichthys latos</u> (Pahrump killifish)
<u>Megupsilon aporus</u> (Catarina pupfish)
<u>Romanichthys valsanicola</u> (asprete)
<u>Lentipes concolor</u> (O'opu-alamo'o)

Endangered genera - reptiles all E

<u>Batagur baska</u> (river terrapin, tuntong)
<u>Pseudemys umbrina</u> (short-necked or swamp turtle)

Caiman crocodilus (spectacled caiman)
Caiman latirostris (broad-nosed caiman)
Melanosuchus niger (black caiman)
Brachylophus fasciatus (Fiji banded iguana)
Bolyeria multocarinata (Round Island boa)
Casarea dussumieri (Round Island keel-scaled boa)

Endangered genera - birds

all E

Nipponia nippon (Japanese crested ibis)
Gymnogyps californianus (California condor)
Eutriorchis astar (Madagascar serpent-eagle)
Pithecophaga jefferyi (monkey-eating eagle)
Oreophasis derbianus (horned guan)
Catreus wallichi (cheer pheasant)
Notornis mantelli (takahe)
Tricholimnas sylvestris (Lord Howe wood-rail)
Choriotis nigriceps (Great Indian bustard)
Thinornis novaeseelandiae (New Zealand stone plover)
Nesoenas mayeri (pink pigeon)
Rhynchopsitta pachyrhyncha (thick-billed parrot)
Strigops habroptilus (kakapo)
Sapheopico noguchii (Okinawa woodpecker)
Picathartes gymnocephalus (white-necked rock-fowl)
Picathartes oreas (grey-necked rock-fowl)
Moho braccatus ('o'o'a'a)
Leucopezza semperi (Semper's warbler)
Hemignathus lucidus (nukupu'u)
Hemignathus obscurus ('akioloa)
Hemignathus wilsoni ('akiapola'au)

Endangered genera - mammals

all E

Chaeropus ecaudatus (pig-footed bandicoot)
Macroderma gigas (ghost bat)
Indri indri (indri)
Brachyteles arachnoides (woolly spider monkey)
Simias concolor (pig-tailed langur)
Pygathrix nemaeus (douc langur)
Pentalagus furnessi (Ryukyu rabbit)
Romerolagus diazi (volcano rabbit)
Caprolagus hispidus (Assam rabbit)
Megaptera novaengliae (humpback whale)
Baleana mysticetus (bowhead whale)
Eubalaena glacialis (right whale)
Pteronura brasiliensis (giant otter)
Macrogalidia musschenbroeckii (palm civet)
Prionailurus iriomotensis (Iriomote cat)
Neofelis nebulosa (clouded leopard)

Monachus monachus (Mediterranean monk seal)
Monachus tropicalis (Caribbean monk seal)
Monachus schauinslandi (Hawaiian monk seal)
Rhinoceros unicornis (great Indian rhinoceros)
Rhinoceros sondaicus (Javan rhinoceros)
Didermoceros sumatrensis (Sumatran rhinoceros)
Babyrousa babyrussa (babirusa)

APPENDIX 4Check-list of fundamental requirements for conservation

1. Public commitment to conservation by heads of state and of government.
2. Constitutional commitment to conservation.
3. Support of conservation by politicians and administrators.
 - Propagation of internally consistent arguments showing that sustainable development is impossible without conservation.
 - Exploitation of circumstances in which politicians and governments may be convinced that pursuit of conservation is in their interest.
4. Adoption of measures of economic growth and social progress that take full account of the costs of degrading or depleting living natural resources and of the benefits of conserving them.
5. Support of conservation by general public and special interest groups.
 - Conservation education in school curricula.
 - Information materials on importance and problems of priority ecosystems and species.
 - Field guides to plants and animals of protected areas near cities.
 - Publicity for model examples of successful conservation and sustainable development.
6. National or regional training centres and programmes.
7. Training programmes for local communities.
8. National and provincial conservation strategies.
9. Living natural resource inventories.
10. Ecosystem capability assessments.
11. Environmental impact assessments.
12. Public disclosure and influence of 8-11.
13. Government institutions capable of carrying out 8-11.
 - Clear mandates specifying conservation.
 - Permanent mechanism for joint consultation among administrations concerned.

Independent representation of interests.

Implementation of policies and decisions.

Adequate funding.

Appropriate legislation, effectively understood by the public and implemented.

14. Research to fill gaps in knowledge revealed by 8-11.

15. Monitoring and regular improvement of 8-11.

16. Protection of representative samples of the range of ecosystems in each country and province.

Review existing network and establish as complete a network as possible as soon as possible.

17. Protection of centres of endemism and species-rich ecosystems.

18. Protection of habitats of species threatened by habitat destruction or degradation.

Protect external sources of nutrients and other essentials as well as the habitats themselves.

Regulate exploitation and other impacts along migration routes.

Make bilateral or multilateral agreements where necessary.

19. Sustainable management of modified ecosystems.

20. Regulation of use of highly productive coastal and marine ecosystems so that their productivity is not reduced.

21. Regulation of use of watershed forests and pastures so that both their productivity and their capacity to protect areas downstream are maintained.

22. Forest protection, reforestation and watershed management high priorities of governments and bilateral and multilateral aid agencies.

23. Protection of wild relatives of cultivated plants and domesticated animals. Protection of locally domesticated varieties of cultivated plants and livestock in agricultural conservation areas.

Sponsorship by industry of crop, commodity and livestock genetic conservation areas.

24. Research into minimum critical size and optimum distribution of protected areas, and implementation of results.

25. Complementary sustainable development projects in association with protected areas.
26. Full involvement of local communities in protected areas.
27. Use of protected areas for research.
28. Establishment of modified areas within easy reach of human settlements as recreation areas.
29. Encouragement of pride in protected areas.
30. Adherence to World Heritage Convention and provision of adequate funds to safeguard world heritage sites.
31. Maximum care in allocation of ecosystems for transformation.
Proof of necessity of proposed transformation and of suitability of area.
32. Management of transformed ecosystems as efficiently as possible.
33. Rehabilitation of disused transformed ecosystems or their conversion to another use requiring transformation.
34. Planning of built environments to provide habitats for as great a variety of plants and animals as possible.
35. Reduction of demand by elimination of waste, improvement of distribution, and avoidance of unnecessary use.
36. Reduction or stabilization of human numbers and per capita consumption.
Initiation or expansion of family planning programmes.
37. Special efforts to eliminate poverty in ways that by restoring and protecting the environment reduce the likelihood of poverty returning.
38. Energy conservation and diversification of power production systems.
39. Increased development and use of solar energy and other benign forms of power production.
40. Use of elements of subsistence and semi-subsistence cultures that enable the peoples concerned to have a sustainable relationship with their environment. Participation of such peoples in the devising and implementation of measures regulating their use of the environment.
41. Documentation and application of environmental knowledge of subsistence and semi-subsistence peoples.

42. Prevention of extinction of any species.
43. Maintenance of enough viable populations of species of expected value as breeding material to safeguard the full range of variation in those species.
44. Ensuring that all populations of species of expected value for harvesting can be restored to maximum sustainable yield levels.
45. Restoration of all populations of species of current economic value to maximum sustainable yield levels and ensuring that harvesting thereafter is well within those levels.
46. Maintenance of ecosystem processes essential for the achievement of 42-45.
47. Provision of adequate resources for the achievement of 42-46.
48. Tackling the problems of highest priority species before those of high priority species, and the problems of high priority species before those of lower priority species.
49. Improvement of taxonomy's consistency and usefulness to conservation.
50. Reinforcement of subsistence communities' harvesting regulations, if effective; otherwise, assistance in devising and enforcing effective regulations.
 - Restrictions on total harvest and on times and places of harvesting.
 - Prohibition or restriction of use of certain technologies.
 - Provisions for habitat renewal.
 - Prohibition or restriction of commercial harvesting.
 - Where severe regulation is needed, provision of alternative food, fuel or fibre.
 - Regulation of international trade by placing species on Convention on International Trade in Endangered Species of Wild Fauna and Flora.
51. Tree planting programmes to match tree felling.
52. Conservative fisheries' management objectives. Sustainable catch levels. Increased research to establish sustainable levels with greater confidence of their sustainability.
53. Sustainable harvesting of plants and animals for the souvenir trade. Investigation of that trade.
54. Understanding of and support for sustainable harvesting.

55. Close monitoring of harvest levels, trade, and response to regulations.
56. Stabilization of trade and commodity prices.
57. Prevention of introductions of exotic species.
 - Intensive public education campaign on effects of introduced species.
 - Proposed introductions to be subject of environmental impact assessment. Onus of proof of harmlessness on introducer.
58. Reduction of killing to protect crops, livestock or prey, through education campaigns and protection kill quotas.
59. Management of ecosystems and species to support species threatened by loss or diminution of food supply. Regulation of use of pesticides and discharge of pollutants to prevent contamination of food of threatened and other species.
60. Cooperative programme of action by governments and international and national organizations to research, develop and implement ways of reducing incidental take and of making full use of such incidental catches that it is impossible to prevent.
61. Regulation of insecticide use to minimize killing of non-target species and to facilitate recolonization of sprayed areas by non-target species.
62. Recognition by every nation of its responsibility to behave with particular restraint towards:
 - ecosystems and species that occur outside national jurisdictions or within disputed jurisdictions;
 - species that move between one national jurisdiction and another;
 - ecosystems and species in one jurisdiction that depend on or are affected by events in another;
 - species that are traded internationally.
63. Development of international agreements and other institutions to regulate use of the ecosystems and species listed in 62 and to maintain the processes on which they depend. Adherence to, and implementation of, such agreements and institutions.
64. Restoration and sustainable management of tunas, whales, and other pelagic resources. Sustainable management of the living resources of the Southern Ocean.
65. An international law of the sea that adequately provides for the conservation of living marine resources.

66. Institutions for the management of living marine resources that:
- are responsible for regions that are ecologically coherent;
 - cooperate closely with the authorities responsible for contiguous areas of land and sea;
 - are responsible not only for fixing catch levels and closed seasons but also for ensuring the integrity of the processes on which the living marine resources within their jurisdiction depend;
 - take full account of the effects of changes in ecosystems on the harvested species and of changes in catch levels on ecosystems;
 - fix catches at levels that are sustainable and allow for error, uncertainty and ignorance;
 - are empowered to enforce the catch levels and closed seasons they fix;
 - base their decisions on the best available scientific information;
 - encourage and facilitate research on the living marine resources within their jurisdiction;
 - make public the data available to them, the scientific advice they receive, and the assumptions behind their decisions.
67. Concerted action to control pollution, especially of shared seas.
68. Review of the remaining conservation needs of migratory species.
69. Review of the conservation needs of shared drainage basins.
70. Adherence to, and implementation of, the Convention on International Trade in Endangered Species of Wild Fauna and Flora.
71. Implementation of the urgent measures to conserve the highest priority ecosystems and species.
72. Implementation of A World Conservation Strategy.

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