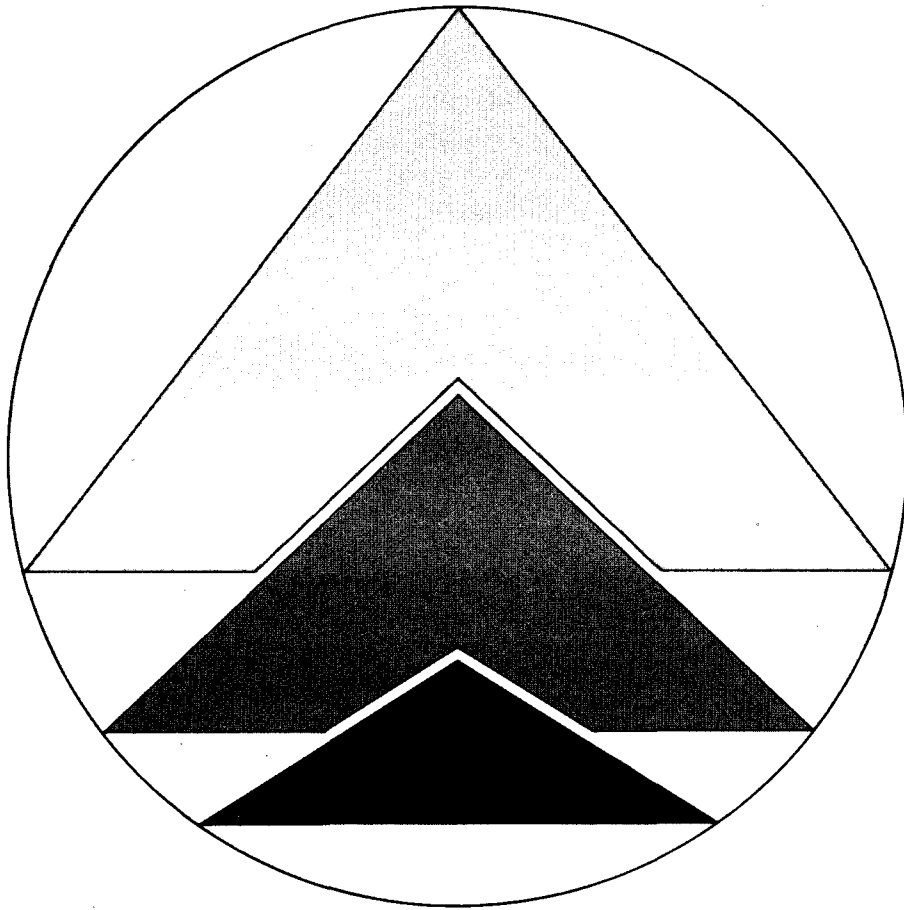


WORLD CONSERVATION STRATEGY

Living Resource Conservation
for Sustainable Development

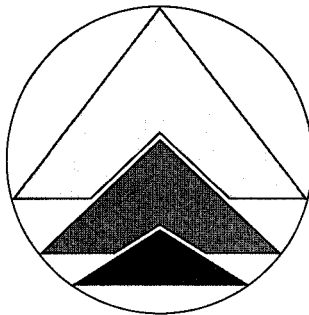


Prepared by the International Union for
Conservation of Nature and Natural Resources (IUCN)

with the advice, cooperation and financial assistance of
the United Nations Environment Programme (UNEP)
and the World Wildlife Fund (WWF)

and in collaboration with
the Food and Agriculture Organization of the
United Nations (FAO)
and the United Nations Educational, Scientific
and Cultural Organization (Unesco)





The Symbol

The circle symbolizes the biosphere—the thin covering of the planet that contains and sustains life. The three interlocking, overlapping arrows symbolize the three objectives of conservation:

- maintenance of essential ecological processes and life-support systems;
- preservation of genetic diversity;
- sustainable utilization of species and ecosystems.

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1980

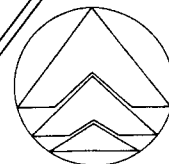


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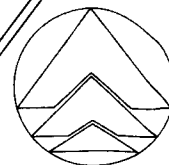
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Foreword



Human beings, in their quest for economic development and enjoyment of the riches of nature, must come to terms with the reality of resource limitation and the carrying capacities of ecosystems, and must take account of the needs of future generations. This is the message of conservation. For if the object of development is to provide for social and economic welfare, the object of conservation is to ensure Earth's capacity to sustain development and to support all life.

Two features characterize our time. The first is the almost limitless capacity of human beings for building and creation, matched by equally great powers of destruction and annihilation. The escalating needs of soaring numbers have often driven people to take a short-sighted approach when exploiting natural resources. The toll of this approach has now become glaringly apparent: a long list of hazards and disasters, including soil erosion, desertification, loss of cropland, pollution, deforestation, ecosystem degradation and destruction, and extinction of species and varieties. This situation underlines the need for conservation, comprising the ecologically sound management of productive systems and the maintenance of their viability and versatility.

The second is the global interrelatedness of actions, with its corollary of global responsibility. This in turn gives rise to the need for global strategies both for development and for conservation of nature and natural resources. The international community addresses the former through the development decades and associated enterprises sponsored by the United Nations, and is now addressing the latter through the World Conservation Strategy presented in this pack.

The World Conservation Strategy provides both an intellectual framework and practical guidance for the conservation actions necessary. It calls for global coordinated efforts backed by will and determination, for concerted action at national and international levels, and for global solidarity to implement its programmes. World-wide action to give practical effect to this strategy is a necessary complement to a world-wide programme for rational development of the resources of our planet. Development and conservation are equally necessary for our survival and for the discharge of our responsibilities as trustees of natural resources for the generations to come.

IUCN, UNEP and WWF have joined hands in the preparation of the present World Conservation Strategy, and will continue to coordinate their endeavours in support of its implementation.

Mohamed Kassas
President
IUCN

Mostafa K. Tolba
Executive Director
UNEP

John H. Loudon
President
WWF

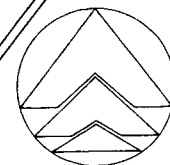
Preface and acknowledgements

The World Conservation Strategy (WCS) was commissioned by the United Nations Environment Programme (UNEP) which together with the World Wildlife Fund (WWF) provided the financial support for its preparation and contributed to the evolution of its basic themes and structure. IUCN is grateful to both organizations for all their support. While the WCS has been prepared by IUCN and primarily reflects IUCN's views and approaches it is intended that the Strategy represent a consensus of policy on conservation efforts in the context of world development. To this end the final draft was submitted to the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organization (Unesco), as well as to UNEP and WWF, and all four organizations carefully reviewed it and made significant contributions to it. The WCS is endorsed by the Ecosystem Conservation Group (ECG) the members of which are UNEP, FAO, Unesco and IUCN.

The WCS, as the product of an extremely thorough consultation process, inevitably reflects a compromise: among conservationists, who may differ on the relative importance of particular ecosystems, species, issues and measures; and between conservationists and the practitioners of development, who may differ in their emphasis on maintenance on the one hand and production on the other. The document also shares the limitations of every global analysis: it is obliged to aggregate and simplify a host of diverse local phenomena and to ignore a host of local problems. Knowledge of the world is so patchy that global generalizations are particularly prone to error. These drawbacks are recognized; but they are considered less important than the need to present a statement of agreed conservation requirements and priorities, around which conservationists and development practitioners alike could rally, and to adopt a perspective unconfined by the boundaries that separate but do not insulate nation from nation, sector from sector, or interest from interest.

There is a parallel, paperback version of the World Conservation Strategy for the general reader. The paperback differs from the version in this pack in style and layout and in providing both a fuller account of the importance of living resource conservation and a more detailed description of the priority conservation issues. The paperback devotes less space than the pack to the organizational aspects of conservation and its integration with development. Its purpose is to make more people aware of the vital importance of living resource conservation.

As a supplement to the two versions of the WCS, a Sourcebook will be published over several years in a number of volumes—on species, on ecosystems of the land,



fresh waters and the sea, and on issues and measures. The Sourcebook will provide more detailed information than can be contained in the Strategy, and a basis for the Strategy's further development. The WCS is intended to be an evolving effort and is expected to be up-dated and improved from time to time, in response to new knowledge, better understanding, changes in perception and values, and conservation progress as a result of the Strategy's implementation. For it is strongly hoped that governments, nongovernmental organizations and intergovernmental bodies will be quick to carry out the relevant recommendations. The members of the Ecosystem Conservation Group and WWF are ready to give whatever help they can within the limits of available resources, should their assistance be requested.

Many governments, nongovernmental organizations and individuals from both developed and developing countries have participated in the preparation of the Strategy. IUCN's membership currently consists of more than 450 government agencies and conservation organizations in over 100 countries. These members were first polled for their views on conservation priorities. Subsequently two drafts of the WCS were sent to them for comment, as well as to IUCN's Commissions of more than 700 scientists and other experts on ecology, threatened species, protected areas, environmental planning, environmental policy, law and administration and environmental education. The individuals concerned are too numerous to name here, but the assistance of each is gratefully acknowledged.

Special thanks, however, should go to the members of the four panels that reviewed drafts of the WCS: Emmanuel O.A. Asibey, Mona Björklund, Cecilia de Blohm, Mario A. Boza, William G. Conway, Sylvia Earle, Charles de Haes, N.D. Jayal, Mohamed Kassas, Ashok Khosla, F. Wayne King, P.H.C. Lucas, Duncan Poore, G. Carleton Ray, Mats Segnestam, Thomas B. Stoel Jr., Maurice F. Strong, and Lee M. Talbot. The generous contribution of their time and expertise was invaluable.

Patrick Virolle who devised the symbol and designed this pack, Dounia Morgan who translated the text into French, and the many IUCN secretaries who at various times typed one draft or another also deserve particular appreciation.

Robert Allen, as compiler and editor of the Strategy, guided it through the four working drafts and prepared the present text. His contribution has been central to the whole endeavour.

David A. Munro
Director General
IUCN

Guide to the World Conservation Strategy

The aim

The aim of the World Conservation Strategy is to help advance the achievement of sustainable development through the conservation of living resources. The Strategy:

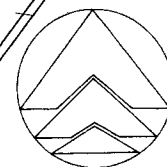
1. explains the contribution of living resource conservation to human survival and to sustainable development;
2. identifies the priority conservation issues and the main requirements for dealing with them;
3. proposes effective ways for achieving the Strategy's aim.

The Strategy is intended to stimulate a more focussed approach to living resource conservation and to provide policy guidance on how this can be carried out. It concentrates on the main problems directly affecting the achievement of conservation's objectives; and on how to deal with them through conservation. In particular, the Strategy identifies the action needed both to improve conservation efficiency and to integrate conservation and development.

The users

The Strategy is intended chiefly for three groups of user (none of which is wholly separate from the others):

1. Government policy makers and their advisers. Few governments have the financial and technical resources to address all of the problems of living resource conservation at once. Therefore they need to know what needs to be done first. Accordingly, the Strategy both recommends ways of overcoming the main obstacles to conservation and provides guidance on what action is most important. The Strategy is relevant to any level of government with significant responsibilities for planning and managing the use of living resources.
2. Conservationists and others directly concerned with living resources. For this group, the Strategy indicates those areas where conservation action is most urgently needed and where it is likely to yield the greatest and most lasting results. It also proposes ways in which conservation can participate more effectively in the development process, thereby increasing the likelihood of its being positively received by the development community and of helping to ensure that development is sustainable.
3. Development practitioners, including aid agencies, industry and commerce, and trade unions. For this group the Strategy demonstrates that conservation im-



proves the prospects of sustainable development and proposes ways of integrating conservation into the development process. It also attempts to identify those areas where the interests of conservation and of development are most likely to coincide and therefore where a closer partnership between the two processes would be particularly advantageous to both.

Arrangement of the text

The Strategy consists of 20 double page sections. The introduction (section 1), which defines key terms, is followed by three groups of sections. The first group (sections 2-7) describes the contribution of each of the objectives of conservation to human survival and wellbeing; outlines the main threats to them; and identifies the priority requirements for achieving the objectives. The second group (sections 8-14) sets out a strategy for action at the national and subnational levels. A framework for the strategy is outlined; then each of the main obstacles to conservation is described, together with recommendations for dealing with the obstacles. The third group (sections 15-20) is devoted to international action to stimulate and support national and subnational action. Section 20 includes a checklist of priority requirements, national actions and international actions.

Priority issues

The priority issues discussed in the Strategy are (numbers in parentheses refer to sections): reduction in quality and quantity of agricultural land (2, 5, 16) and grazing land (4, 7, 16); soil erosion and the degradation of catchment areas and watersheds (2, 5, 11, 16, 19); desertification (2, 5, 16); loss of the support systems of fisheries (2, 5, 11, 18, 19); extinction of species, subspecies and varieties (3, 6, 15, 17); overexploitation of fish and other wildlife (4, 7, 11, 18, 19); deforestation (4, 7, 16); climate alteration and air pollution (18); narrow sectoral approach to conservation (8, 9); failure to integrate conservation and development (9, 20); inadequate environmental planning and irrational resource allocation (10); inadequate or unenforced legislation (11); poor organization (11); lack of trained personnel (12); lack of information (12); lack of support for conservation (13); lack of conservation-based rural development (14). Most of these problems are common in both developed and developing countries. Several, however, such as erosion, desertification, deforestation and lack of conservation-based rural development, are much more acute in developing countries than in developed ones.

Executive Summary

The World Conservation Strategy is intended to stimulate a more focussed approach to the management of living resources and to provide policy guidance on how this can be carried out by three main groups:

- government policy makers and their advisers;
- conservationists and others directly concerned with living resources;
- development practitioners, including development agencies, industry and commerce, and trade unions.

1. *The aim of the World Conservation Strategy is to achieve the three main objectives of living resource conservation:*

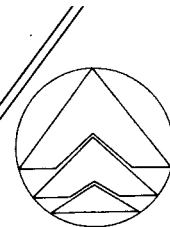
- a. **to maintain essential ecological processes and life-support systems** (such as soil regeneration and protection, the recycling of nutrients, and the cleansing of waters), on which human survival and development depend;
- b. **to preserve genetic diversity** (the range of genetic material found in the world's organisms), on which depend the functioning of many of the above processes and life-support systems, the breeding programmes necessary for the protection and improvement of cultivated plants, domesticated animals and microorganisms, as well as much scientific and medical advance, technical innovation, and the security of the many industries that use living resources;
- c. **to ensure the sustainable utilization of species and ecosystems** (notably fish and other wildlife, forests and grazing lands), which support millions of rural communities as well as major industries.

2. *These objectives must be achieved as a matter of urgency because:*

- a. **the planet's capacity to support people is being irreversibly reduced in both developing and developed countries:**
 - thousands of millions of tonnes of soil are lost every year as a result of deforestation and poor land management;
 - at least 3,000 km² of prime farmland disappear every year under buildings and roads in developed countries alone;
- b. **hundreds of millions of rural people in developing countries, including 500 million malnourished and 800 million destitute, are compelled to destroy the resources necessary to free them from starvation and poverty:**
 - in widening swaths around their villages the rural poor strip the land of trees and shrubs for fuel so that now many communities do not have enough wood to cook food or keep warm;
 - the rural poor are also obliged to burn every year 400 million tonnes of dung and crop residues badly needed to regenerate soils;
- c. **the energy, financial and other costs of providing goods and services are growing:**
 - throughout the world, but especially in developing countries, siltation cuts the lifetimes of reservoirs supplying water and hydroelectricity, often by as much as half;
 - floods devastate settlements and crops (in India the annual cost of floods ranges from \$140 million to \$750 million);
- d. **the resource base of major industries is shrinking:**
 - tropical forests are contracting so rapidly that by the end of this century the remaining area of unlogged productive forest will have been halved;
 - the coastal support systems of many fisheries are being destroyed or polluted (in the USA the annual cost of the resulting losses is estimated at \$86 million).

3. *The main obstacles to achieving conservation are:*

- a. **the belief that living resource conservation is a limited sector**, rather than a process that cuts across and must be considered by all sectors;
- b. **the consequent failure to integrate conservation with development;**
- c. **a development process that is often inflexible and needlessly destructive**, due to inadequacies in environmental planning, a lack of rational use allocation and undue



emphasis on narrow short term interests rather than broader longer term ones;

d. **the lack of a capacity to conserve**, due to inadequate legislation and lack of enforcement; poor organization (notably government agencies with insufficient mandates and a lack of coordination); lack of trained personnel; and a lack of basic information on priorities, on the productive and regenerative capacities of living resources, and on the trade-offs between one management option and another;

e. **the lack of support for conservation**, due to a lack of awareness (other than at the most superficial level) of the benefits of conservation and of the responsibility to conserve among those who use or have an impact on living resources, including in many cases governments;

f. **the failure to deliver conservation-based development where it is most needed**, notably the rural areas of developing countries:

4. *The World Conservation Strategy therefore:*

a. **defines living resource conservation and explains its objectives**, its contribution to human survival and development and the main impediments to its achievement (sections 1-4);

b. **determines the priority requirements for achieving each of the objectives** (sections 5-7);

c. **proposes national and subnational strategies** to meet the priority requirements, describing a framework and principles for those strategies (section 8);

d. **recommends anticipatory environmental policies, a cross-sectoral conservation policy and a broader system of national accounting** in order to integrate conservation with development at the policy making level (section 9);

e. **proposes an integrated method of evaluating land and water resources, supplemented by environmental assessments**, as a means of improving environmental planning; and **outlines a procedure for the rational allocation of land and water uses** (section 10);

f. **recommends reviews of legislation** concerning living resources; **suggests general principles for organization within government**; and in particular **proposes ways of improving the organizational capacities for soil conservation and for the conservation of marine living resources** (section 11);

g. **suggests ways of increasing the number of trained personnel**; and **proposes more management-oriented research and research-oriented management**, so that the most urgently needed basic information is generated more quickly (section 12);

h. **recommends greater public participation** in planning and decision making concerning living resource use; and **proposes environmental education programmes and campaigns** to build support for conservation (section 13);

i. **suggests ways of helping rural communities to conserve** their living resources, as the essential basis of the development they need (section 14).

5. *In addition, the Strategy recommends international action to promote, support and (where necessary) coordinate national action, emphasizing in particular the need for:*

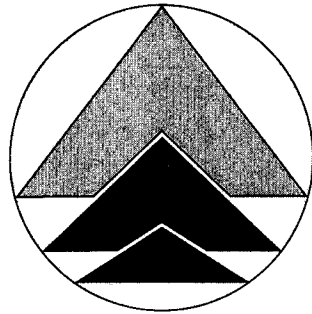
a. **stronger more comprehensive international conservation law, and increased development assistance for living resource conservation** (section 15);

b. **international programmes** to promote the action necessary to conserve **tropical forests and drylands** (section 16), to protect areas essential for the preservation of **genetic resources** (section 17), and to conserve the global "commons"—**the open ocean, the atmosphere, and Antarctica** (section 18);

c. **regional strategies** to advance the conservation of **shared living resources** particularly with respect to **international river basins and seas** (section 19).

6. The World Conservation Strategy ends by summarizing **the main requirements for sustainable development**, indicating conservation priorities for the Third Development Decade (section 20).

WORLD CONSERVATION STRATEGY



World
Conservation
Strategy

1. Introduction: living resource conservation

1. Earth is the only place in the universe known to sustain life. Yet human activities are progressively reducing the planet's life-supporting capacity at a time when rising human numbers and consumption are making increasingly heavy demands on it (see box). The combined destructive impacts of a poor majority struggling to stay alive and an affluent minority consuming most of the world's resources are undermining the very means by which all people can survive and flourish.

2. Humanity's relationship with the biosphere (the thin covering of the planet that contains and sustains life) will continue to deteriorate until a new international economic order is achieved, a new environmental ethic adopted, human populations stabilize, and sustainable modes of development become the rule rather than the exception. Among the prerequisites for sustainable development is the conservation of living resources.

3. Development is defined here as: the modification of the biosphere and the application of human, financial, living and non-living resources to satisfy human needs and improve the quality of human life. For development to be sustainable it must take account of social and ecological factors, as well as economic ones; of the living and non-living resource base; and of the long term as well as the short term advantages and disadvantages of alternative actions.

4. Conservation is defined here as: the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. Thus conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment. Living resource conservation is specifically concerned with plants, animals and microorganisms, and with those non-living elements of the environment on which they depend. Living resources have two important properties the combination of which distinguishes them from non-living resources: they are renewable if conserved; and they are destructible if not.

5. Conservation, like development, is for people; while development aims to achieve human goals largely through use of the biosphere, conservation aims to achieve them by ensuring that such use can continue. Conservation's concern for maintenance and sustainability is a rational response to the nature of living resources (renewability + destructibility) and also an ethical imperative, expressed in the belief that "we have not inherited the earth from our parents, we have borrowed it from our children".

6. Conservation is a process—to be applied cross-sectorally—not an activity sector in its own right. In the case of sectors (such as agriculture, fisheries, forestry and wildlife) directly responsible for the management of living resources, conservation is that aspect of management which ensures that utilization is sustainable and which safeguards the ecological processes and genetic diversity essential for the maintenance of the resources concerned. In the case of other sectors (such as health, energy, industry), conservation is that aspect of management which ensures that the fullest sustainable advantage is derived from the living resource base and that activities are so located and conducted that the resource base is maintained.

7. Living resource conservation has three specific objectives:

to maintain essential ecological processes and life-support systems (such as soil regeneration and protection, the recycling of nutrients, and the cleansing of waters), on which human survival and development depend;

to preserve genetic diversity (the range of genetic material found in the world's organisms), on which depend the breeding programmes necessary for the protection and improvement of cultivated plants and domesticated animals, as well as much scientific advance, technical innovation, and the security of the many industries that use living resources;

to ensure the sustainable utilization of species and ecosystems (notably fish and other wildlife, forests and grazing lands), which support millions of rural communities as well as major industries¹.

8. Living resource conservation is just one of a number of conditions necessary to assure human survival and wellbeing, and a world conservation strategy is but one of a number of strategies needed: a strategy for peace; a strategy for a new international economic order; a strategy for human rights; a strategy for overcoming poverty; a world food supply strategy; a population strategy. Several of these issues are properly the subject of the International Development Strategy for the Third United Nations Development Decade. All such strategies should be mutually reinforcing. None has much chance of success unless they are. The integration of conservation and development is particularly important, because unless patterns of development that also conserve living resources are widely adopted, it will become impossible to meet the needs of today without foreclosing the achievement of tomorrow's.

9. Conservation and development have so seldom been combined that they often appear—and are sometimes represented as being—incompatible. Conservationists themselves have helped—quite unwittingly—to foster this misconception. Too often they have allowed themselves to be seen as resisting all development—although often they have been forced into that posture because they have not been invited to participate in the development process early enough. The result has been not to stop development, but to persuade many development practitioners, especially in developing countries, that conservation is not merely irrelevant, it is harmful and anti-social. Consequently, development has continued unimpeded by conservationists yet with the seeds of its eventual failure lying in the ecological damage that conservation could have helped prevent.

10. That conservation and sustainable development are mutually dependent can be illustrated by the plight of the rural poor. The dependence of rural communities on living resources is direct and immediate. For the 500 million people who are malnourished², or the 1500 million people whose only fuel is wood, dung or crop wastes³, or the almost 800 million people with incomes of \$50 or less a year⁴—for all these people conservation is the only thing between

Notes and references

1. Ecosystems are systems of plants, animals and microorganisms together with the non-living components of their environment.
2. FAO. 1977. *The fourth world food survey*. FAO, Rome.

3. FAO. 1978. *Forestry for local community development*. FAO Forestry Paper, 7.
4. World Bank. 1978. *World development report*. World Bank, Washington, DC.
5. Arnold, J. E. M., and Jules Jongma. 1977. *Fuelwood and char-*

coal in developing countries: an economic survey. Unasylva, 29:2-9.
6. Myers, Norman. 1978. *Forests for people*. *New Scientist*, 80:951-953.
7. See section 2 for references.

for sustainable development



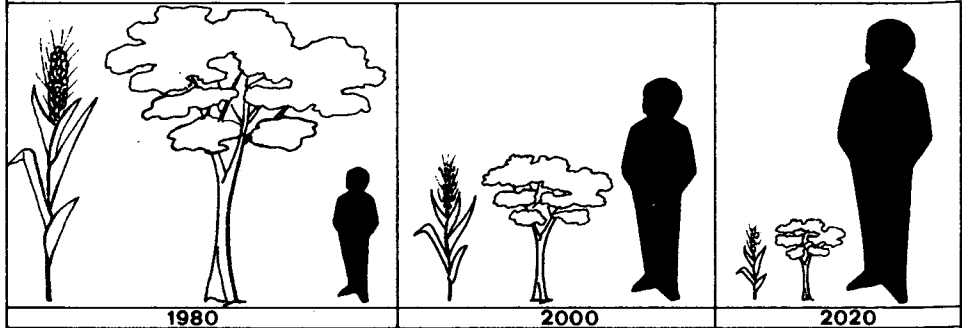
them and at best abject misery, at worst death. Unhappily, people on the margins of survival are compelled by their poverty—and their consequent vulnerability to inflation—to destroy the few resources available to them. In widening circles around their villages they strip trees and shrubs for fuel until the plants wither away and the villagers are forced to burn dung and stubble. The 400 million tonnes of dung and crop wastes that rural people burn annually⁵ are badly needed to regenerate soils already highly vulnerable to erosion now that the plants that bind them are disappearing.

11. It would be wrong, however, to conclude that conservation is a sufficient response to such problems. People whose very survival is precarious and whose prospects of even temporary prosperity are bleak cannot be expected to respond sympathetically to calls to subordinate their acute short term needs to the possibility of long term returns. Conservation must therefore be combined with measures to meet short term economic needs. The vicious circle by which poverty causes ecological degradation which in turn leads to more poverty can be broken only by development. But if it is not to be self-defeating, it must be development that is sustainable—and conservation helps to make it so. The development efforts of many developing countries are being slowed or compromised by lack of conservation. In Southeast Asia excessive clearing of forests has caused fluctuations in river flow that are lowering rice yields⁶. Throughout the developing world the lifetimes of hydroelectric power stations and water-supply systems are being cut as reservoirs silt up—because siltation is accelerated by deforestation, overgrazing and other unwise land uses⁷.

12. The activities of every organism modify its environment, and those of human beings are no exception. Although environmental modification is both natural and a necessary part of development, this does not mean that all modification leads to development (nor that preservation impedes it). While it is inevitable that most of the planet will be modified by people and that much of it will be transformed, it is not at all inevitable that such alterations will achieve the social and economic objectives of

Why a world conservation strategy is needed

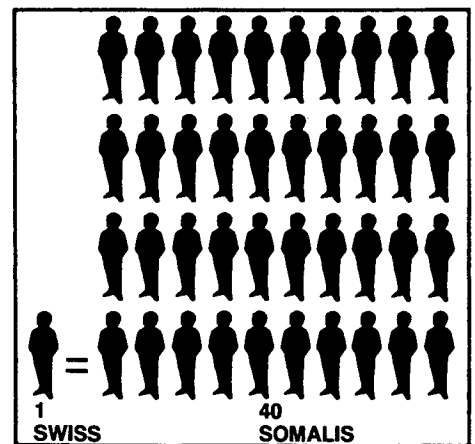
A world strategy for the conservation of Earth's living resources is needed now because:



1. Living resources essential for human survival and sustainable development are increasingly being destroyed or depleted⁸. At the same time human demand for those resources is growing fast. The problem is illustrated above. If current rates of land degradation continue, close to one third of the world's arable land (symbolized by the stalk of grain) will be destroyed in the next 20 years⁹. Similarly, by the end of this century (at present rates of clearance), the remaining area of unlogged productive tropical forest will be halved¹⁰. During this period the world population is expected to increase by almost half—from just over 4,000 million to just under 6,000 million¹¹. The predicament caused by growing numbers of people demanding scarcer resources is exacerbated by the disproportionately high consumption rates of developed countries (illustrated below).

2. The action required to cure the most serious current conservation problems and to prevent still worse ones takes time: time for planning, education, training, better organization and research; and when such action is undertaken, it takes time for the biosphere to respond—reforestation, the restoration of degraded land, the recovery of depleted fisheries, and so on, are not instantaneous processes.

3. National and international capacities to conserve are ill-organized and fragmented—split up amongst sectors such as agriculture, forestry, fisheries and wildlife—with consequent duplication of effort, gaps in coverage, competition for money and influence, and conflict; and they have little influence on the development process, with the result that development, the principal means of tackling human problems, too often adds to them by destroying or degrading the living resource base of human welfare.



Disproportionate consumption of resources by the affluent. One Swiss consumes as much as 40 Somalis. Source: 12.

development. Unless it is guided by ecological, as well as by other environmental, and by social, cultural and ethical considerations, much development will continue to have undesired effects, to provide reduced benefits or even to fail altogether. As will be seen in sections 2-4, there is a close relationship between failure to achieve the objectives of con-

servation and failure to achieve the social and economic objectives of development—or, having achieved them, to sustain that achievement. Hence the goal of the World Conservation Strategy is the integration of conservation and development to ensure that modifications to the planet do indeed secure the survival and wellbeing of all people.

8. See sections 2-4 for examples.

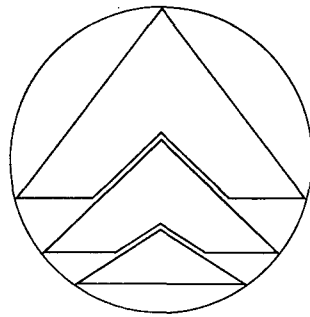
5. United Nations. 1978. *United Nations Conference on Desertification: round-up, plan of action and resolutions*. United Nations, New York.

10. Lanly, J.P., and J. Clement. 1979. *Present and future forest and*

plantation areas in the tropics. FO: MISC/79/1. FAO, Rome. And: J.P. Lanly; personal communication, 1979.

11. World Bank. 1979. *World development report*. World Bank, Washington, DC.

12. Strahm, Rudolf H. 1974. *Pays industrialisés, pays sous-développés: faits et chiffres*. A la Baconnière, Neuchâtel.



The objectives of
conservation
and requirements for
their achievement

2. Maintenance of essential ecological processes

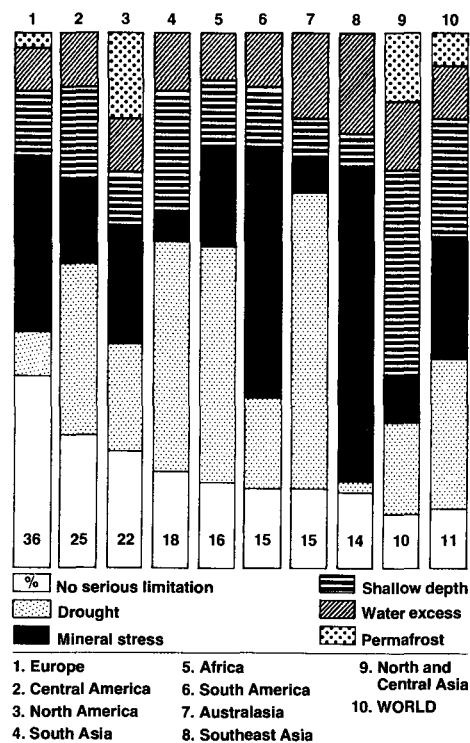
1. Essential ecological processes are those processes that are governed, supported or strongly moderated by ecosystems and are essential for food production, health and other aspects of human survival and sustainable development. "Life-support systems" is shorthand for the main ecosystems involved—for example, watershed forests or coastal wetlands. The maintenance of such processes and systems is vital for all societies regardless of their stage of development. Many archaeological relics, whether of great civilizations or peasant villages, testify to the consequences of not doing so. Today, the most important and most threatened life-support systems are agricultural systems, forests, and coastal and freshwater systems.

Agricultural systems

2. Only about 11% of the world's land area (excluding Antarctica) offers no serious limitation to agriculture; the rest suffers from drought, mineral stress (nutritional deficiencies or toxicities), shallow depth, excess water, or permafrost¹. The best land is not evenly distributed (see figure A). The world's cropland currently occupies 14 million km², and although it may be possible to double this area, much of the best land is already being farmed¹. Unfortunately large areas of prime quality land are being permanently taken out of agricultural use by being built on. In developed countries at least 3,000 km² of prime agricultural land are submerged every year under urban sprawl: between 1960 and 1970 Japan lost 7.3% of its agricultural land to buildings and roads and European countries lost from 1.5% (Norway) to 4.3% (Netherlands)². In addition, close to one third of the world's arable land will be destroyed in the next 20 years if current rates of land degradation continue³.

3. Soil is a crucial life-support system, since the bulk of all food production depends on it. Soil erosion is a natural and continuous process, but in undisturbed ecosystems with a protective cover of plants the soil is usually regenerated at the same rate it is removed⁴. If soil and vegetation are not in balance, as often they are not when influenced by

poorly managed human activities, erosion is accelerated with disastrous consequences. Even under natural conditions of vegetation cover, nature takes from 100 to 400 years or more to generate 10 millimetres of top soil; and 3,000 to 12,000 years would be needed to generate soil to a depth of the length of this page. So once the soil has gone, for all practical purposes it has gone for good.



A. Regional distribution of soils with or without limitations for agriculture. Source: 1.

4. Soil loss has accelerated sharply throughout the food-hungry tropics, which are generally more susceptible to erosion than the temperate zone, due to the topography of the land and the nature of the soils and rainfall⁵. More than half of India, for example, suffers from some form of soil degradation: out of her total of 3.3 million km², 1.4 million km² are subject to increased soil loss, while an additional 270,000 km² are being degraded by floods, salinity and alkalinity⁶. An estimated 6,000 million tonnes of soil are lost every year from 800,000 km² alone; with them go more than 6 million tonnes of nutrients—more than the amount that is applied in the form of fertilizers⁷.

5. The productivity of agricultural ecosystems depends not only on maintaining soil quality but also on retaining the habitats of beneficial insects and other animals, such as crop pollinators and the predators and parasites of pests. Effective pest control is no longer a matter of heavy applications of pesticides, partly because of the rising cost of petroleum-derived products but largely because excessive pesticide use promotes resistance (the number of pesticide-resistant insects and mites has doubled in 12 years—see figure B), destroys natural enemies, turns formerly innocuous species into pests, harms other non-target species, and contaminates food and feed. Instead pesticides should be used to supplement a battery of methods integrated in appropriate combinations: these methods include introduction of pest-resistant crop varieties, special planting combinations and patterns, mechanical methods, the use of repellents and hormones, and encouragement of natural enemies.

Forests

6. Besides supplying timber and other products, forests have a vital effect on processes of great significance for people. They influence local and regional climates, generally by making them milder, and they help to ensure a continuous flow of clean water. Some forests, notably tropical cloud forests, even increase the availability of water by intercepting moisture from clouds. Watershed forests are particularly important because they protect soil cover on site and protect areas downstream from excessive floods and other harmful fluctuations in streamflow. By thus reducing the silt load of rivers, watershed forests also help prevent the clogging of reservoirs, irrigation systems, canals and docks, and the smothering by sediment of coral reefs.

7. Yet watershed forests are being widely devastated—by clearance for agriculture, by logging and cutting for fuel, by overgrazing, and by badly managed road building. The results can be extremely expensive. It costs Argentina \$10 million a year to dredge silt from the estuary of the River Plate and keep

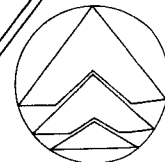
Notes and references

1. FAO. 1978. *The state of food and agriculture 1977*. FAO, Rome.
2. All figures from: Organization for Economic Cooperation and Development (OECD). 1979. *The state of the environment: an appraisal of economic conditions and trends in OECD countries*. OECD. ENV/Min(79)1.
3. United Nations. 1978. *United Nations Conference on Desertification: round-up, plan of action and resolutions*. United Nations, New York.
4. Constantinesco, I. 1976. *Soil conservation for developing countries*. FAO Soils Bulletin, 30.
5. Hudson, N. W. 1977. Research needs for soil conservation in

- developing countries. In: FAO. *Soil conservation and management in developing countries: report of an expert consultation held in Rome 22-26 November 1976*. FAO Soils Bulletin, 33.
6. Bali, Y. P., and J. S. Kanwar. 1977. *Soil degradation in India*. In: FAO. *Assessing soil degradation: report of an FAO/UNEP consultation held in Rome, 18-20 January 1977*. FAO Soils Bulletin, 34.
7. Das, D. C. 1977. *Soil conservation practices and erosion control in India—a case study*. In: FAO Soils Bulletin, 33 (see ref. 5).
8. FAO. 1967. *Report of first session of FAO Working Party of*

- Experts on Resistance of Pests to Pesticides*. FAO Meeting Report, PL/1965/18; FAO. 1968. *Report of third session of FAO Working Party of Experts on Resistance of Pests to Pesticides*. FAO Meeting Report, PL/1967/M/8; FAO. 1977. *Report of the first session of the FAO Panel of Experts on Pest Resistance to Pesticides and Crop Loss Assessment*. FAO Plant Production and Protection Papers, 6. All cited by: UNEP. 1979. *The state of the environment: selected topics—1979*. Report of the Executive Director. UNEP/GC.7/4.
9. Pereira, H. C. 1973. *Land use and water resources in temperate and tropical climates*. Cambridge University Press.
10. Sterling, C. 1976. *Nepal*. Atlantic Monthly, October 1976. Cited

sses and life-support systems



Buenos Aires open to shipping: yet 80% of the 100 million tonnes of sediment that every year threaten to block the harbour comes from only 4% of the drainage basin—the heavily overgrazed catchment area of the Bermejo River 1,800 km upstream⁹. In India the annual cost of damage by floods ranges from \$140 million to \$750 million^{7, 10}.

8. Sedimentation as a result of careless use of watershed forests can cut drastically the economic life of reservoirs, hydroelectric facilities and irrigation systems. The capacity of India's Nizam-sagar reservoir has been more than halved (from almost 900 million m³ to fewer than 340 million m³) and there is now not enough water to irrigate the 1,100 km² of sugarcane and rice for which it was intended—and hence not enough sugarcane to supply local sugar factories⁷. Deforestation in northern Luzon in the Philippines has silted up the reservoir of the Ambuklao Dam so fast that its useful life has been reduced from 60 to 32 years¹¹. Such problems are not confined to developing countries: for example, it has been estimated that more than 1,000 million m³ of sediment are deposited every year in the major reservoirs of the USA¹². Although they have not been calculated (indeed, probably cannot be), the global costs of sediment removal, river dredging, reconstruction of irrigation systems and loss of investment in expensive structures like dams must be huge. Only 10% of the world's population live in

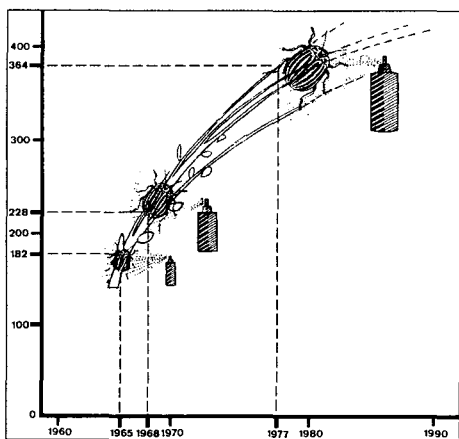
mountainous areas, but another 40% live in the adjacent plains¹³; so the lives and livelihoods of half the world directly depend on the way in which watershed ecosystems are managed.

9. In areas under shifting cultivation forests also act to restore soil fertility. More than 200 million people occupying about 30 million km² of tropical forests live by practising shifting cultivation—cropping an area for a few years, then clearing another area, leaving the first one fallow to revert to scrub and forest. The fallow period lasts from 8-12 years in tropical rain forests to 20-30 years in drier areas, and during this time the forest cover enables the soil to regenerate. This is a stable, productive practice if the population itself is stable; but if populations are growing, which nowadays they usually are, the pressure on land increases, fallow periods shorten, the soil has no chance to regenerate, and wider and wider tracts of otherwise productive forest land are destroyed. Almost two-thirds of the land under shifting cultivation is upland forest, much of it on steep slopes, and the resulting erosion is severe¹. In the Ivory Coast, shifting cultivation reduced the forest cover by 30% between 1956 and 1966 and now only 50,000 km² remain out of the 150,000 km² that is believed to have existed at the beginning of this century¹. Similarly, shifting cultivators clear about 3,500 km² a year in the Philippines—in Mindanao alone they cleared 10,000 km² between 1960 and 1971¹⁴.

extremely important for coastal protection: without the activities of corals and other reef-building organisms, for example, more than 400 islands would not exist¹⁶. Similarly, many freshwater wetlands and floodplains support important inland fisheries, while floodplain agriculture has long relied on the regular supply of nutrients by floodwaters.

11. Wetlands, floodplains, seagrass beds and coral reefs are being destroyed the world over, with severe effects on the economies that depend on them most closely. For example, the cost of damage to US marine fisheries caused by degradation of coastal wetlands has been estimated to be almost \$86 million a year¹⁷. In Sri Lanka repeated removal of corals for the production of lime is so extensive that a local fishery has collapsed; mangroves, small lagoons and coconut groves have disappeared; and local wells have been contaminated with salt¹⁸. In many parts of the world the construction of dams has blocked the passage of migrating fish and drowned or otherwise destroyed the habitats of others; and although the new reservoir may support a new fishery this does not always compensate for the loss of the floodplain¹⁹. The habitats of many other aquatic animals also are threatened. For example, many sea turtle nesting beaches have been wrecked for roads, housing and other developments; while the breeding areas of gray whales and belugas (or white whales) are also at risk.

12. These are typical effects of the impacts on coastal and freshwater ecosystems everywhere: impacts such as industrial and agricultural pollution; the construction of dams; siltation from eroded uplands; filling to provide sites for industry, housing, recreation, airports and farmland; dredging to create, deepen or improve harbours; quarrying; and cutting of mangroves for fuel. As the commercially valuable fisheries for fish, crustaceans and molluscs become more fully exploited, so the effects of habitat destruction and pollution—particularly on those species depending on coastal wetlands and shallows or on inland wetlands and floodplains for nutrients or for spawning grounds and nurseries—will become more evident.



B. Number of pesticide-resistant species of insects and mites. Source: 8.

Coastal and freshwater systems

10. Coastal wetlands and shallows—especially estuaries and mangrove swamps—provide food and shelter for waterfowl and for fishes, crustaceans and molluscs utilized by an estimated two-thirds of the world's fisheries¹⁵. Some are among the world's most lucrative fisheries, notably those for shrimp. Seagrass meadows also act as nurseries and nutrient suppliers for economically important fish species. Coral ecosystems are of more local, but nonetheless vital, significance—providing habitats for the fish on which many coastal communities in developing countries depend. In addition, coastal wetlands and coral reefs are

by: Kunkle, S. H. and D. A. Harcharik. 1977. Conservation of upland wildlands for downstream agriculture. In: *FAO Soils Bulletin*, 33 (see ref. 5).

11. US Agency for International Development. 1979. *Environmental and natural resources management in developing countries: a report to Congress. Volume 1: Report*. USAID, Department of State, Washington, DC.

12. Holeman, N. 1968. The sediment yield of major rivers of the world. *Water Resources Research*, 4: 737-747. Cited by: FAO. 1978. *The state of food and agriculture 1977*. FAO, Rome.

13. FAO. 1978. Forestry for local community development. *FAO Forestry Paper*, 7.

14. FAO. 1971. Environmental aspects of natural resources management: forestry. Cited by: FAO. 1978 (see ref. 1).

15. This figure is extrapolated from an analysis of the relationship between commercial fisheries and estuaries in the USA, by: McHugh, J. L. 1966. Management of estuarine fisheries. In: A symposium on estuarine fisheries. *Special Publications of the American Fisheries Society*, 3: 133-154. Locally, the proportion may be much higher (for example, an estimated 97% in the Gulf of Mexico) or lower.

16. Salvat, Bernard. 1979. Trouble in paradise. Part 2: coral reef parks and reserves. *Parks*, 4: 1-4.

17. Total figure combined from: Kumpf, Herman E. 1977. Eco-

logic impact of the effects of pollution on the coastal fisheries of the Atlantic and Gulf of Mexico regions of the United States of America. *FAO Fisheries Technical Paper*, 172. And: Hester, Frank J. 1976. Economic aspects of the effects of pollution on the marine and anadromous fisheries of the western United States of America. *FAO Fisheries Technical Paper*, 162.

18. Library of Congress, Science and Technology Division. 1978. Draft environmental report on Sri Lanka. Cited by: USAID. 1979 (see ref. 11).

19. Welcomme, R. L. 1975. The fisheries ecology of African floodplains. *CIFA Technical Paper*, 3. Committee for Inland Fisheries of Africa. FAO.

3. Preservation of genetic diversity

1. The preservation of genetic diversity is both a matter of insurance and investment—necessary to sustain and improve agricultural, forestry and fisheries production, to keep open future options, as a buffer against harmful environmental change, and as the raw material for much scientific and industrial innovation—and a matter of moral principle.

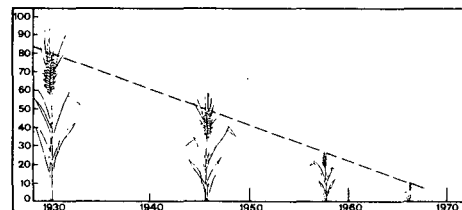
2. The issue of moral principle relates particularly to species extinction, and may be stated as follows. Human beings have become a major evolutionary force. While lacking the knowledge to control the biosphere, we have the power to change it radically. We are morally obliged—to our descendants and to other creatures—to act prudently. Since our capacity to alter the course of evolution does not make us any the less subject to it, wisdom also dictates that we be prudent. We cannot predict what species may become useful to us. Indeed we may learn that many species that seem dispensable are capable of providing important products, such as pharmaceuticals, or are vital parts of life-support systems on which we depend. For reasons of ethics and self-interest, therefore, we should not knowingly cause the extinction of a species.

Disappearing cultivars

3. The genetic material contained in the domesticated varieties of crop plants, trees, livestock, aquatic animals and microorganisms—as well as in their wild relatives—is essential for the breeding programmes in 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. For example, the average lifetime of wheat and other cereal varieties in Europe and North America is only 5-15 years¹. This is because pests and diseases evolve new strains and overcome resistance; climates alter; soils vary; consumer demands change. Farmers and other crop-producers, therefore, cannot do without the reservoir of still-evolving possibilities available in the range of varieties of crops, domesticated animals, and their wild

relatives. The continued existence of wild and primitive varieties of the world's crop plants is humanity's chief insurance against their destruction by the equivalents for those crops of chestnut blight and Dutch elm disease. This is not a remote eventuality. It happened once with the European grape vine. In the 1860s *Phylloxera*, an insect which lives on the roots of the vine, arrived in Europe from North America. Its effect was catastrophic. Almost every vineyard on the continent was destroyed. Then it was discovered that the native American vine is tolerant of *Phylloxera*. Europe's wine production was saved only by the grafting of European vines onto American rootstocks—a practice that continues today².

4. The prospects of similar disasters striking other crops increase as farmers rely on fewer varieties. Because of intensive selection for high performance and uniformity the genetic base of much modern food production has grown dangerously narrow. Only four varieties of wheat produce 75% of the crop grown on the Canadian prairies; and more than half the prairie wheatlands are devoted to a single variety (Neepawa)³. Similarly, 72% of US potato production depends on only four varieties,



Loss of crop genetic diversity. Percentage of primitive cultivars in Greek wheat crop. The decline is typical of most crops in most countries. Source: 5.

and just two varieties supply US pea production. Almost every coffee tree in Brazil descends from a single plant, and the entire US soybean industry is derived from a mere six plants from one place in Asia⁴. These and other crops in a similar position are extremely vulnerable to outbreaks of pests and diseases and to sudden unfavourable changes in growing conditions. Unfortunately, while the genetic base of the world's crops and other living resources is narrowing rapidly, the means by which this

dangerous situation could be corrected (the diversity of crop varieties and relatives) are being destroyed. Many wild and domesticated varieties of crop plants—such as wheat, rice, millet, beans, yams, tomatoes, potatoes, bananas, limes and oranges—are already extinct and many more are in danger of following them⁵.

5. Valuable but primitive or locally distributed varieties are to an extent victims of their own utility, since the qualities of higher productivity and greater disease resistance that give the advanced varieties such an advantage over them are in large measure derived from them. The rapid replacement of traditional varieties by new ones is a necessary and positive development given the need for more food; but it could prove counterproductive if the traditional varieties and their wild relatives are not saved as well. Primitive populations of crops and their wild relatives are an important source, and often the only source, of pest and disease resistance worth many millions of dollars, of adaptations to difficult environments and of other agronomically valuable characteristics such as the dwarf habit in rice and wheat, which has revolutionized their cultivation and led to greatly increased yields in many parts of the world⁶.

6. Useful breeds of livestock are also at risk. Of the 145 indigenous cattle breeds in Europe and the Mediterranean region, 115 are threatened with extinction⁷. Yet, as with crops, many traditional strains are of great value for breeding purposes. The very rare Wensleydale sheep has been used to produce a heat tolerant breed able to produce good quality wool in subtropical lands; and the Cornish hen, once of interest only to poultry fanciers, proved so useful for crossing with other strains to produce a quick-growing meat bird that it is effectively the basis of the broiler industry⁸.

Resources for health

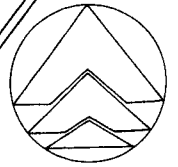
7. Although only a minute proportion of the world's plants and animals have been investigated for their value as medicines and other pharmaceutical products, modern medicine depends heavily on them. According to one analysis,

Notes and references

1. No international study has been made to support this statement; but this seems to be an acceptable estimate.
2. Olmo, H.P. 1976. Grapes. In: N.W. Simmonds (editor). *Evolution of crop plants*. Longman, London and New York.
3. Cheshire, Bob. 1978. Sowing the seeds of suspicion. *Maclean's*, 18 December 1978.
4. Harlan, Jack R. 1972. Genetic disaster. *Journal of Environmental Quality*, 1:212-215.

5. Frankel, O.H. (editor). 1973. *Survey of crop genetic resources in their centres of diversity: first report*. FAO/IBP. Additional reports in *Plant Genetic Resources Newsletter*.
6. International Board for Plant Genetic Resources (IBPGR). 1975. *The conservation of crop genetic resources*. IBPGR, FAO, Rome.
7. FAO/UNEP. 1975. *Pilot study on conservation of animal genetic resources*. FAO, Rome.
8. UNEP. 1976. *Overviews in the priority subject areas, oceans*

- and conservation of nature, wildlife and genetic resources. UNEP/Prog./4.
9. Farnsworth, Norman R., and Ralph W. Morris. 1976. Higher plants: the sleeping giant of drug development. *American Journal of Pharmacy*, 146:46-52.
10. Hänsel, Rudolf. 1972. Medicinal plants and empirical drug research. In: Tony Swain (editor). *Plants in the development of modern medicine*. Harvard University Press.
11. United Nations Industrial Development Organization (UNI-



more than 40% of the prescriptions each year in the USA contain a drug of natural origin—either from higher plants (25%) or microbes (13%) or from animals (3%)—as sole active ingredient or as one of the main ones⁹. In the USA alone the value of medicines just from higher plants is reported to be about \$3,000 million a year and rising⁹. The most important applications of higher plants and animals for medicine are¹⁰:

as constituents used directly as therapeutic agents—for example, digitoxin, morphine, and atropine, which are still unsurpassed in their respective fields;

as starting materials for drug synthesis—for example, adrenal cortex and other steroid hormones, which are normally synthesized from plant steroidal sapogenins;

as models for drug synthesis—for example, cocaine, which led to the development of modern local anesthetics. This application should not be underestimated. As one authority comments: “without naturally occurring active principles, it seems probable that neither the principle nor the activity would otherwise have been discovered. Put yourself in the place of a chemist who would like to develop a remedy for cardiac insufficiency; methods currently available would not lead him to synthesize a digitoxin-like molecule without knowledge of the natural prototype”¹⁰.

8. Paradoxically, a country's dependence on its own diminishing store of genetic diversity—as well as on that of other countries—is likely to grow as the country develops. Several developing countries, for example, are currently setting up their own pharmaceutical industries in order to supply their peoples with essential drugs at an acceptable cost. As a service to this effort a UN workshop recently compiled a basic list of medicinal plants found in Africa, Asia and Latin America whose active principles are used in modern medicine. More than 40 of the 90 species listed are available only from the wild; and another 20, though cultivated, are also taken from the wild¹¹. Preservation of these

species and their habitats is thus one of the preconditions for maintaining indigenous pharmaceutical industries.

9. The history of human use of plant and animal species demonstrates that vanishing and apparently insignificant species can suddenly become useful, even important. The “pescado blanco” *Chirostoma estor*, a fish which in the wild occurs in a single Mexican lake, was until recently in danger of extinction as a result of overfishing, habitat degradation, and predation and competition by introduced species¹². Now, as a result of good management and artificial propagation, the fish is being stocked in several reservoirs and dams and a 15 hectare farm is under construction¹³. Many species—for example the armadillo and the polar bear—unexpectedly have been found useful for scientific research, whether as experimental material or as the providers of clues to technical innovations. Armadillos are the only animals other than human beings known to contract leprosy. They are now proving to be invaluable aids in the search for a cure for this disease¹⁴. The recent discovery that polar bear hairs are exceptionally efficient heat absorbers has provided researchers with a clue that may help them design and produce materials for the manufacture of better cold-weather clothing and solar energy collectors¹⁵.

10. Preservation of genetic diversity is thus necessary both to secure supplies of food, fibre, and certain drugs, and to advance scientific and industrial innovation. It is also necessary to ensure that the loss of species does not impair the effective functioning of ecological processes. It is unlikely that the particular communities of plants, animals and microorganisms that make up the ecosystems associated with so many essential processes—particularly pollination and naturally occurring pest control—can readily be substituted by other communities. The genetic composition of such ecosystems may be crucial for their performance.

Threats to wild species

11. Just as many varieties of domesticated plants and animals are disappear-

ing, so too are many species of wild plants and animals. An estimated 25,000 plant species¹⁶ and more than a thousand vertebrate species and subspecies¹⁷ are threatened with extinction. These figures do not take account of the inevitable losses of small animal species—particularly invertebrates like molluscs, insects and corals—whose habitats are being destroyed. Indeed estimates that do attempt to take this factor into account suggest that from half a million to a million species will have been made extinct by the end of this century¹⁸. If these species disappeared, the loss to humanity could be irreparable. The most serious threat is habitat destruction^{16, 19}, which includes: replacement of the entire habitat by settlements, harbours 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); overextraction of water (for domestic, agricultural and industrial purposes); removal of materials (such as vegetation, gravel and stones) for timber, fuel, construction and so on; dredging and dumping; overgrazing; and erosion and siltation.

12. The two other most serious threats to species are overexploitation (see following section) and the effects of introduced exotic species. Exotic species, which may be introduced deliberately or inadvertently, can have adverse effects on native species in one or more of the following ways: competition for space or food; predation; habitat destruction or degradation; and transmission of diseases and parasites. The native species of fresh waters and of islands are particularly vulnerable to the harmful effects of introduced species. For example, introduced trout and bass are threatening many species of fishes in the USA; and introduced goats and rabbits are destroying the habitats of plants, birds and reptiles in the islands of the Pacific and Indian Ocean.

DO). 1978. Report of the Technical Consultation on Production of drugs from Medicinal Plants in Developing Countries, Lucknow, India, 13-20 March 1978. ID/222 (ID/WG.271/6). UNIDO, Vienna.

12. Rosas, Mateo. 1970. *Pescado blanco (Chirostoma estor): su fomento y cultivo en México*. Instituto nacional de investigaciones biológico pesqueras/Comisión nacional Consultiva de Pesca. México.

13. Aquaculture development and coordination programme. 1979.

Aquaculture development in Mexico: report of a review mission 1978. ADCP/MR/79/4. UNDP/FAO.

14. Storrs, Eleanor E. 1971. The nine-banded armadillo: a model for leprosy and other biomedical research. *International Journal of Leprosy*, 39: 703-714.

15. Furry funnels: are polar bears really white? *Time*, 4 December 1978.

16. Lucas, Gren, and Hugh Syngé. 1978. *The IUCN plant red data book*. IUCN, Gland.

17. IUCN. 1975. *Red Data Book* (separate, frequently supplemented or revised volumes, on fishes, amphibians and reptiles, birds, and mammals). IUCN, Gland.

18. See, for example: Myers, Norman. 1979. *The sinking ark*. Pergamon Press, Oxford.

19. Allen, Robert, and Christine Prescott-Alan. 1978. Threatened vertebrates (second draft). General Assembly Paper GA.78/10 Add.6. IUCN.

4. Sustainable utilization of species and ecos

1. The necessity of ensuring that utilization of an ecosystem or species is sustainable varies with a society's dependence on the resource in question. For a subsistence society, sustainable utilization of most, if not all, its living resources is essential. So it is for a society (whether developing or developed) with a "one crop" or "few crop" economy, depending largely on a particular living resource (for example, the fishing communities of eastern Canada). The greater the diversity and flexibility of the economy, the less the need to utilize certain resources sustainably—but by the same token the less the excuse not to. Sustainable utilization is also necessary for the rational planning and management of industries dependent on the resources concerned (for example, timber, fish). Sustainable utilization is somewhat analogous to spending the interest while keeping the capital. A society that insists that all utilization of living resources be sustainable ensures that it will benefit from those resources virtually indefinitely. Unfortunately, most utilization of aquatic animals, of the wild plants and animals of the land, of forests and of grazing lands is not sustainable.

Aquatic animals

2. On average, fish and other aquatic animals account for 6% of the total protein and 17% of the animal protein in the human diet¹. If this seems small, it should be remembered that on a world basis most (65%) protein comes from plants—chiefly cereals, beans and peas, nuts and oilseeds. Meat accounts for 16% and milk products for 9.5% of the average total protein intake¹. These averages conceal substantial differences between and within countries. Thirty-two countries get 34% or more of their animal protein from seafood, and another 11 countries consume double the world average for seafood consumption¹ (see map 5 in the map section for the main seafood consuming countries). Aquatic animals are also important for trade. There are no world figures for domestic trade, but it is clear from export values alone that trade in seafood is both substantial and growing fast. In 1978 exports of fish and fishery products reached \$10.8 thousand million, an increase of 15% over the previous year²

(see map 5 in the map section for the main seafood exporting countries).

3. Because much utilization of fisheries is not sustainable, their contribution to national diets and incomes is likely to diminish. The result of past and present overfishing is that the annual world marine catch is 15-20 million tonnes (or about 20%-24%) lower than it might otherwise have been³, and at least 25 of the world's most valuable fisheries are seriously depleted⁴. The consequences of such overexploitation can be illustrated from the northwest Atlantic, where due to overfishing in the late 1960s cod catches are still only a third of their estimated potential. The drops in cod, herring and haddock catches (all caused by overfishing) could not be compensated by increased catches of capelin and mackerel; and the total catch of the fishery as a whole has declined from 4.3 million tonnes in 1970 to 3.5 million tonnes in 1976⁴. It can no longer be assumed that depleted stocks will recover to their full potential, because: the spawning fishes and juveniles 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.

4. Overfishing is the main threat to marine living resources and a significant threat to freshwater ones. It occurs locally in all regions, but it is generally most pronounced in regions dominated by developed countries. Five of the eight regions with most stocks that are depleted are developed (northwest Atlantic, northeast Atlantic, Mediterranean, northwest Pacific, northeast Pacific). Of the remaining three, two (eastern central Atlantic and southeast Atlantic) are dominated by developed country fishing fleets: France, Japan, Poland, Spain, USSR, South Africa—with Cuba and the Republic of Korea operating the only major developing country fleets. The only developing region dominated by developing country fleets is the southeast Pacific, where most of the fishing is done by Peru and Chile⁴.

5. As well as depleting many fish and a few mollusc stocks, overfishing has almost extinguished entire species of whales, sea cows and sea turtles. Many aquatic animal groups are also under pressure because of accidental overexploitation or "incidental take". The incidental capture and killing of non-target animals in the course of hunting or fishing for other species is one of the more destructive yet neglected problems of aquatic living resource management. It is not only highly wasteful, destroying an estimated 7 million tonnes of fish every year, it also threatens the survival of several sea turtle species, notably the Kemp's ridley turtle which has been reduced almost to extinction. A million seabirds are killed accidentally in nets every year; and more cetaceans, notably dolphins and porpoises, are taken incidentally than deliberately⁵.

Wild plants and animals of the land

6. Wildlife is an important subsistence resource in developing countries and an important recreational resource in both developed and developing countries. Many wild plants and animals of the land are an important renewable resource and source of food, particularly for rural communities in developing countries. In parts of Ghana, Zaire and other countries in west and central Africa, for example, up to three-quarters of the animal protein comes from wild animals^{6,7}. The nutritional importance of wild animals and plants for large numbers of people is invariably underestimated (and often ignored), largely because many of the more frequently eaten plants and animals (for example, vetches and porcupines) seldom feature in the diets of nutritionists and are harvested in areas far from the scrutiny of statisticians. This is unfortunate, for were the true nutritional value and the use made of wild plants and animals appreciated by governments they might be more ready to encourage these resources to be managed sustainably and to take steps to retain their habitats.

7. Wild animals and plants also provide a significant, and sometimes the only, source of income for rural communities. In Canada, for example, the wild fur trade helps support 40,000 trappers, who in the 1975-1976 season

Notes and references

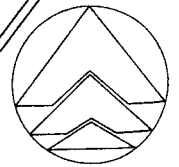
1. FAO. 1977. *Provisional food balance sheets, 1972-1974 average*. FAO, Rome.
2. The increase is partly due to inflation. Source: FAO. 1979. *Fishery commodity situation and outlook 1978/79*. Committee on Fisheries. Thirteenth Session, Rome, 8-12 October 1979. COFI/79/Inf.5.

3. Estimate derived by subtracting the current catches from major depleted stocks from the estimated potential catches. Source: FAO. 1979. *Review of the state of world fishery resources*. Committee on Fisheries. Thirteenth Session, Rome, 8-12 October 1979. COFI/79/Inf.4.

4. FAO. 1976. *Review of the state of exploitation of the resources*. Committee on Fisheries. Eleventh Sessi

- 19-26 April 1977. COFI/77/5. And: FAO. 1978. *Review of the state of world fishery resources*. Committee on Fisheries. Twelfth Session, Rome, 12-16 June 1978. COFI/78/Inf.4.

5. Allen, Robert and Christine Prescott-Allen. 1978. *Threatened vertebrates* (second draft). General Assembly Paper GA.78/10. Add. 6. IUCN.
6. Asibey, Emmanuel O. A. 1974. *Wildlife as a source of protein in Africa south of the Sahara*. *Biological Conservation*, 6:32-39.



caught \$25 million worth of pelts, mostly from beaver, muskrat, lynx, seal, mink and fox. By comparison, in the same season, farms produced \$17 million worth of furs, 99% being mink⁸. World trade in wildlife and wildlife products has become big business: in 1975 the USA alone imported more than \$1,000 million of wildlife products⁹.

8. International trade has become a threat to many species as well-organized commercial enterprises attempt to supply a vastly expanded market (mainly industrialized countries) with increasingly scarce "commodities" taken from the wild (mainly in developing countries):

hides and skins for the luxury fur and leather industry; exotic meat and fish for luxury food; a wide range of other animal and plant products for pharmaceuticals, perfumes, cosmetics, aphrodisiacs, decoration, souvenirs or investment; specimens for natural history museums;

live plants for horticulture; live animals for the pet trade, zoos and menageries, aquaria and other collections; and for the testing of new chemical products and for biomedical research.

Most of the trade is openly advertised, but a significant part of it takes place illegally, often through channels and by methods not unlike those of the drug traffic. The impact of this trade on many species and ecosystems is now serious. For example, overexploitation threatens almost 40% of all vertebrate species in danger of extinction, and is the most serious of the threats faced by reptiles⁵. Because of the difficulty of securing supplies, world trade in crocodilian hides has dropped from an estimated 10 million hides to 2 million⁹.

9. Finally, wildlife is a major resource base for recreation and tourism. Tourism, largely based on wildlife, is among Kenya's top three foreign exchange earners. In Canada 11% of the population hold hunting licences; in the USA 8% hold hunting licences and 13% hold fishing licences; and in Sweden from 12% to 18% hold fishing licences¹⁰. Many more people enjoy simply looking at wildlife: in the USA there are about 7 million birdwatchers, 4.5 million wildlife photographers, and almost 27 million nature

hikers¹¹. For a great many people, too, wildlife is of great symbolic, ritual and cultural importance, enriching their lives emotionally and spiritually.

Forests and woodlands

10. Forests and woodlands provide a rich variety of goods, useful to affluent industrial and poor rural communities alike: timber, sawnwood and panels for construction, walls, doors, shuttering and furniture; pulpwood for pulp, paper, cartons and rayon; poles, posts, mining timbers and railway track sleepers; fuelwood; fodder, fruits, game meat, honey, pharmaceuticals, fibres, resins, gums, dyes, skins, waxes and oils; beauty, amenity and recreation. 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 about \$40,000 million a year¹². 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 year¹³.

11. In developing countries the heaviest demand on forests and woodlands is for fuel and as a site for shifting cultivation. More than 1,500 million people in developing countries depend on wood for cooking and keeping warm. Their annual consumption of wood is estimated to be more than 1,000 million m³, well over 80% of developing countries' total wood use (excluding exports)¹⁴. In Africa the contribution of trees to total energy use is as high as 58%; in South-east Asia and Latin America it is 42% and 20% respectively¹⁴. The effect of such intense demand is to denude the land of wood over wide areas. Around one fishing centre in the Sahel region of Africa, where the drying of 40,000 tonnes of fish consumes 130,000 tonnes of wood every year, deforestation extends as far away as 100 km¹⁵. Fuelwood is now so scarce in the Gambia that gathering it takes 360 woman days a year per family¹⁶. Even when firewood is available for sale, it is often beyond the budgets of poor householders. In the highlands of the Republic of Korea cooking and heating can cost up to 15% of the household budget; and in the poorer parts of the Andean Sierra and the Sahel it can

be as high as 25%¹⁴. Consequently many families are forced to do without¹⁶.

Grazing lands

12. Permanent pastures (land used for 5 years or more for herbaceous forage crops, whether cultivated or wild) are the most extensive land-use type in the world—occupying 30 million km², or 23% of the earth's land surface¹⁴. Permanent pastures and other grazing land are generally in areas of low and irregular rainfall and are usually unsuitable for crops without intensive capital investment. Their productivity is generally low, ranging from 1 hectare supporting 3-5 animal units on fertile, well-managed pastures in central Europe to 50-60 hectares to support 1 animal unit in Saudi Arabia. Nonetheless, grazing lands and forage support most of the world's 3,000 million head of domesticated grazing animals, and hence most of the world's production of meat and milk¹⁴.



The reality behind a statistic: women in Mali carrying fuel. Photo: Franco Mattioli/Unasylva.

13. Unfortunately, mismanagement of grazing lands is widespread. Overstocking has severely degraded grazing lands in Africa's Sahelian and Sudanian zones. In parts of North Africa, the Mediterranean and the Near East, it is a major contributor to desertification¹⁴. In many areas farmers are moving onto land that is marginal for agriculture, thereby displacing pastoralists onto land that is marginal for livestock rearing. Overstocking together with uncontrolled grazing is also a serious problem in mountain areas, such as the Himalaya and the Andes. There, too many improperly tended animals remove both trees and grass cover—which is often very poor, both as forage and for soil protection—and erosion accelerates¹⁴.

7. de Vos, Antoon. 1977. Game as food. *Unasylva*. 29:2-12.

8. *The New Canadian Oxford Atlas*. 1977. Oxford University Press (Canada).

9. King, F. Wayne. 1978. The wildlife trade. In: Howard P. Brokaw (editor). *Wildlife in America*. Council on Environmental Quality, US Fish and Wildlife Service, Forest Service, National Oceanic and Atmospheric Administration, Washington, DC.

10. OECD. 1979. The state of the environment: an appraisal of economic conditions and trends in OECD countries. OECD. ENV/Min(79)1.

11. Allen, Durward L. 1978. The enjoyment of wildlife. In *Wildlife in America* (see ref. 9).

12. World Bank. 1978. *Forestry: sector policy paper*. World Bank, Washington, DC.

13. FAO. 1977. *FAO trade yearbook, 1976*. (Vol. 30). FAO, Rome.

14. FAO. 1978. *The state of food and agriculture 1977*. FAO, Rome.

15. FAO. 1971. *Environmental aspects of natural resources management: forestry*. Cited by: FAO. 1978. (see ref. 14).

16. FAO. 1978. *Forestry for local community development*. FAO Forestry Paper, 7.

5. Priority requirements: ecological process

1. **Reserve good cropland for crops.** In view of the scarcity of high quality arable land and the rising demand for food and other agricultural products, land that is most suitable for crops should be reserved for agriculture. This will reduce the pressure on ecologically fragile marginal lands which tend to degrade rapidly if exploited beyond their productive capacities. However, this requirement may conflict with urban, industrial, energy or transport policy. There are many examples of prime farmland drowned by dams or lost to airports, roads, factories or housing. Without careful planning and zoning, human settlements sited in farming areas are bound to encroach on farmland as they expand. Such conflict should be anticipated and where possible avoided. Since it is not possible to resite high quality cropland but it is possible to be flexible about the siting of buildings, roads and other structures, agriculture as a general rule should have precedence.

2. The requirement to reserve good cropland for crops may also conflict with other conservation needs. There are unmodified ecosystems with great agricultural potential which should be protected to preserve genetic diversity and as a control area for baseline monitoring and scientific research. Again, agriculture generally should have precedence, but *only* in the case of land with no serious limitation for agriculture, since such land is at a premium especially in developing countries. In countries where land "most suitable" for agriculture nonetheless has moderately severe limitations for agriculture, it is necessary to protect some areas as controls so that the long term effects of agricultural and other activities on such land can be assessed. Floodplains and wetlands are special cases. When drained or protected from inundation they can provide productive agricultural land. However, such conversion may deprive important fisheries of essential support and may also lead to the loss of other valued living resources. Where floodplain agriculture is practised the losses of agricultural production and of fisheries may not be compensated by production from the irrigated agriculture that generally replaces them. The social, economic and ecological costs and benefits of converting floodplains and wetlands need to be

thoroughly assessed, therefore, before conversion is permitted.

A general note on priority requirements (sections 5-7)

Sections 5-7 set out the priority requirements for achieving each of the objectives of conservation, indicate some of the likely conflicts between those requirements and also with other policy objectives, and provide broad guidance on avoiding or resolving such conflicts.

Three criteria have been adopted for deciding whether a requirement is a priority: significance; urgency; irreversibility.

Significance is determined by asking such questions as:

how important is this requirement in relation to others for achieving the objective concerned?

what proportions of the global, regional, national population depend on this requirement being met?

how important is the requirement to the people most affected?

how much of a particular resource will be conserved if the requirement is met?

Urgency is a function of the rate at which a significant problem will get worse if the requirement is not met and of the time required to meet that requirement.

Irreversibility is the key criterion: highest priority is given to significant, urgent requirements to prevent further irreversible damage to living resources—notably the extinction of species, the extinction of varieties of useful plants and animals, the loss of essential life-support systems, and severe soil degradation.

3. **Manage cropland to high, ecologically sound standards.** This requires soil and water conservation, the recycling of nutrients, and retention of the habitats of organisms beneficial to agriculture. To avoid aquatic pollution and to conserve inorganic fertilizers, crop residues and livestock wastes should, as far as possible, be returned to the land. To maintain and promote the beneficial

contribution of crop pollinators and of the natural enemies of pests to integrated pest control, the habitats necessary for the organisms concerned should as far as possible be retained. In intensive production systems where the habitats of the required organisms are too few to maintain them in adequate numbers, the organisms should be propagated artificially. Chemical fertilizers and pesticides will still be needed, but they should be used with care and should supplement rather than supplant good nutrient, soil and pest management practices.

4. Many tropical soils quickly lose their fertility. Traditional systems of shifting cultivation restored fertility by leaving the land fallow for long periods, but fertilizers are indispensable for continuous cropping. Manufactured fertilizers are beyond the means of many developing country farmers because of their high cost, low prices for farm products, shortage of credit and a lack of fertilizer supplies. Since chemical fertilizers are derived from petroleum their cost is likely to continue to rise sharply with the growing cost of oil. The estimated 113 million tonnes of plant nutrients that are potentially available to developing countries from human and livestock wastes and from crop residues should as far as possible be used to fertilize the land¹. Properly managed, organic wastes could help substantially to increase agricultural production, restore and maintain land in good condition, and reduce aquatic pollution. In many areas, even when inorganic fertilizers are readily available, they should be used only in combination with organic fertilizers. For example, the dominant kaolinitic clay soils of the humid tropics have low absorption capacity, and chemical fertilizers need to be combined with organic manures to be fully effective². The use of organic wastes as plant nutrients and soil restorers can be combined with the production of biogas (methane). This process eases the problems of storing and delivering organic wastes, reduces the loss of organic matter through decomposition, and provides gas for domestic uses.

5. If land is eroding so rapidly that it must be retired, there is seldom any alternative to the generally difficult tasks of resettling the farmers concerned else-

Notes and references

1. FAO. 1978. *The state of food and agriculture 1977*. FAO, Rome.
2. Agboola, A.A., G.O. Obigbesan and A.A.A. Fayemi. 1974. Interrelationships between organic and mineral fertilizers. Paper presented at the FAO/SIDA Expert Consultation on Organic

Materials as Fertilizers in December 1974. Cited by: Constantinesco, I. 1976. Soil conservation for developing countries. *FAO Soils Bulletin*, 30.

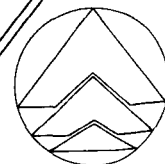
Further reading

Constantinesco, I. 1976. Soil conservation for developing countries. *FAO Soils Bulletin*, 30.

Dasmann, Raymond F., and Duncan Poore. 1979. *Ecological guidelines for balanced land use, conservation and development in high mountains*. IUCN, Gland.

FAO. 1977. Guidelines for watershed management. *FAO Conservation Guide*, 1.

es and life-support systems

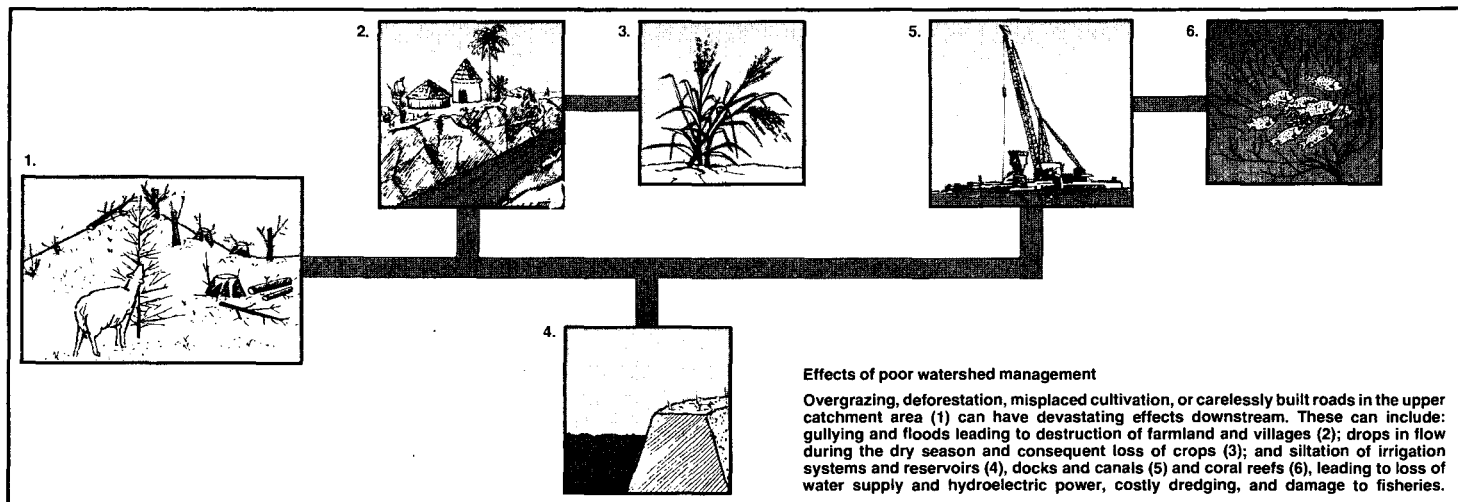


where or of absorbing them into other sectors of the economy. Situations where land retirement is the only solution can be avoided by promoting systems of production adapted to ecological conditions in which modern technology and techniques are integrated with traditional systems of resource management. This is particularly important for communities whose shifting cultivation practices have become unstable because the rising population demands more intensive production than the soil can support without considerable improvement. The techniques and inputs of sustainable permanent cropping—such as chemical fertilizers, improved seed, and soil conservation measures—are usually beyond the economic means of poor farmers. But it is possible to shorten the fallow period of shifting cultivation gradually through mixed cropping practices, the limited use of inorganic fertilizers, and recycling organic materials. It is also possible to improve the efficiency of the fallow period by replacing natural cover

er be cleared. In other areas, uses compatible with watershed protection may be permitted provided the government is able to ensure that the primary management goal is respected. For example, protective forest may be converted to a tree crop (either for timber or for some other product, such as a tea plantation), if great attention is paid to hydrological control. This demands high capital input, professional skill and great conscientiousness. If the regulatory authority feels any of these requirements is lacking, the forest should not be altered. Where watershed forests have already been severely reduced, and siltation and flooding have increased, efforts should be made to restore the ecosystem by reforestation rather than to resort to channelization or impoundment. Sometimes, however, a government will have little room for manoeuvre—as when a watershed forest is already being converted to agriculture by local communities. Reforestation and other land rehabilitation measures, matched by

management goals for coral ecosystems and active floodplains (where they are important for fisheries) should be maintenance of the fisheries concerned. Fishing at sustainable levels using non-destructive methods (not, for example, dynamite) is of course compatible with this goal, and so too are recreation and tourism at sustainable levels. An additional major goal of coral reef management will often be the preservation of genetic diversity. The management of active floodplains is likely to be complicated by many competing uses which may be as or more important than fisheries: for example, agriculture and livestock raising. However such uses need not be incompatible.

8. Control the discharge of pollutants. The discharge of pollutants and use of pesticides and other toxic substances should be controlled. Care should be taken to avoid contamination of the habitats of threatened, unique or economically important species. Special at-



with cover crops which can be used economically—such as pasture for livestock in mixed agri-pastoral systems, or tree crops in mixed agri-silvicultural systems.

6. Ensure that the principal management goal for watershed forests and pastures is protection of the watershed. This is particularly important in the upper catchment areas where rivers originate and where often rainfall is greatest. Especially fragile or critical areas, notably steep slopes with erodible soils and the source areas of major rivers should nev-

conservation-based rural development and intensification of production from better land, will then be needed.

7. Ensure that the principal management goal for estuaries, mangrove swamps and other coastal wetlands and shallows critical for fisheries is the maintenance of the processes on which the fisheries depend. Other uses of these ecosystems should not impair their capacity to provide food and critical habitat for economically and culturally important marine species. Similarly, major

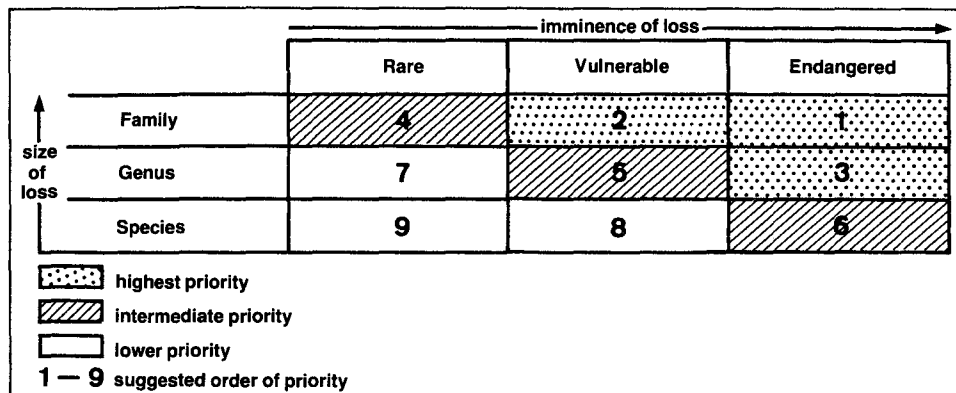
attention should be paid to substances that are highly toxic, or are released in large quantities, or persist in the environment and accumulate in living organisms. The impacts of such substances on ecosystems and species should be monitored, regularly evaluated, and reduced to levels that can be tolerated by the ecosystems and species concerned. Since the effects on ecosystems and species of the thousands of chemicals that enter the environment are largely unknown, general surveillance of the environment should be undertaken.

McEachern, John, and Edward L. Towle. 1974. *Ecological guidelines for island development*. IUCN, Gland.
 Odum, William E. 1976. *Ecological guidelines for tropical coastal development*. IUCN, Gland.
 Poore, Duncan. 1976. *Ecological guidelines for development in tropical rain forests*. IUCN, Gland.

Ray, G. Carleton. 1976. Critical marine habitats: definition, description, criteria and guidelines for identification and management. In: IUCN. *An international conference on marine parks and reserves*. Papers and proceedings of an international conference held at Tokyo, Japan, 12-14 May 1975. IUCN, Gland.

6. Priority requirements: genetic diversity

1. **Prevent the extinction of species.** Priority should be given to species that are endangered throughout their range and to species that are the sole representatives of their family or genus, according to the following formulation: the greater the potential genetic loss¹ the less imminent that loss need be to justify preventive action. The formulation is illustrated in figure A.



A. Formulation for determining priority threatened species.

2. Families and genera that are monotypic (consist of only one species) should receive priority over polytypic ones, since—theoretically—the smaller the family (or genus) the greater the gap between the nearest related family (or genus)² and therefore the more distinct that group of species is from others. Other things being equal, an endangered species should be given priority over a vulnerable one; a vulnerable over a rare one; and a rare species over one that even if it is declining is considered insufficiently threatened to qualify for one of the three categories³. Imminence of threat, however, is partly a matter 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 (families and genera).

3. Prevention of extinction requires sound planning, allocation and management of land and water uses, supported by on site (*in situ*) preservation in protected areas and off site (*ex situ*) protection such as in zoos and botanical gardens. Protected areas can preserve more wild species, subspecies and varieties than can off site protection; but to be fully effective both must be integral components of rational resource man-

agement (see figure B). Such management should include protection from threats other than habitat destruction or degradation, notably overexploitation (both deliberate and incidental) and the effects of introduced exotic species. These measures may be assisted by participation in international programmes for the prevention of species extinction⁴. Where an introduced exotic

species is having adverse effects on native species, the introduced species should be eliminated if possible. Given the extreme difficulty of eliminating introduced species, however, every effort should be made to prevent all introductions except those which, before the introduction is made, can be shown to provide economic, social and ecological benefits substantially greater than any costs, and over which adequate control can be exercised. A proposed introduction should be the subject of an environmental assessment, including a full enquiry into the likely and possible ecological effects.

4. **Preserve as many varieties as possible of crop plants, forage plants, timber trees, livestock, animals for aquaculture, microbes and other domesticated organisms and their wild relatives.** Priority should be given to those varieties that are most threatened and are most needed for national and international breeding programmes. This requires both off site and on site preservation and may be assisted by participation in international programmes for the preservation of genetic resources⁵.

5. There are three ways of preserving genetic diversity:

on site—in which the stock is pre-

served by protecting the ecosystem in which it occurs naturally;

off site, part of the organism—in which the seed, semen or other element from which the organism concerned can be reproduced is preserved;

off site, whole organism—in which a stock of individuals of the organism concerned is kept outside its natural habitat in a plantation, botanical garden, zoo, aquarium, ranch or culture collection.

Of the three, the preferred measure is on site preservation. However, this is not possible for domesticated species; and even wild species should be preserved off site as a safeguard against any failure in on site preservation.

6. Off site preservation involves the following steps: exploration of the remaining diversity of the target species; collection, giving priority to materials likely to be lost if nothing were done; preservation in storage (part of the organism) or maintenance in a plantation, culture collection, and so on (whole organism); documentation, requiring the systematic description of collected materials (especially their place of origin and their taxonomic and morphological features) and the recording, organization and retrieval of this information; evaluation of agronomic qualities (such as yield potential, cooking and nutritional qualities), biotic qualities (such as pest and disease resistance), and ecodaphic qualities (such as drought resistance, temperature tolerance, responsiveness to different soil conditions); and utilization, combining genes from various sources into improved strains or varieties.

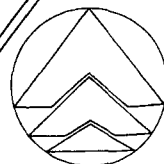
7. Special attention should be paid to the preservation of genetic material for forestry and for aquaculture. If forestry and fisheries are to make as complete a transition to domestication as crop production has done, the genetic base of the two industries must be preserved. This requires accelerated programmes of off site preservation in protected areas (see section 17), coupled with inventories of existing protected areas, documenting, evaluating and utilizing the materials within them. Microorganisms are a special case, because of their vast numbers, great resilience and ability to adapt to environmental change, and

Notes and references

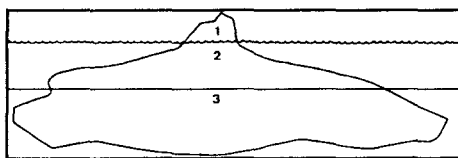
1. The size of potential genetic loss is related to the taxonomic hierarchy because, ideally at least, different positions in this hierarchy reflect greater or lesser degrees of genetic difference, and hence difference in such variables as morphology, behaviour, physiology, chemistry and ecology.

2. 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 a consistent means of classification.

3. The definitions of the three categories of threat are: 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



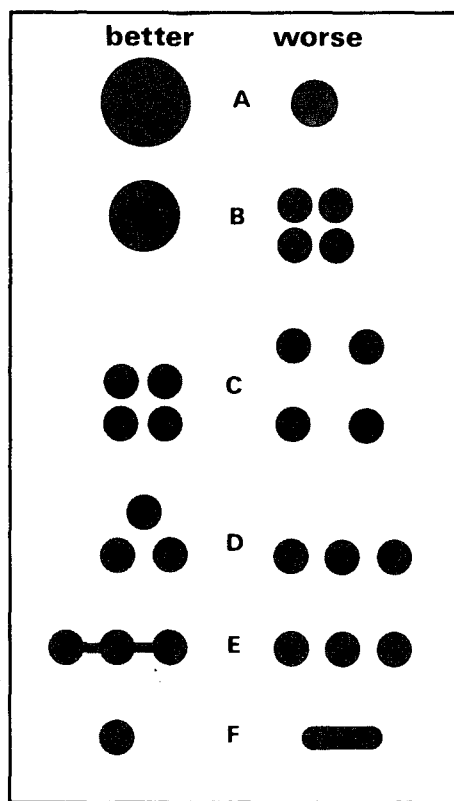
their very rapid rates of reproduction. Preservation of microbial strains is necessary not so much to prevent extinction but to aid utilization. Isolating from nature a strain with a particular desired property is tedious. Once isolated, therefore, such strains need to be maintained in culture collections.



B. The genetic resource management iceberg. Off site protection (1) can preserve only a small proportion—the “tip of the iceberg”—of genetic diversity. Protected areas or on site protection (2) can preserve much more—but still very little compared with the potential of the sound planning, allocation and management of land and water uses (3). In practice, all three sets of measures are necessary.

8. **Ensure that on site preservation programmes protect: the wild relatives of economically valuable and other useful plants and animals and their habitats; the habitats of threatened and unique species; unique ecosystems; and representative samples of ecosystem types.** Inventories of existing protected areas should be made to determine what threatened, unique and other important species may already be protected adequately. Each country should identify the habitats of such species, and ensure their preservation in protected areas as a matter of priority. Whenever feasible, each protected area should safeguard all the critical habitats (the feeding, breeding, nursery and resting areas) of the species concerned. Where this is clearly not feasible—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. Other uses of protected areas may be permitted provided they are compatible with protection of the habitats concerned. 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.

9. Unique ecosystems should be protected as a matter of priority. Only those uses compatible with their preservation should be permitted. In addition, a complete range of ecosystems representative of the different types 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 these purposes. 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 the provinces in which few of the ecosystem types are represented in protected areas (see map 3 in the map section). Attention should be paid to the adequacy of protection of each area. Global biogeographical classifications⁶ should be used together with more detailed national or regional classifications derived



C. Suggested geometric principles, derived from island biogeographic studies, for the design of nature reserves. In each of the six cases labelled A to F, species extinction rates will be lower for the reserve design on the left than for the reserve design on the right. Source: 7.

from them. Special attention should be paid to marine ecosystems which are particularly poorly represented in protected areas. Priority should be given to ecosystems that are particularly rich in species or have no adequately protected areas.

10. **Determine the size, distribution and management of protected areas on the basis of the needs of the ecosystems and the plant and animal communities they are intended to protect.** Generally, a large reserve is better than a small one. Preferable size and distribution patterns are shown in the left-hand column of figure C.

11. Areas chosen for protection should have as much internal variation as possible. The necessary measures should be taken to safeguard the support systems of protected 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. 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. Security for protected areas must be clearly provided for in national legislation. Legal provisions by which the status of a protected area may be declassified only following a careful review by the legislature are required to give a degree of permanency to such status.

12. **Coordinate national protected area programmes with international ones,** particularly the biosphere reserves programme of Unesco's Man and the Biosphere Project 8 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. One of the major objectives of the international network of biosphere reserves is to conserve for present and future use the diversity and integrity of plant and animal communities within natural ecosystems, and to safeguard the genetic diversity of species on which their continuing evolution depends. Countries are urged to contribute to this network by designating sites representative of the biogeographical provinces or other major ecosystem groups found in their territory.

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).

Resources (whose secretariat is at: Crop Ecology and Genetic Resources Unit, Plant Production and Protection Division, FAO, via delle Terme di Caracalla, 00100 Rome). FAO's forest genetic resources programme, and FAO's animal genetic resources programme.

tion of coastal and marine environments. IUCN, Gland; and: Udvardy, Miklos D. 1975. *A classification of the biogeographical provinces of the world*. IUCN, Gland.

4. Notably those of IUCN's Survival Service Commission.

5. Notably those of the International Board for Plant Genetic

6. For example: Ray, G. Carleton. 1975. *A preliminary classifica-*

7. Diamond, Jared M. 1975. The island dilemma: lessons of modern biogeographic studies for the design of natural reserves. *Biological Conservation*, 7:129-146.

7. Priority requirements: sustainable utilization

1. **Determine the productive capacities of exploited species and ecosystems and ensure that utilization does not exceed those capacities.** Species and ecosystems should not be so heavily exploited that they decline to levels or conditions from which they cannot easily recover. Such levels and conditions vary depending—in the case of a species—not only on the biology of the species but also on the quality of the ecosystems that support it. If the ecosystems are being altered by human activities (such as exploitation of associated species, pollution, incidental take) then the level from which the population is unable to recover could be substantially higher than the level presumed from study of the species alone.

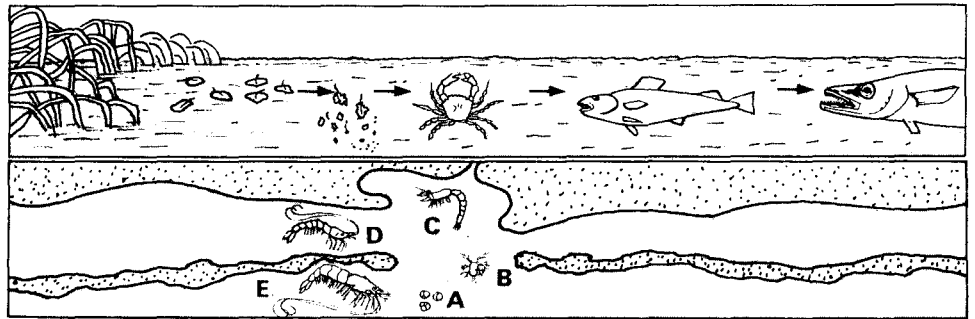
2. **Adopt conservative management objectives for the utilization of species and ecosystems.** Management objectives should take adequate account of important relationships between the exploited species or ecosystems and the species and ecosystems with which they are linked. They should allow for error, ignorance and uncertainty. When a single species (rather than a group of species or an ecosystem) is exploited, and the species is at the top of the food chain, stocks should be kept at or above the level at which they provide the greatest net annual increment. If the species is not at the top of the food chain, stocks should not be depleted to a level such that the population's productivity, or that of the populations of other species dependent on it, is significantly reduced. When a group of species is exploited, catch levels should be fixed so that the productivity of the species with the slowest recovery time (often predators at the top of the food chain) is not significantly reduced.

3. **Ensure that access to a resource does not exceed the resource's capacity to sustain exploitation.** Measures to regulate utilization can include: restricting the total take, the number of persons, vessels or other units allowed to participate in exploitation and the times and places of exploitation; and prohibiting or restricting the use of certain methods and equipment. Of these, a combination of quotas and restrictions on access to the resource is usually essential. Quotas alone are highly vulnerable to excessive increase in response to political pressure by vested interests, if those interests are

allowed to grow to a size which the species or ecosystem cannot support.

4. **Reduce excessive yields to sustainable levels.** Industries, communities and countries that are overexploiting living resources on which they depend would be better off in the medium and long term if they voluntarily reduced yields to levels that are sustainable. In this way they could adjust to realistic levels of consumption and trade and avoid unexpected drops in yield, instead of being surprised by them when they occurred. The economic distress that involuntary, unscheduled cuts may cause is avoidable

6. **Equip subsistence communities to utilize resources sustainably.** Where a community depending for subsistence wholly or partly on living resources effectively regulates utilization so that it is sustainable, its regulatory measures should be supported. Where there is no regulation or where traditional regulatory measures have been rendered obsolete (by, for example, growth in the community's population, the advent of more destructive methods of exploitation or of commercial exploitation), the community should be helped to devise and enforce a set of effective regulations. Should overexploitation have become



Coastal wetlands and marine fisheries. Coastal wetlands provide nutrients and nurseries for many important fisheries. The top illustration shows the flow of nutrients (highly simplified) from a mangrove swamp to offshore fisheries. The illustration below shows aspects of the life history of several commercially valuable species of shrimp: the eggs (A) are laid offshore; the larvae (B) move inshore; juveniles (C) and adolescents (D) then shelter and feed in mangrove swamps, estuaries and lagoons; before returning to sea as adults (E). Source: 1.

by the planned reduction of utilization to sustainable levels.

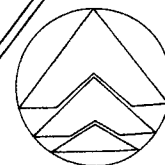
5. **Reduce incidental take as much as possible.** This can be done through the establishment of protected areas or of closed seasons (prohibiting fishing in at least one self-sustaining area or at times when the affected species is particularly vulnerable, in the case of sea turtles, for example, during both the nesting and the hibernating periods); or through modifications of fishing gear or methods. Many of the commercially exploited marine and freshwater fish communities, however, occur in species complexes. It is impossible to exploit such complexes intensively without disturbing the species ratios and threatening at least some species with severe depletion. In such cases, reserves should be established in which commercial exploitation is prohibited. Subsistence exploitation may still be compatible with species protection, depending on fishing intensity and methods.

so acute that very severe regulation is needed (including an outright ban of months or years on exploitation) efforts should be made to gain the understanding of the community and its participation in enforcement; and an alternative food, fuel or fibre should be offered. Commercial utilization and trade should be prohibited before the subsistence take is reduced.

7. **Maintain the habitats of resource species.** Where agriculture can supply more food, more economically and on a sustainable basis, than can the utilization of wildlife, the conversion of wildlife habitat to farmland is rational. Often, however, the habitats of wildlife are destroyed for short-lived agricultural and other developments with a net loss in welfare for the local communities. Especially in areas with severe limitations for agriculture, the value of wildlife should be carefully assessed and the returns on habitat management for more intensive, yet sustainable, wildlife utilization com-

Notes and references

1. Clark, John. 1977. *Coastal ecosystem management: a technical manual for the conservation of coastal zone resources*. John Wiley & Sons, New York.



pared with the returns on the destruction of habitat to enable some other use. This requirement is most important in tropical forest areas, where rural communities often depend on wildlife for a high proportion of their protein as well as for other goods. It is also important to maintain the freshwater, coastal and marine systems that supply food and shelter to aquatic animals, especially those that support fisheries. This requires control of human impacts in river basins (including the upper catchment area) as well as in the coastal zone and at sea.

8. Regulate international trade in wild plants and animals. The most promising way of doing this is through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES now has a worldwide membership of more than 50 states. To make its system of export/import controls fully effective other trading nations should join (see also section 15). Those that have become members should take all necessary administrative measures to enforce the Convention at the national level. Species threatened by overexploitation that are not yet covered by CITES should be, if they are likely to enter international trade.

9. Allocate timber concessions with care and manage them to high standards. The siting and management of timber operations should be such that essential processes (especially watershed protection) are maintained. Unnecessary damage to trees that are not utilized should be avoided. Felling programmes should be matched by planting programmes, as far as possible using the species exploited, so that what is taken out is replaced. Most timber companies are capable of taking all the necessary measures and should undertake to do so. It is advisable that governments equip themselves to inspect and control the conduct of logging operations before they take place. Similarly, if there is any likelihood that spontaneous settlement will occur in a forest area once it has been opened up for logging, governments should ensure they have a practicable plan for assisting settlers to develop the land sustainably, for providing firewood plantations or alternative fuels, for securing essential processes and for protecting important genetic resources.

10. Limit firewood consumption to sustainable levels. Where vegetation is being destroyed by cutting and stripping for fuel immediate measures should be taken to:

establish plantations for firewood, 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;

restore the vegetation;

provide stoves that utilize firewood more efficiently;

provide alternative sources of energy (such as biogas).

11. Regulate the stocking of grazing lands so that the long term productivity of plants and animals can be maintained.

The carrying capacity of grazing lands is determined by the annual production of plant growth in excess of what is required by the plants for their metabolism, health and vigour. Much of this excess production can be cropped by wild animals or livestock without damage to the vegetation. Careless or excessive use, however, impairs the plants' capacity to grow and reproduce. This in turn leads to sometimes permanent destruction of the vegetation or to a decline in the proportion of plants palatable to livestock or both. In arid regions, where rainfall and plant growth are erratic, stocking den-

sities must be more conservative than where annual productivity is more consistent. In such regions nomadism and transhumance (the seasonal movement of livestock) are often the most sustainable strategies and, if still practised, should not be abandoned without good reason.

12. Utilize indigenous wild herbivores, alone or in combination with livestock, where the use of domestic stock alone will degrade the land. Native wild herbivores are adapted to make use of natural grazing land without deterioration. In extreme conditions they may be the only species that can do so; and elsewhere they can provide an economically, ecologically and socially desirable alternative or supplement to domestic livestock. The potential of wild herbivores for subsistence and commercial use should be given priority attention. Two main actions are needed:

assessment of social and economic potential of game ranching, looking at commercial utilization, subsistence utilization, and domestication options, as well as at market potential for products;

assessment of current and potential ecological impacts of trypanosomiasis control in Africa, including consideration of new developments in control techniques.

Summary of priority requirements (sections 5-7)

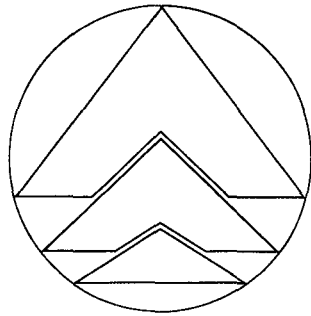
The requirements for achieving the objectives of conservation can be summarized as follows:

the maintenance of essential ecological processes and life-support systems primarily requires rational planning and allocation of uses and high quality management of those uses;

the preservation of genetic diversity primarily requires the timely collection of genetic material and its protection in banks, plantations, and so on, in the case of off site preservation; and ecosystem protection in the case of on site preservation;

the sustainable utilization of ecosystems and species requires knowledge of the productive capacities of those resources and measures to ensure that utilization does not exceed those capacities.

Both the last two objectives require the achievement of the first. Also, the genetic composition of exploited ecosystems and of the life-support systems of certain processes (for example, pollination and naturally occurring pest control) is probably important for their long term maintenance—so the preservation of genetic diversity may be required for the achievement of aspects of the first and third objectives.



Priorities
for
national action

8. A framework for national and subnational

1. To ensure that the objectives of conservation are achieved as expeditiously as possible and to speed the integration of conservation with development, it is recommended that every country review the extent to which it is achieving conservation, concentrating on the priority requirements and on the main obstacles to them. The review should form the basis of a strategy to overcome the obstacles and meet the requirements. The strategy may be at the national level or at one or more subnational levels (provincial, state, municipal), or there may be separate (but, it is hoped, complementary) strategies at several levels, depending on the division of government responsibilities for the planning and management of land and water uses.

2. The purpose of these strategies is to focus attention on the relevant priority requirements for conservation, to stimulate appropriate action, to raise public consciousness, and to overcome any apathy or resistance there might be to taking the action needed. National and subnational strategies are intended to provide a means of focussing and coordinating the efforts of government agencies, together with nongovernmental conservation organizations, to implement the World Conservation Strategy within countries.

3. Although the planning and execution of conservation strategies is primarily the responsibility of governments, nongovernmental organizations should be fully involved to ensure that all the resources available to conservation are deployed coherently and to the full and thus to accelerate the achievement of conservation objectives. Indeed in some countries nongovernmental organizations may wish to take the initiative.

Steps in a strategy

4. It is recommended that each strategy proceed as follows:

a. review development objectives in relation to each of the conservation objectives; and describe the extent to which each of the conservation objectives is or is not being achieved—with particular emphasis on the priority requirements—and the status of and threats to the living resources concerned;

b. identify the main obstacles to achieving the objectives and to removing or reducing the threats; and identify any special opportunities there may be for overcoming such obstacles;

c. identify the measures required to achieve the objectives and to remove or reduce the threats to the living resources concerned;

d. determine priority ecosystems and species, the requirements for their conservation, and how these requirements could be met—providing planning and management guidelines with respect to such ecosystems and species;

e. analyze present and planned activities, comparing them with c and d, and identify gaps that need filling and activities that need strengthening and supporting;

f. estimate the financial and other resources, and the legislative and administrative measures, required to carry out the actions identified in e, and identify the organizations that should be carrying them out;

g. propose ways of supplying the financial and other resources required and of authorizing and equipping the appropriate organizations to carry out the required actions, identifying the bodies that possess the necessary resources and powers of decision;

h. set out a plan of action to bring about the required political decisions and allocations of financial and other resources;

i. set out a programme of required measures, including administrative and legislative measures, for the maintenance of essential ecological processes and life-support systems, the preservation of genetic diversity, and the sustainable utilization of ecosystems and species, noting particularly those priority requirements not yet met.

5. Irrespective of its purpose, every strategy has certain functions:

to determine the priority requirements for achieving the objectives;

to identify the obstacles to meeting the requirements;

to propose the most cost-effective ways of overcoming those obstacles.

When resources are limited and time is running out, it is essential to be sure that the available resources and effort are applied to the highest priority requirements first, and only afterwards to lesser priorities. Conservation is in exactly this situation, yet conservation organizations have seldom attempted to agree priorities. This is an understandable failing, since there are so many urgent problems to be dealt with, people have different perceptions of priorities, and there have been few universally accepted criteria for what is important. However, it is precisely because there are so many requirements—most of them urgent, and many of them alone demanding all or more of the resources at conservation's disposal—that priorities must be determined and followed. The recommended criteria for determining priorities have been given in section 5: significance, urgency, and irreversibility.

Strategic principles

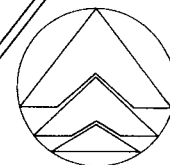
6. In addition, strategies to meet the priority requirements for the achievement of conservation objectives should take into account these four strategic principles:

Integrate. The separation of conservation from development together with narrow sectoral approaches to living resource management are at the root of current living resource problems. Many of the priority requirements demand a cross-sectoral, interdisciplinary approach.

Retain options. Our understanding of the dynamics and capacities of many ecosystems, particularly tropical ones, is often insufficient to assure rational use allocation or high quality management. Scientific knowledge of the productive capacities of most tropical ecosystems, as well as of their ability to absorb pollution and other impacts, is generally inadequate. Land and water use, therefore, should be located and managed so that as many options as possible are retained.

Mix cure and prevention. Current problems are often so severe that it is tempting to concentrate on them alone; impending problems could be

al conservation strategies



still worse, however, unless early action is taken to prevent them. Strategies for action should therefore be a judicious combination of cure and prevention—of tackling current problems and of equipping peoples and governments to anticipate and avoid future problems.

Focus on causes as well as symptoms. When conservation puts itself into the position of dealing only with symptoms it appears unduly negative and obstructive. A late attempt to modify a development, whether successful or not, comes across as anti-development (hence anti-people) even though this is seldom the case. The result is either an outright defeat or, because it generates hostility and misconceptions, a victory that has within it the seeds of future defeats. Furthermore, by the time symptoms appear it is often too late to do anything about them, because many ecologically unsound projects are the results of already fixed policies and part of complex and expensive plans the proponents of which are understandably reluctant to unravel (see figure A). This said, it is also important not to neglect the symptoms. Although interventions are more effective the earlier in the development process they are made, in practice they are needed at all stages. In addition it is sometimes not possible to deal with causes, since many of them are complex and beyond the capabilities of conservation organizations to influence. Action directed at causes generally yields results only over the long term. Symptoms may be so acute that action must be taken immediately.

Main obstacles

7. The most effective way of preventing irreversible damage to living resources is through overcoming the main obstacles to achieving the requirements of conservation. These are discussed further in sections 9-14 and are (number in parentheses refers to the appropriate section):

- absence of conservation at the policy making level (9);
- lack of environmental planning and of rational use allocation (10);

poor legislation and organization (11);

lack of training and of basic information (12);

lack of support for conservation (13);

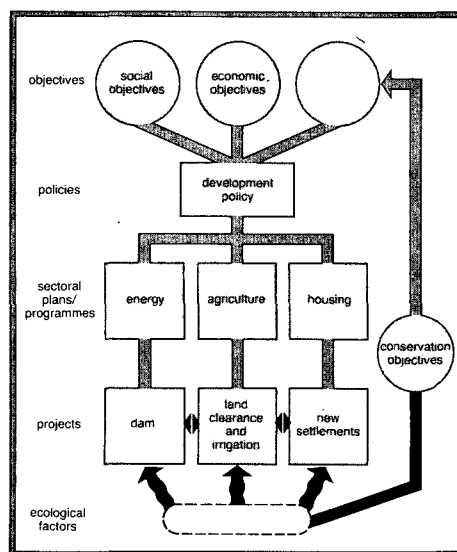
lack of conservation-based rural development (14);

8. The importance of these obstacles cannot be overemphasized. Few if any countries take adequate account of ecological considerations when making policy or planning development. Few allocate or regulate uses of their living resources so as to ensure that they are ecologically appropriate and sustainable. Many lack either the financial or technical resources, or the political will, or adequate legislative, institutional or public support for conservation (or any combination of these) to carry out fully the conservation measures required. The result is that the number of urgent con-

servation problems proliferates. A species may be rescued, an area protected, or an environmental impact reduced, but such successes will be temporary or will be overshadowed by much greater failures unless every country's capacity to conserve is greatly improved and permanently strengthened.

9. Special attention needs to be paid to the ability of government agencies to deal not only with current problems but also with potential ones since they may often be beyond the capacities, mandates and experience of the bodies responsible. The mandates, capacities and procedures of the government agencies and other bodies responsible for development and conservation should be analyzed to assess the extent to which ecological considerations are incorporated into the development process and whether conservation laws and organizations are strong enough to ensure that the required conservation measures are carried out. The analysis should focus on the factors which help or hinder meeting the priority requirements for conservation. Then, particular strengths and weaknesses should be brought to the attention of the public, legislators and the policy making level of government, together with specific proposals for filling any serious gaps in planning, decision making and management.

10. Although most conservation progress is to be won within government bodies and other organizations concerned with development and conservation, the measure of such progress will be improvements on the ground and in the water: more secure and widespread maintenance of essential ecological processes and life-support systems, preservation of genetic diversity, and sustainable utilization of species and ecosystems. The status of key species and ecosystems needs therefore to be closely monitored, and strategies adjusted in the light of any improvement, deterioration or absence of change. Strategies are means, not ends in themselves. But the process by which they are forwarded is itself usually of value, as it can inform and educate, develop participation in and support for decision making, change attitudes, and help to foster a conservation ethic.



A. The need to integrate conservation with development: an example.

Attempts to minimize the ecological harm (and hence the social and economic harm) of a dam rarely succeed if ecological factors are considered only at the project stage. By then the dam is a key component of other major projects (like land clearance, irrigation, and new settlements), themselves essential parts of several sectoral programmes. These programmes are often expressions of social and economic policies from which ecological considerations are entirely absent. Unless ecological considerations influence the development process along with social and economic considerations – and unless there is also an explicit policy to achieve conservation objectives – the prospects of avoiding ecological harm and of making the best use of living resources are dim. Thus when ecological factors are considered only at the point shown at the bottom of this picture their influence is usually limited or negative. Instead, for development policy to be ecologically as well as economically and socially sound, the empty circle at the top of the picture needs filling as shown.

9. Policy making and the integration of con

1. Development that is inflexible and little influenced by ecological considerations is unlikely to make the best use of available resources. By causing ecological damage it is likely also to cause economic and social damage. The most effective way society can avoid such problems is to integrate every stage of the conservation and development processes, from the initial setting of policies to their eventual implementation and operation. This section proposes that this be done through the adoption of anticipatory environmental policies and of a cross-sectoral conservation policy.

The problems

2. To achieve the objectives of conservation governments need to dispel any notion that conservation is a limited, independent sector largely concerned with wildlife or with soil; and that ecological factors are impediments to development which in some cases may safely be overlooked and in others may be considered simply on a project by project basis, not as a matter of policy. Unfortunately these beliefs are implicit in the way policies generally are made and operated. Such a narrow interpretation of conservation has at least three important consequences. First, the ecological effects of a particular development policy are seldom anticipated and hence the policy is not adjusted in time to avoid expensive mistakes. Second, those sectors directly responsible for living resources (notably agriculture, forestry, fisheries, and wildlife) are often impelled to concentrate on production at the expense of maintenance, with the result that otherwise renewable resources are dissipated and the resource-base of future utilization is undermined. Third, because of a previous lack of conservation, the policies of other sectors may be frustrated. The energy sector's forecasts of the life of a hydroelectric power station, for example, may be completely falsified by poor watershed management.

3. Even when ecological factors are considered, it is seldom at the critical policy making stage when the basic pattern of development is often fixed. Consideration at the project stage, although often necessary, is no substitute for proper consideration at the policy stage—for by the project stage economic and social requirements will normally have been set so firmly that only mini-

mal or cosmetic adjustments are possible. If, however, a bold decision is taken to uphold conservation and arrest an ecologically unsound scheme, it may be at the cost of major confrontations with vested interests, social conflict and a waste of human and financial resources.

4. The bias of living resource agencies towards production rather than maintenance is often a response to competition within governments for scarce financial resources, and the consequent pressure on all sectors to show results that can be directly related to economic performance. Under the circumstances, agencies with the dual task of regulating and promoting resource development are likely to find it difficult to balance the two requirements. This difficulty is exacerbated by the lack of a well-defined, generally agreed measure of conservation performance. Economic performance can be measured in terms of gross domestic product; employment in terms of the percentage of the labour force employed; agricultural, forestry and fisheries production in terms of crop, timber and fish yields and the income derived from them. While such easily measured production may be won at the cost of diminishing the resource base, and although conservation can bring real benefits by securing that resource base, the costs and benefits are not readily related¹.

5. Not all governments have explicit conservation policies; and the policies that exist tend to be narrowly sectoral. Consequently opportunities for the joint planning and realization of the conservation requirements of agriculture, forestry, fisheries, wildlife, and so on, may be overlooked. Indeed, the policies of the sectors concerned may conflict. Similarly, the interests of sectors not usually thought of as deriving benefits from living resource conservation may be neglected. Health is an example: conservation can advance the achievement of health objectives not only by ensuring a healthier environment—for example through the maintenance of clean air and water—but also by preserving genetic resources needed for the production of medicines. Policy makers in the health and industrial sectors need to be satisfied that the genetic resource-base of domestic pharmaceutical manufacture can be secured.

Action required

Anticipatory environmental policies

6. Policies that attempt to anticipate significant economic, social and ecological events rather than simply react to them are becoming increasingly necessary for the achievement of several important policy goals: the satisfaction of basic needs, such as food, clothing, sanitation and shelter; the development of a high quality environment; the optimum use of available resources; and the control of pollution and other forms of environmental degradation. Achievement of these goals requires not merely policies that promote recycling, reduce the production, marketing and disposal of products dangerous to the environment, and make economic use of residual wastes. It also requires policies that actively promote human health and well-being, the protection of the living resource base, and the adoption of resource-conserving settlement patterns, transport systems and modes of trade and consumption. Such anticipatory environmental policies² involve actions to ensure that conservation and other environmental requirements are taken fully into account at the earliest possible stage of any major decision likely to affect the environment. They are not intended to replace reactive or curative policies; simply to reinforce them.

7. Adoption of anticipatory environmental policies may pose difficulties. By their nature they require action before damage to the environment has created a demand for it. They also incur the costs of planning, research and preventive action and sometimes of delays or modifications to particular developments. Yet in general these difficulties are heavily outweighed by the advantages. Anticipatory policies enable societies to avoid the high and usually recurring costs of environmental mistakes—mistakes that can frustrate development objectives, waste resources, and impair the very capacity for development. Measures to prevent environmental degradation taken at the design stage of products and development projects alike are normally more cost-effective than measures taken once a problem has arisen when they may require redesign, restructuring, the banning of a product or the abandonment of a partially completed project. Anticipatory measures are often not only beneficial to society—

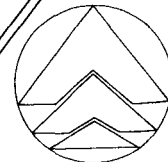
Notes and references

1. This lack of an acceptable measure of conservation performance is probably one of the main reasons why central agencies, despite

their broad powers to protect the environment, sometimes may find it difficult to persuade, for example, the forestry department to utilize forests sustainably or the agricultural department to regulate the use of agricultural chemicals.

2. OECD (Organization for Economic Cooperation and Development). 1979. Discussion paper on anticipatory environmental policies. OECD. ENV/Min(79)4.

conservation and development



avoiding high external economic, social and health costs—but also profitable to the enterprise concerned. To avoid delays environmental factors should be taken into account when a project is first formulated and subsequently in parallel with project development.

Cross-sectoral conservation policy

8. It is recommended that governments adopt a cross-sectoral conservation policy to:

- commit themselves to achieving the objectives of conservation;
- define the conservation requirements and responsibilities of the various government sectors in relation to those objectives;
- indicate a timetable or target dates for meeting the requirements and carrying out the responsibilities.

9. Depending on the constitutional structure of the country concerned and on the distribution of planning responsibility and powers of decision over resource use, conservation policies may be required at more than one level of government. The roles and responsibilities of each level of government should be made clear and effectively related to those of the levels of government above and below it. In addition, national policies should include specific guidance on the giving and receipt of aid and technical assistance, as well as on international agreements relevant to conservation. Several agencies may be responsible for preparing national positions with respect to international organizations and these should be harmonized: consistent positions should be developed for the governing bodies of United Nations and other intergovernmental organizations on which the government sits.

10. As a matter of policy, agencies responsible for living resources should be as much concerned with maintenance as with production. The need for food, fuel and fibre and other natural products, as well as for foreign exchange, may tempt living resource managers into encouraging or permitting overexploitation of the resources in question or the undermining of the ecological processes and genetic diversity on which they depend. This is highly likely if policy goals are concerned mainly with production and only incidentally with maintenance. The

policies of agencies responsible for living resources should also require that each sector's conservation responsibilities are discharged with the conservation needs of other sectors in mind.

11. For example, the policy goals of forestry should include:

- to increase yields of goods and services from forests, such as wood products, water, wildlife, recreation, education and research, provided that
 - such yields are sustainable, and that
 - the resource base (essential ecological processes and genetic diversity) is secured;
- to manage the forest estate on the principle of stewardship, with commitment to maintain in perpetuity ecological processes, watersheds, soils and genetic diversity;
- to assist other sectors (such as agriculture, rural development) to make efficient, ecologically sound use of forest goods and services.

12. Similarly, the policy goals of agriculture should include:

- to supply food and other agricultural products in sufficient quantity and of acceptable quality, consistent with
 - the maintenance of the resource base, particularly soils, water, the habitats of organisms necessary for pollination and integrated pest control, and the genetic diversity of crops, domestic animals and their wild relatives;
- to maintain and enhance the quality and attractiveness of rural areas;
- to recycle nutrients, ensuring that crop residues and livestock wastes are returned to the land, controlling pollution, and assisting where practicable in the recycling of urban wastes.

Integrating conservation and development

13. Conservation can be integrated with development through the instruments used to implement anticipatory environmental policies, through the establishment of coordinating mechanisms to ensure that a cross-sectoral conservation policy is applied, and by the adoption of national accounting systems to include measures of conservation per-

formance. Instruments for the implementation of anticipatory environmental policies include: taxes, charges and financial incentives (to encourage choices compatible with the maintenance of a healthy environment); technology assessment; design and product regulation; environmental planning; and procedures for rational use allocation. The latter two instruments are regarded as crucial for the integration of conservation with development and are the subject of the next section. Coordinating mechanisms are considered in section 11.

14. Although the deficiencies of gross domestic product as a measure of national welfare are generally acknowledged, national accounting systems and many policy decisions are still couched in strictly monetary terms. Consequently the costs of conservation and of measures to enhance human welfare in other ways may often appear to outweigh the benefits, since the costs are entirely calculable in money while the benefits are not³. In order for governments to take adequate account of the costs of destroying, degrading or depleting living resources and of the benefits of conserving them, it is recommended that non-monetary indicators of conservation performance be selected for inclusion in national accounting systems. This is easier said than done, but suitable indicators might be:

- extent of most suitable agricultural land that has not been lost to non-agricultural activities or degraded by poor farming practices;
- silt load of rivers as a proportion of the size of the river basin (an index of erosion);
- proportion of unique species and of unique varieties of domesticated plants and animals and their wild relatives whose survival is secured;
- proportion of ecosystems and species that are being utilized sustainably.

This list is illustrative; but all are possible measures of the state of important national assets (good soil, secure catchment areas, and genetic and other renewable resources). Nevertheless, further consideration needs to be given to the selection of ecological indicators to ensure that their measurement and monitoring is practicable and that in combination they provide a reasonable reflection of conservation performance.

3. Although many conservation measures can be justified at least in part in monetary terms, they often bring other benefits relating to values—utilitarian, intrinsic, aesthetic, symbolic, ethical—that cannot be so quantified, if at all.

10. Environmental planning and rational use

1. This section proposes the integration of conservation and development through environmental planning and rational use allocation—specifically through ecosystem evaluations, environmental assessments, and a procedure for allocating uses on the basis of such evaluations and assessments.

The problems

2. Environmental planning and the allocation of uses on the basis of investigation and planning are essential if optimum use is to be made of available resources. Without them, the prospects of sustainable development will be impaired, sometimes permanently. For example, dams may be sited so that they drown and destroy highly productive land or important areas of genetic diversity. Pollution emission standards may be set so low that acid rain reduces the productivity of forests and fresh waters, or pathogens and heavy metals contaminate food (such as shellfish) rendering it unmarketable or, if it is marketed, directly damaging human health. Industries and settlements may be built on the best farmland or on land “reclaimed” from coastal wetlands, thus reducing the productivity of agriculture and fisheries.

Action required

Ecosystem evaluation

3. Every use of the land, fresh waters and the sea has its own site requirements, as well as different degrees of compatibility with other uses. Equally, every ecosystem has its own characteristics which make it more or less suitable for a particular use. The function of ecosystem evaluation is to assess the characteristics of ecosystems and match them to the most appropriate uses. Ecosystem evaluation is carried out in many guises under many names: land evaluation, land capability assessment, land suitability assessment, and so on. Sometimes a rather limited range of potential uses is considered: for example, agriculture, livestock production, wildlife production, forestry. Often only land areas are assessed. Here the term ecosystem evaluation (EE) is preferred to land evaluation for two reasons: to make clear that marine and freshwater areas should be evaluated as well as land areas; and that the areas being evaluated are dynamic ecosystems with linkages of varying strength to other ecosystems. A particular use of an ecosystem may be incompatible not only with other pos-

sible uses of that ecosystem but also with certain uses of other ecosystems. For example, a coastal wetland might be assessed for its suitability as a nature reserve for birds (if protected), as a harbour (if dredged) or as farmland (if filled in); but the wetland might also be an important nursery area and source of nutrients for a valuable fishery elsewhere, with which only the first use would be compatible. Any evaluation would be incomplete if such interrelationships were not taken into account.

4. Certain principles are fundamental to the approach and methods employed in ecosystem evaluation¹:

- a. *Ecosystem suitability is assessed and classified with respect to specified kinds of use.* The concept of ecosystem suitability is meaningful only in terms of specific kinds of use, each with its own requirements. The characteristics of each ecosystem are compared with the requirements for each use.
- b. *Evaluation requires a comparison of the outputs obtained and the inputs needed for each different use.* An ecosystem that is not being used may still be useful: for example, an unexploited tract of forest will moderate the local climate, regulate water flow, and so on. Conversely, even non-consumptive uses may require the expenditure of resources other than those present in the ecosystem concerned: a nature reserve preserving genetic diversity requires measures for its protection; a recreation area requires roads and other infrastructure. Suitability for each use is assessed by comparing the required inputs with the outputs obtained. The input-output comparison should be quantified only to the extent that quantification does not distort what is being compared and does not attempt to compare what is not comparable. While inputs (such as labour, money, fertilizers) can normally be expressed without distortion in money terms, many outputs cannot. Quantification, therefore, should be done with great care and any assumptions should be stated explicitly.
- c. *An interdisciplinary approach is required.* The evaluation process requires the integration of contributions from ecology and related natural sciences, the technologies of

ecosystem use (agriculture, forestry, fisheries, and so on), economics and sociology.

- d. *Evaluation is in terms relevant to the physical, economic and social context of the area concerned.* Such factors as the regional climate, standards of living of the population, availability and cost of labour, need for employment, the local or export markets, systems of land tenure that are socially and politically acceptable, and availability of capital, form the context within which evaluation takes place. Assumptions about such factors should be stated explicitly.
 - e. *Suitability refers to use on a sustained basis.* The possibility of degradation and depletion should be taken into account when assessing suitability. For example, there might be forms of use highly profitable in the short run but likely to lead to soil erosion, progressive pasture degradation, or adverse changes in river regimes downstream. Most changes of use, other than protection, involve a loss of equilibrium in the ecosystem concerned, sometimes a radical loss, as when a forest is converted to farmland; but there should be a strong probability that the new equilibrium will be long-lasting. Essentially, this requires that the resultant impacts on ecological processes (such as soil regeneration), genetic diversity and the productivity of ecosystems and species should be assessed as accurately as possible.
 - f. *Evaluation involves comparison.* Comparison can be between an existing use and a potential use, between potential uses, or between a potential consumptive use and a non-consumptive use. Comparison can also be broad or fine: for example, between agriculture and forestry, between two or more farming systems, or between one crop and another.
5. Ecosystem evaluations should be prepared as a matter of priority and be used to influence all policies from the earliest possible date. An interim EE may be necessary in countries in the middle of a multi-year planning cycle—for example, a five year or ten year economic or development plan. The preparation of EEs should be based on available knowledge and should not be deferred because of lack of knowledge.

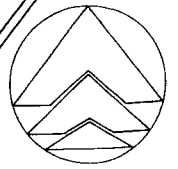
Notes and references

1. These principles are adapted from: FAO. 1978. A framework for land evaluation. *FAO Soils Bulletin*, 32.

2. This definition is adapted from: Munn, R. E. (editor). 1975. Environmental impact assessment: principles and procedures. *SCOPE Report*, 5.

3. OECD. 1979. How to include environmental concerns in the decision-making process. OECD. ENV/Min(79)6.

allocation



The degree of detail and area of coverage possible will vary greatly from country to country. It is preferable to achieve coverage at the expense of detail rather than the other way round. In due course the evaluation can be completed in greater detail area by area. Areas scheduled or proposed for development should be given priority.

Assessment of environmental effects

6. An assessment of environmental effects is an activity designed to identify, predict, interpret and communicate information about the effects of an action—be it a policy, programme, legislative proposal, engineering project or other operation with environmental implications—on human health and wellbeing, including the wellbeing of ecosystems on which human survival depends². Environmental assessments are a means of ensuring that ecological and social information is included with physical and economic information as the basis for making decisions.

7. Environmental assessments should be an integral part of the planning of all major actions (both public and private) requiring government authorization. They should be carried out at the same time as engineering, economic and socio-political assessments; and should examine alternatives to the proposed action. Major actions should be interpreted as including tax and fiscal policies, as well as other policies which by influencing investment can have a significant impact on the environment. It should be the responsibility of government agencies to assure the quality of environmental assessments. If an assessment is prepared by the proponent of an action—whether a private party or a government agency—there should be a mechanism for independent review. To avoid delays environmental assessments should be prepared as early as possible in decision making, from the preliminary study stage onwards, examining acceptable actions in increasing detail as their formulation proceeds. Experience suggests that the costs of environmental assessments vary considerably but need not be high: in the USA, for example, they range from 0.05% to 2% of the value of the project assessed³.

A procedure for allocating uses

8. To make optimum use of available living resources, it is recommended that land and water uses be allocated as fol-

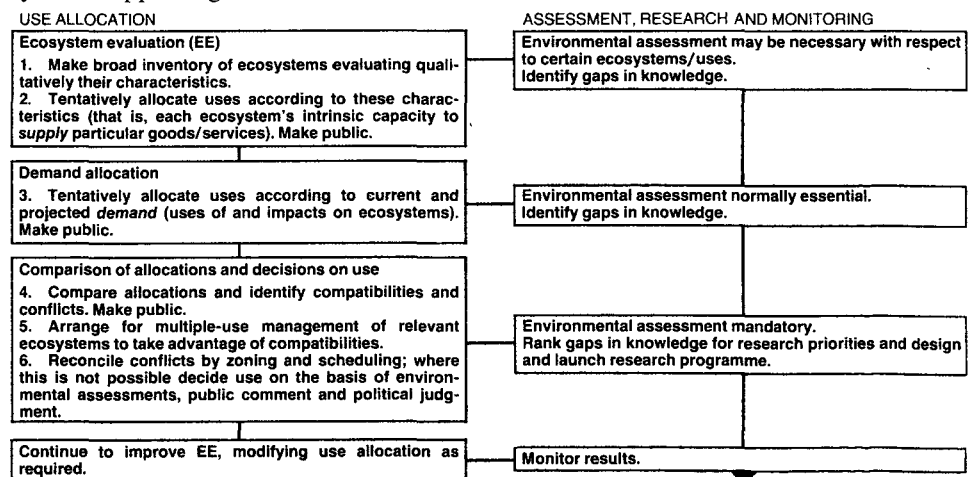
lows. First, uses should be allocated tentatively according to their compatibility with each ecosystem's capacity to supply particular goods and services (or fulfil particular functions). The ecosystem evaluation, elaborated as necessary by environmental assessments, will achieve this first step. Next, uses should be allocated tentatively a second time on the basis of current and projected patterns of demand on each ecosystem as reflected by current use. Here, demand equals present uses of, plus impacts on, ecosystems. Current uses of each ecosystem should be identified, and projected increases and changes in demand indicated. At this stage demand for non-living resources (construction materials, minerals, oil, gas, space for roads and buildings) as well as energy consumption and settlement patterns should be included.

9. Finally, the results of allocation by supply characteristics (the EE) and of allocation by demand characteristics should be compared to reveal conflicts and compatibilities between the two. In the case of compatible uses care should be taken to define precisely what those uses are and to ensure that management systems are available to manage the areas concerned on a multiple-use basis. Management requirements to ensure retention of those characteristics of the ecosystem that permit multiple-use should be noted. Conflicts should be reconciled where possible by zoning and scheduling. Where this is not possible their resolution will be a matter of political judgement. However, uses that depend on unique or irreplaceable ecosystem characteristics should have priority over other uses. For example, an ecosystem supporting a critical habitat of

an endangered species should as far as possible be managed to protect that habitat.

10. The allocation procedure outlined is an integrating mechanism. It enables policy makers to confront simultaneously ecological, social and economic criteria and therefore to make informed choices before resources are irrevocably committed. It can suggest those development opportunities likely to be both productive and sustainable, and show where trade-offs between one policy and another may be expected to be large or small. If all policies were adjusted at this point, many resource conflicts could be minimized, and others resolved without social or economic disruption.

11. Use allocations, together with ecosystem evaluations, environmental assessments, and other supporting data and opinions, should be made available to the public so that the political process is properly informed. The public should be given adequate time and opportunity to consider relevant information and to influence decisions. Research needs should be identified concurrently with the preparation of ecosystem evaluations and use allocations. Use allocations should be evolutionary in nature, being modified from time to time in the light of events, new knowledge, and changes in perceived needs, aspirations and values. The results of policies, ecosystem evaluations, use allocations, and of other actions and decisions—whether or not they are directly concerned with conservation—should be monitored and regularly evaluated. *The assumptions behind all such actions and decisions should be stated explicitly so that they can be tested.*



The relationship between the allocation of land and water uses and assessment, research and monitoring.

11. Improving the capacity to manage: legisla

1. In addition to the integration of conservation and development, sound living resource management requires effective legislation, organization, training and information. This section covers the first two needs; training and information are covered in the next section. It is recognized that governments differ greatly in their constitution, organization and responsibilities. These two sections, therefore, present only general principles for adaptation by governments according to their needs.

The problems

2. The development of conservation law, like that of environmental law in general, until recently has been somewhat piecemeal and haphazard—in response to sectoral needs and, sometimes, to emergencies. Consequently, legislation concerning living resources in many countries is marred by gaps, duplication and even conflicts. A still more common and especially serious problem, however, is the failure to implement laws and regulations whatever their quality. Sometimes lack of implementation is due to the law being so stringent that people must flout it to survive. Generally, however, it is because the law implies a governmental commitment and infrastructure or a degree of public understanding and support that simply do not exist. Legislation may, for example, authorize the sale of pesticides only upon a written affidavit that the pesticide has been tested—yet the facilities for testing may be inadequate¹. Often budgets are entirely inadequate for enforcement, penalties are weak, and jurisdictional conflicts between agencies or between central government and local government prevent the law from being implemented.

3. Two common failings of organization are a lack of coordination among agencies responsible for living resources, and mandates that charge the same agency with both the exploitation and the protection of a resource. Living resources are commonly the responsibility of several different agencies: for example, agriculture, forestry, fisheries, wildlife, rural development, water. The consequences of such fragmentation vary. On the one hand, conservation arguments may be diluted and positions

weakened—especially if the views of conservation units are not reflected in the official positions of the larger administrations of which they are part. On the other hand, the consequences may be positive: the presence of a conservation administration within a number of different government departments means that conservation arguments and positions may be brought to bear in many more policy areas than they would be if lumped in a single department. This is more likely to be the case if the mandates of each department specify conservation. It is therefore not essential to combine these and closely related agencies such as public health in departments of environment and natural resources, but it is necessary to provide a coordinating mechanism for living resource agencies in order to bridge gaps and reduce conflicts and duplication. Similarly, while the combination of use and protection of a resource is perfectly rational, the mandates of agencies charged with the two duties should specify conservation, making it clear that unsustainable exploitation of the resource concerned would be a breach of the mandate.

4. The need for cross-sectoral coordination is particularly important in the cases of soil conservation and the conservation of marine living resources. Few developing countries have the organizational capacity to check the rapidly increasing loss of land and water resources by erosion and to prevent further loss through effective soil and water conservation measures². Still fewer countries (whether developing or developed) are able to manage efficiently their use of the sea. Like the land, the sea is an area of multiple use. It is used for food production, transport, mining and quarrying, oil production, recreation and waste disposal. Unlike the land, however, very little attempt is made to manage for multiple use. Such regulatory bodies as exist are generally concerned with a single resource, such as fish. As a result, the seas and their living resources are increasingly being overexploited and degraded.

5. The capacity to manage living resource use can also be weakened by the division of conservation responsibilities among different levels of government—normally central (or national),

provincial (or state) and local (or municipal). Since ecosystems and species seldom observe institutional or political boundaries it is most important that there be close coordination among these levels. It is also most important that the jurisdictions of the different levels of government be clearly defined. Conservation opportunities can be missed and problems left unresolved when disputes over which government is responsible for what cannot be settled.

6. Another widespread problem, especially in developing countries, is the lack of skilled personnel. Often this is due to inadequate training facilities (see next section); but low salaries (in comparison with the private sector) and poor administrative organization are also significant factors. As an example of this last, the few trained foresters available may be located only in national and provincial capitals. In Thailand, because field staff are paid less than headquarters staff, and because of the hardship of life in the field, more than half the trained foresters work in the capital¹.

Action required Legislation

7. Each country should review and consolidate its legislation concerning living resources to ensure that it provides sufficiently for conservation. Each country should also review—and if necessary strengthen—its capacity to implement its conservation legislation, both existing and required. Ideally, a commitment to conserve the country's living resources should be incorporated in the constitution or other appropriate legal instrument. The commitment should lay down the obligation of the state to conserve living resources and the systems of which they are part, the rights of citizens to a stable and diversified environment, and the corresponding obligations of citizens to such an environment.

8. There should be specific legislation aimed at achieving the objectives of conservation by providing for both the sustainable utilization and the protection of living resources and of their support systems. Comprehensive conservation legislation should provide for the planning of land and water uses and should regulate both direct impacts on the resource, such as exploitation and habitat removal, and

Notes and references

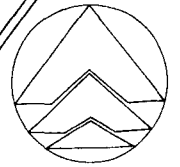
1. US Agency for International Development. 1979. *Environmental and natural resource management in developing countries: a report to Congress*. Volume 1: Report. USAID, Department of State, Washington, DC.

2. FAO. 1977. Soil conservation and management in developing countries: report of an expert consultation held in Rome 22-26 November 1976. *FAO Soils Bulletin*, 33.

3. These recommendations are based on those of the working group of the expert consultation cited in ref. 2; and on: Gil, N.

1977. Development of soil and water services in developing countries—specific requirements and possibilities for assistance. In *FAO Soils Bulletin*, 33.

ation and organization



indirect ones, such as pollution or introduction of exotic species. In addition, it should include requirements to undertake ecosystem evaluations, environmental assessments, and like mechanisms to ensure the incorporation of ecological considerations into policy making. The law should also provide for the participation of citizens in the elaboration of policies, for the provision of sufficient information for participation to be effective, and for legal recourse to implement these rights. In addition there is a need to revise traditional concepts of the law of remedy, which currently envisage compensation only for economic loss, narrowly defined, and do not provide for indirect or long term damage to individuals and communities through the depletion of species or the destruction or degradation of ecosystems.

9. Special attention should be paid to the enforcement of conservation law. Enforcement is a multidisciplinary activity that should begin with the design of legislation. It is necessary but not sufficient to provide adequately trained and funded personnel to implement and police the law. It is also important to make sure in advance that the law is ecologically, economically and socially feasible. Public education programmes may be required both before and after the law comes into force to help the public understand and support it. If the law imposes undue hardship on a particular segment of society, then measures to relieve that hardship may be needed. The effects and the effectiveness of the law should be monitored so that, if necessary, the law or its enforcement can be improved.

Organization

10. Governments should review the status, organization and funding of agencies with responsibilities for living resources. They should take the necessary steps—including changes in legislation—to ensure that conservation policies are implemented and that the agencies concerned have the resources and the staff to carry out promptly and fully ecosystem evaluations, environmental assessments and any other measure required for the conservation of living resources.

11. The following principles should form the basis of organization within government to achieve conservation:

- a. the different agencies with responsibilities for living resources should have clear mandates and such mandates should specifically include conservation;
- b. there should be a permanent mechanism for joint consultation on and coordination of both the formulation and the implementation of policies;
- c. such a mechanism can be achieved by giving new authority to existing agencies or by establishing new units in existing agencies; by setting up comprehensive agencies responsible for all living resources; or by setting up cabinet-level units to ensure that all sectors concerned carry out their conservation responsibilities;
- d. each agency should be required by statute to disclose and explain its positions to the public;
- e. policies and decisions should be implemented; sufficient financial and other resources should be provided to make this possible.

12. The more limited the availability of trained planners and managers the more important it is to avoid dispersing them among agencies with narrow mandates and conflicting aims. To encourage recruitment at the technical level it may be necessary to provide professional recognition to technicians. Where disparities between private sector and public sector salaries increase the shortage of trained personnel, public sector salaries should be increased. Similarly, the salaries of field personnel should be at least as high as those of headquarters staff—indeed they may need to be higher to compensate for poor conditions.

13. Because soil and water conservation involves environmental planning and many kinds of land use (for example, agriculture, livestock raising, forestry, mining, road building) a special organization is needed to promote and coordinate conservation measures. It is therefore recommended that a soil and water conservation body be established at the policy making level. If no related organization exists, a high level technical unit should be set up in association with the policy making body to initiate and

coordinate operations. If soil or water management services already exist within some agencies, they should be brought into a single unit, combining: aspects of land use and of soil and farm management relevant to conservation, erosion control, soil conservation, land consolidation, range management, irrigation and drainage, flood control, surface water storage, groundwater resources, and so on. It is recommended that the unit include a section responsible for comprehensive watershed planning. Since a full-scale unit, as outlined here, would initially be beyond the reach of many countries, it would be sensible to form a small comprehensive watershed planning service as a first step. This service could start off with relatively small projects covering a few lesser watersheds, allowing it to acquire expertise and accumulate greater responsibilities over a period of time³.

14. New organizations are needed—or mechanisms need to be established to coordinate existing organizations—so that marine living resources can be managed comprehensively rather than along sectoral lines. The basic unit of management should be the ecosystem. There should be close cooperation among the organization or organizations responsible for the living resources of one ecosystem and those responsible for ecosystems linked to that ecosystem by significant exchanges of nutrients or movements of species. There should also be close cooperation between marine management bodies and the authorities responsible for contiguous areas of the land, since impacts on freshwater systems and on coastal habitats greatly affect marine living resources. Coordination should be especially close between organizations responsible for fixing catch levels, closed seasons and other fisheries regulations and those charged with ensuring the integrity of the habitats on which the marine living resources depend. Great care should be taken to ensure that coastal wetlands, shallows and other critical marine habitats are properly protected from pollution and other forms of inappropriate modification. Full account should be taken of the effects of changes in ecosystems on the species utilized and of changes in catch levels on ecosystems.

12. Improving the capacity to manage: train

The problems

1. A major constraint on the implementation of conservation measures is a lack of trained personnel. In many countries the lack of environmental lawyers, for example, means that out-of-date laws are not revised or another country's legislation is duplicated without being adapted to local conditions¹. There is often an acute need for people trained in living resource management, such as foresters, and watershed managers. Indonesia, for example, currently has only 400 foresters, or one forester per 3000 km² of forest (or fewer than one per timber concession)². The list of scientists and professionals needed by developing countries is long: ecologists, geologists, hydrologists, public health engineers, environmental economists, environmental planners, and so on. Even where professional staff are available there is an acute shortage of technicians: scientists, for example, may find themselves having to maintain their own equipment³. Sometimes the shortage of technicians is exacerbated by the shortage of professionals, because successful trainee technicians may decide to continue their education so that they can achieve the higher status and salaries of the professions³.

2. Many countries also lack adequate information. Generally this is because the countries' data gathering capabilities are weak, but even when they are satisfactory information flow is hampered by poor data retrieval and distribution systems. As a result of such deficiencies countries lack the information base necessary for rational resource planning and management: for example, the extent of forest cover and the rate of its removal; aquatic pollution levels and assimilative capacities; and species inventories for protected areas. Comprehensive air and water monitoring systems are so expensive and sophisticated that only developed countries can afford them³; but not enough is known about the dynamics of tropical ecosystems to develop less expensive but equally reliable systems using indicator species. The level of applied research on ecosystems and their modification needs to be stepped up considerably if policy makers are to be given better advice on such

matters as the extent to which coastal wetlands can be modified, the pollution absorption capacities of fresh waters, and the most favorable cropping patterns for integrated pest control.

3. Although a great deal is known about many species and ecosystems, what we know about the biosphere is less than what we do not know. The dynamics of many important ecosystems and the relationships among ecosystems are also poorly known. It is therefore seldom possible to predict accurately the effects of human actions on a great many ecosystems—at least not in a way that might be useful to a policy maker—without special and often lengthy research. The same generalization applies to determining sustainable yields from multi-species fisheries. Such lack of knowledge often causes difficulties between policy makers and resource managers on the one hand and the ecologists and other scientists that advise them on the other. The former expect a clarity and precision of advice that is premature (and, if attempted, may well make the advice wrong); the latter cannot avoid stressing the real and important uncertainties that exist.

4. Governments and resource users are scarcely ever in a position to defer action pending the outcome of a protracted research programme. Yet action based on inadequate knowledge carries a grave risk that it will fail or be unnecessarily destructive. Unacceptable consequences of lack of knowledge are best avoided (as far as possible) by good planning and management, so that development activities can be so located and conducted that risk is reduced. At the same time management needs to be more research-oriented and research more management-oriented so that the most urgently required knowledge is generated most quickly.

Action required

Training

5. Each country should review the capacities of its universities and other centres of higher education to train professionals and technicians in the expertise and skills necessary for planning and managing the use of living resources. National and regional training facilities

should be strengthened as appropriate. Training is required at three levels: professional; technician; user.

6. At the professional level there is a need both for specialists (individuals able to make detailed studies, surveys, and designs for specific practices) and for generalists (individuals with a broad grasp of the theory and practice of conservation—either within a sector or cross-sectorally—and with an overall understanding of the various disciplines involved). Appropriate university or college courses are required to meet either need. The interdisciplinary courses required for the training of generalists may well have to involve several faculties—as indeed will the training of some specialists, such as soil conservationists, where the subject demands knowledge of a number of disciplines (such as, in the case of soil conservation for example, agriculture; range management, forestry, civil engineering, hydrology, ecology). Research components of university courses should be relevant to the student's own country and preferably should be carried out there. Universities providing courses for foreign students should make every effort to provide for this requirement.



Trainees at the Garoua College of Wildlife Management, Cameroon. Photo: Andrew Allo/Parks.

7. At the technician level there is an acute need for people trained to operate in the field as agricultural and fisheries extension officers, wildlife and protected area managers, soil conservation workers, foresters, and so on. This need is probably most effectively met by a com-

Notes and references

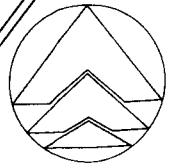
1. Allott, Anthony N. 1970. *New essays in African law*. Butterworths, London. Cited by USAID 1979 (see ref. 3).
2. Myers, Norman. 1979. *The sinking ark*. Pergamon Press, Oxford.

3. US Agency for International Development. 1979. *Environmental and natural resource management in developing countries: a report to Congress*. Volume 1: Report. USAID, Department of State, Washington, DC.

4. For this suggestion, see: Holt, S.J. 1977. Whale management

policy. In: International Whaling Commission. *Twenty-seventh report of the Commission*. IWC, Cambridge.

5. For discussions of experimental management, also called active adaptive management, see: Walters, Carl J., and Ray Hilborn. 1978. Ecological optimization and adaptive management. *An-*



combination of institutional and in-service training. Institutional (post-secondary school) training both enables the student to enhance his or her basic educational skills (where necessary) and provides recognition of status through the conferral of diplomas. In-service training enables the student to acquire rapidly essential practical experience. To help countries build up cadres of trained personnel, overseas organizations operating in developing countries should include counterpart training in every project.

8. Finally at the user level, farmers, pastoralists, fishermen, loggers, plantation operators and other land and water users need to be trained in production methods that are both sustainable and more productive in the long term than present practice. This requires that extension services be staffed with sufficient numbers of extension workers to maintain effective contact with land/water users and of specialists to provide extension workers with adequate technical support. To be successful, extension services must take great pains to explain to land/water users the need, purpose and expected results of any measures they recommend. Demonstration, normally involving the more responsive members of the community, will be most important for convincing the community at large of the value of such measures.

Research

9. 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. Too often the need for additional study is put forward as an excuse for not taking conservation action. By contrast, development projects are too often initiated without sufficient study of their potential impacts. Environmental assessment of development projects and other actions may reveal the need for research. Whether such actions should be deferred pending the outcome of the required research will depend on the circumstances of each case. Prior relevant research can reduce the necessity for such hard choices.

10. Governments should place living resource research high in their national

scientific and research programmes. They should establish national councils to encourage universities and other bodies to increase and coordinate their living resource research activities and to relate research to conservation action on the ground. Research programmes should cover three broad overlapping areas:

inventory—this includes research on the distribution of ecosystems and species in each country;

functional—this includes research on ecosystem dynamics and relationships, the effects of human activities on ecological processes and vice versa, baseline monitoring, and other basic ecosystem, species and population studies;

management-oriented—this includes research into standards, techniques and technologies that will improve the planning and management of living resource use.

11. Inventories and functional studies provide essential information for ecosystem evaluations, for decisions on the optimum distribution and management objectives for protected areas, for decisions on where particular conservation measures are most needed, and for many other aspects of planning and management. Important studies falling under these headings include: field studies, including mapping; of the location, extent and severity of erosion; mapping of the relationships between the distribution of important, rare or threatened species, ecosystems and their support systems, and of actually or potentially damaging human activities; research on those social and institutional factors contributing to living resource problems, contributing to the solution of such problems, or acting as obstacles to solutions.

12. Although such studies are not so directly management-oriented as are, for example, investigations of the productive capacity of a fishery so that a catch level can be set, or of the assimilative capacity of a river so that a pollution standard can be fixed, they make a substantial contribution to management effectiveness. Indeed management in the broadest sense can be regarded as in-

cluding assessment, research and monitoring. Accordingly managers should be concerned as much with generating new knowledge to improve management of the resources for which they are responsible as they are with implementing management decisions made in response to current knowledge. Often this will mean increased emphasis on experimental management, for example by deliberately overexploiting one stock and underexploiting another to test whether otherwise untestable assumptions about the state of the exploited population are valid⁴. Experimental management is likely to be the most rapid and reliable, and frequently the only way of determining what production systems (whether of agriculture, livestock production, forestry, fisheries, or combinations of these) are both highly productive and sustainable. A non-experimental, passive approach to management, by contrast, may lead to the adoption of systems that are either unnecessarily conservative (with the desire for sustainability leading to a loss of output) or recklessly exploitative (with the desire for output leading to collapse of the resource)⁵.

International research

13. Much research necessary for the management of living resources can be conducted most cost-effectively either by international organizations or by national organizations working within internationally coordinated research programmes. The latter are particularly useful, not only for the study of large-scale phenomena such as climate and biogeochemical cycles but also as a means of avoiding unnecessary duplication of research effort. Examples of such programmes include Unesco's Man and the Biosphere (MAB) Programme and the work of the Scientific Committee on Problems of the Environment (SCOPE) of the International Council of Scientific Unions (ICSU). MAB provides a valuable opportunity for an integrated research programme into ecosystems and ecological processes, using the world-wide network of biosphere reserves, to provide a strategic ecological information base. SCOPE provides, amongst other things, an international research agenda concerning essential ecological processes.

13. Building support for conservation: parti

1. Ultimately the behaviour of entire societies towards the biosphere must be transformed if the achievement of conservation objectives is to be assured. A new ethic, embracing plants and animals as well as people, is required for human societies to live in harmony with the natural world on which they depend for survival and wellbeing. The long term task of environmental education is to foster or reinforce attitudes and behaviour compatible with this new ethic.

The problems

2. Lack of awareness of the benefits of conservation and of its relevance to everyday concerns prevents policy makers, development practitioners and the general public from seeing the urgent need to achieve conservation objectives. Ultimately, ecosystems and species are being destroyed because people do not see that it is in their interests not to destroy them. The benefits from natural ecosystems and their component plants and animals are regarded by all but a few as trivial and dispensable compared with the benefits from those activities that entail their destruction or degradation. Until people understand *why* they should safeguard ecosystems and species they will not do so.

3. There are two distinct problems:

Public participation in conservation/development decisions is seldom adequate. Consequently the decisions may not reflect sufficiently the experience and wishes of the people affected, and the benefits of the programme or project may be fewer than expected.

Although there has been progress, there is insufficient environmental education. Informal education programmes, directed at the adult public, are haphazard; and formal programmes, directed at schoolchildren and students, are still too few and inadequate. Relatively little can be achieved and few achievements will last while the contribution of conservation objectives to development and the requirements of achieving those objectives remain poorly communicated. Despite the enormous growth of conservation literature, there are few information materials designed

to persuade people of the contribution of conservation to development or the relevance of conservation to the concerns of, say, business people, trade unionists or health officials. There is a wealth of emotional appeals directed at affluent audiences and of didactic explanations of how ecosystems work. But the cases for the maintenance of ecological life-support systems and for the preservation of genetic diversity are too often made anecdotally and without sufficient documentation to convince the sceptical. Furthermore, they have not been documented fully enough or described with sufficient precision to provide guidance to policy makers on what ecological processes and genetic resources are indispensable and should be secured as a matter of priority.

Action required Public participation

4. Local community involvement and consultation and other forms of public participation in planning, decision making and management are valuable means of testing and integrating economic, social and ecological objectives. They also provide a safeguard against poorly considered decisions and an indispensable means of educating both the public in the importance and problems of conservation, and policy makers, planners and managers in the concerns of the public. Participation tends to build public confidence and improve the public's understanding of management objectives. It provides additional data for planners and policy makers. Public participation is particularly important in rural development, for without the active involvement of the people—including identification by them of the problems that most need tackling and how to deal with them—little can be achieved (see box for a list of the advantages of public participation in rural areas).

5. The extent of public involvement in the development planning process depends on both the attitude of the government and the interest of the community. Ideally, however, public participation should be at all stages of the development process from policy making to project formulation and review.

At whatever stage it is involved, the public should be given time and information sufficient for it to influence decisions.

Benefits of public participation in rural areas

More information is acquired about local needs, problems, capabilities and experience; effective planning and implementation require specific information of the sort only local people can provide efficiently.

Better plans can be made that are more realistic about what is possible, what will be done, and what suits actual conditions best.

To the extent that local people are involved in decision making and have had some voice in what is to be done with local resources, they may contribute labour and funds, as well as land and materials.

Implementation will be smoother and quicker once understanding and assent have been generated through participation—as people usually cooperate more willingly in decisions in which they have participated.

Talent for management and administration can be developed in the rural sector to complement that of the government.

Integration of activities and services will be more effective and complete.

Maintenance of investments in roads, canals, terraces, buildings and other facilities is usually better where the local people have been consulted and involved in their creation.

Political support will be greater where the facilities and services created under government auspices are those identified by rural people as more important and valuable.

The judgment of the people affected by development programmes is essential for the evaluation of such programmes.

Source: 1.

Environmental education campaigns and programmes

6. If the users of living resources (farmers, fishermen, foresters, industries based on living resources, recreational

Notes and references

1. Adapted from: World Conference on Agrarian Reform and Rural Development, 1979. *Review and analysis of agrarian reform and rural development in the developing countries since the mid 1960s*. WCARRD/INF3. FAO, Rome.

Participation and education



users, and so on) are unaware of the need to conserve the resources they are using, an education campaign should be prepared for them; the same goes for other groups that may have an impact on living resources, even if they do not use them so directly, if they are unaware of the need to manage their activities in ways that are as compatible as possible with conservation. If, however, government does not recognize the need to meet the conservation requirements concerned, special efforts will be needed to direct information on the importance of such requirements to the appropriate legislators and decision makers.

7. Advantage should be taken of circumstances when pro-conservation decisions are evidently the most profitable within the time-frame of concern of legislators and decision makers, namely:

- when the leaders are personally convinced that conservation policies are the right course to pursue;

- when the electorate is so convinced and makes it clear that it will vote for those policies;

- when influential groups within the country are educated in and committed to conservation policies;

- when pro-conservation decisions are an effective way of achieving other policy objectives.

8. Organizers of education programmes should determine the main target groups of such programmes, define precise programme objectives, and select the media and techniques that are most effective with the target groups. Results, together with the techniques and materials used, should be regularly evaluated against the stated objectives. The most important target groups are:

- legislators and administrators;

- development practitioners, industry and commerce, and trade unions;

- professional bodies and special interest groups;

- communities most affected by conservation projects;

- schoolchildren and students.

9. Education programmes directed at any of the first three groups require clear, succinct information materials showing the contribution of conserva-

tion to the achievement of the policies and goals that most concern the target audience. There is a particular need for well documented accounts of the extent and manner in which societies at different stages of development depend on the achievement of each of the three objectives of conservation. Also needed are collections of case histories of successful conservation and sustainable development projects.

10. Whenever possible, education programmes should be included in all conservation and resource-use projects in order to improve local understanding and support for conservation and to enhance the projects' prospects of lasting success. These programmes should supplement programmes to train and equip local communities in improved resource-use practices. Existing agricultural and other extension services should be used to promote conservation; and literacy programmes should include conservation material.

11. School curricula should include environmental education both as an intrinsic part of other subjects (so that conservation attitudes can influence all activities) and as a separate subject (so that ecology can be taught more formally and its concepts more readily grasped). Inexpensive teaching materials (textbooks, audio-visual aids, posters, pamphlets, and so on) should be prepared. The materials should explain ecological concepts and the objectives of conservation, using local examples wherever possible. The effectiveness of teaching materials should be regularly evaluated. Environmental education should also be an important part of the out-of-school activities of children. Wildlife clubs should be encouraged; and environmental education included in the activities of youth groups.

12. As well as focussing on special interest groups, the several mass media (radio, television, newspapers and periodicals) should be fully used to reach the general public. Advantage should be taken of those occasions when the public comes into contact with plants and animals—in national parks and other protected areas, in zoos and botanical gardens, and in natural history museums—to explain conservation ob-

jectives and their contribution to human survival and wellbeing. In addition, special areas should be set aside for training, demonstration and education in ecology and conservation (for use by schools, universities and the general public). Such conservation education areas, besides serving their essential educational function, could also help take pressure off reserves protecting particularly fragile or unique ecosystems. Public concern for popular animals (such as whales) should be used to foster better understanding of the ecosystems of which those animals are part, and of how people both affect those ecosystems and benefit from them.

13. Certain living resource issues need much greater public exposure. As a matter of priority, an intensive public education campaign, explaining the effects of introduced species, should be directed at the pet trade and consumers, recreational hunting and fishing groups, governmental agricultural, wildlife and fisheries administrations, and at other bodies responsible either for allowing or for promoting introductions. Also understanding of and support for sustainable exploitation should be built up among both users and consumers of living resources; this is especially necessary with respect to those resources that are exploited commercially.

14. The need for environmental education is continuous because each new generation needs to learn for itself the importance of conservation. As such, individual campaigns and programmes should not be regarded as ends in themselves but as part of a long term, iterative process. It should also be recognized that any educational campaign is in competition for public attention with many others, including advertising campaigns. To win and retain as much of this attention as possible, it is essential for conservation to be seen as central to human interests and aspirations. At the same time, people—from heads of state to the members of rural communities—will most readily be brought to demand conservation if they themselves recognize the contribution of conservation to the achievement of their needs, as perceived by them, and the solution of their problems, as perceived by them.

14. Conservation-based rural development

1. Probably the most serious conservation problem faced by developing countries is the lack of rural development. In their struggle for food and fuel growing numbers of desperately poor people find themselves with little choice but to strip large areas of vegetation until the soil itself is washed or blown away. Often the rural communities responsible for this destruction do not need to be told it is a mistake: they are made acutely aware of it by an increasing lack of food, fuel, and other necessities. What such communities need is to be equipped to win their livelihoods in sustainable ways. This section recommends means of helping rural communities to conserve, as the essential basis of the development they so sorely need.

The problems

2. More than 2,000 million people (about half the world's population) live in the rural areas of developing countries, and despite urban migration this number is expected to grow to almost 2,900 million by the end of the century¹. Most rural people live by farming, fishing and forestry or closely related activities. Many are extremely poor, some 1,200 million people being classified by the United Nations as "seriously poor" (of whom almost 800 million are "destitute")² with 500 million suffering from malnutrition³. In their effort to satisfy their needs for food and fuel, the rural poor strip the land of trees and shrubs for firewood, clear steep and unstable slopes for cultivation, overgraze pastures, and overhunt and overfish the local wildlife. As a result, the daily survival decisions of the poor and hungry disrupt their own life-support systems, impair ecological processes and destroy genetic and other renewable resources just as surely as do too many of the development decisions of the rich and powerful in government and industry.

3. It is extraordinarily difficult for governments to deal with these problems because of their huge scale, because there are so many people and production units with which to deal—millions of villages and hundreds of millions of households and small farms—and because of the pace of change. Developments such as improved health services, better veterinary services, new wells, and higher yielding crop varieties, bring further changes to a situation that is already changing rapidly due to sheer

pressure of numbers. Often, because they come separately and not as part of a coordinated rural development programme, such developments ultimately exacerbate the problems of the rural poor. For example, improved veterinary care, new wells, and the opening up of previously uninhabitable land by the eradication or control of diseases such as trypanosomiasis have enabled pastoralists to increase their livestock numbers and have provided them with new areas of grazing land in part compensation for areas lost to farmers. However, when these welcome developments have not been accompanied by effective provisions for better pasture management—and they seldom have been—the eventual result is usually heavy overgrazing and often irreversible soil degradation. Similarly, the change from shifting cultivation to settled arable farming—essential when the cultivation/fallow cycle becomes unstable and pressure on soil and vegetation increases—can cause still greater erosion unless farmers are equipped to apply the necessary soil conservation measures. In rural development, as in development generally, the narrow sectoral approach is almost invariably self-defeating.

4. Unlike urban communities, the rural poor are dispersed over very wide areas. Therefore, rural people are less advantageously placed than their urban compatriots to bring their problems to the attention of government. For the same reason, their problems are less amenable to the kinds of development that governments with a narrow tax-base, inadequate institutions, poor delivery of services to rural areas, and a vociferous urban population, usually initiate. It is ostensibly easier, and certainly more visible, to plan, finance and manage a few large-scale projects—such as a colonization scheme, or a dam + irrigation + hydroelectricity—than to promote and oversee many village-scale projects. Yet the planning and management of most large-scale projects leave much to be desired, they are often short-lived or marred by harmful side-effects, and they yield few benefits to the rural poor.

Action required

5. There is an urgent need for rural development that combines short term measures to ensure human survival with long term measures to safeguard the

resource base and improve the quality of life. A widespread requirement is the restoration of overexploited and heavily degraded living resources. Unfortunately, many rural communities are so poor that they lack the economic flexibility that would enable them to defer consumption of the resources in need of restoration. Conservation measures that require deferral of consumption will need to be complemented by measures that at least will maintain the rural community's standard of living and preferably will improve it.

Restoration and compensation

6. If soil and vegetation need to be restored, they must be given a respite from intensive use. This requires integrated actions. In dryland areas these might include: the reduction of livestock numbers (possibly through price supports that encourage sale to market); increasing the efficiency of food production on nearby irrigated and rainfed farms; the employment of local people in replanting and reseeded schemes; and the provision of alternative settlement areas and alternative sources of water, fuel, food and other services (health, education, job training, and so on). 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 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.

7. 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. Protected areas and other conservation measures, however, may restrict access to fuel, food, forage and other products. If substitutes are not then provided to compensate for the loss of these resources, the local community is likely to frustrate the conservation measures concerned. Compensatory measures might include pasture improvement, the establishment of fuel-

Notes and references

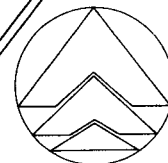
development in the developing countries since the mid 1960s. WCARRD/INF 3. FAO, Rome.

and basic needs; And: World Bank. 1978. *World development report*. Both cited by ref. 1.

1. World Conference on Agrarian Reform and Rural Development. 1979. *Review and analysis of agrarian reform and rural*

2. International Labour Office (ILO). 1972. *Employment, growth*

3. An estimated 455 million people in developing countries were malnourished during the period 1972-1974, the number having



wood plantations, and the provision of credit or alternative food, fuel or fibre, as appropriate. If the measures concerned take time to bear fruit they must be supplemented by measures bringing immediate benefits. For example, if a protected area or a watershed forest is threatened by wood-cutting for fuel, it will be necessary not only to establish a fuelwood plantation but also to provide an alternative source of fuel that can be used at once. It would also be prudent to provide the community concerned with the means of conserving fuel supplies, such as more efficient cookers.

through provision of local advantages such as increased opportunities for employment and commerce. Similarly, to foster local support and understanding, the local community should be involved in the protected area from the start—by being adequately consulted on management and by being given any employment or other economic opportunities associated with the protected area. Every effort should also be made to explain why areas are being protected and what the short and long term advantages to the local community are likely to be. Any feature of the protected area that may make it unique to the community or

To provide demonstrations and training there needs to be a rapid strengthening of extension services. It is particularly important that extension services be interdisciplinary, multisectoral, and sensitive to the social and cultural characteristics of the area. Advice to farmers on how to improve yields or assistance to pastoralists to maintain better herds should be provided within an ecological framework with particular emphasis on soil and water conservation.

Traditional knowledge

10. Rural communities often have 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 community is growing in numbers and is clearly destroying a part of its environment it should not be assumed that all of this knowledge has disappeared or become invalid or that the traditional 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.

11. Many traditional methods of living resource management are worth retaining or reviving, either in their original or in modified forms. For example, field experiments with traditional cropping systems in various parts of the world have demonstrated that many of these systems bring high yields, conserve nutrients and moisture, and suppress pests⁴. The efficiency of traditional cropping systems can often be increased not by introducing completely different ones but by identifying those elements which could be improved and making the appropriate improvement. For example, Indonesian combinations of corn and rice have been shown to be both more resistant to pests and more responsive to applications of nitrogen fertilizer than are monocultures⁵. The original strategy of the so-called “Green Revolution” of replacing tropical polycultures (growing a number of crops together) with temperate-style monocultures is itself increasingly being replaced by a new strategy: to retain the most productive elements of tropical polycultures and improve the remainder.



A Masai herdsman and his cattle at a water hole in Amboseli, Kenya. The perennial waters of this national park are vital to all the region's animal life during the dry seasons. Photo: Robert C. Milne/Parks.

8. A rural community and a protected area may be entirely compatible, depending on the community's relationship with the ecosystems concerned and on the protected area's function. Many protected areas benefit local people directly by assuring a regular supply of water or by providing habitat for wildlife which may be hunted outside the protected area; examples are the Royal Chitwan National Park in Nepal and the Amboseli National Park in Kenya. However, the community should also be able to share in new benefits, such as income from recreation and tourism. Although local communities may benefit indirectly from tourism if receipts by the national treasury are spent on such services as roads, water supply and health facilities, local commitment to a protected area can only be assured

nation should be stressed, and people encouraged to regard the area as a source of local or national prestige.

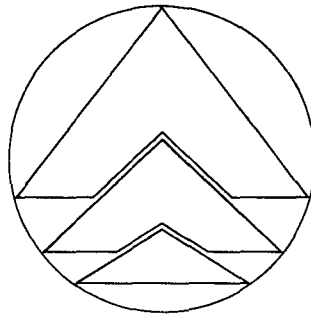
9. For conservation-based rural development to be successful, there will need to be more research into sustainable systems of producing food and other goods from the rural sector, as well as training and incentive programmes to encourage and equip rural communities to adopt those systems known to work now. Among possible incentives are credit and marketing services adapted to the needs of the small farmer and fisherman and tax reductions or exemptions. An indispensable incentive and ultimately the one most likely to work is demonstration within the communities concerned that the new systems provide a higher quality of life using the resources at hand.

grown by 50 million in three years. See: FAO. 1977. *The fourth world food survey*.

4. See, for example: International Rice Research Institute (IRRI). 1974. *Annual report for 1973*; Norman, David W. 1974. *Rationalizing mixed cropping under indigenous conditions: the example of northern Nigeria*. *Journal of Development Studies*, 11:1-21; Centro Internacional de Agricultura Tropical (CIAT). 1974. *Annual report 1974*.

5. International Rice Research Institute. 1974. (see ref. 4).

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Priorities
for
international action

15. International action: law and assistance

1. Some living resources can be conserved only by international action. The principle of permanent sovereignty over natural resources together with recent extensions of national jurisdiction imply that the prime responsibility for conservation achievement lies at the national level. However, application of the principle is limited by the nature of many of the problems of conservation:

- many living resources are shared;
- many living resources occur (temporarily or permanently) in areas beyond national jurisdiction;
- living resources in one state may be affected by activities carried out in another.

Such resources can be conserved only by international action. International action is also necessary:

- to promote the conservation of genetic and other resources that are vital for the survival and wellbeing of all humanity;
- to stimulate and support national action.

2. It is recommended that cooperative programmes combining legislation, assistance and other actions be developed, concentrating on:

- tropical forests and drylands;
- the establishment of protected areas for the preservation of genetic resources;
- the global commons (the open ocean, the atmosphere, and Antarctica);
- regional strategies for international river basins and seas.

These programmes should provide an essential focus for international action on those issues for which it is indispensable, as well as for international support for national action to implement the World Conservation Strategy.

International law

3. Perhaps the most important form of international action is the development of international conservation law and of the means to implement it. Strong international conventions or agreements provide a legally binding means of ensuring the conservation of those living resources that cannot be conserved by national legislation alone. Because international conventions constitute a self-imposed restraint on each state's free-

dom of action, it is often difficult to conclude agreements of sufficient strength. Weak conventions, however, are dangerous and to be avoided, because they permit the illusion that problems are being tackled when in fact they are not.

4. Although there are more than 40 multilateral conventions directly dealing with the management of living resources, and although most have conservation components, few have conservation as their primary purpose¹. All international agreements relevant to living resources need to be reviewed to identify the most significant gaps in coverage, indicating whether each gap would best be filled by a global or a regional approach. The review should examine:

those conventions dealing directly with the management of living resources, to determine whether they provide sufficiently for conservation;

those conventions whose primary purpose is conservation, to determine whether they achieve the intended objectives and if not what measures are necessary to enable them to do so; preliminary suggestions with respect to the four main global conservation conventions (see box) follow.

Wetlands Convention

5. The Wetlands Convention at present lacks force, requiring only that states select at least one wetland for conservation, but not providing criteria to guide selection, guidelines for management, or adequate safeguards against delisting a wetland once selected. Experience has shown that an international convention must have a secretariat and a financial mechanism to be effective, but the Wetlands Convention lacks both. The convention could if it were revised become an important force for the protection of coastal and other wetlands essential for supporting fisheries (as well as for supporting waterfowl, which is the chief concern of the convention at present); but in either case criteria for selection of wetlands and clear obligations on states for their conservation are essential.

World Heritage Convention

6. This convention recognizes the obligation of all nations to protect those unique natural and cultural areas which are of such international value that they

are part of the heritage of all mankind; and the corresponding obligation of the international community to help them. It is important not only that states become party to the World Heritage Convention but also that they contribute generously to the World Heritage Fund. The Fund does not diminish the responsibility of each state to protect its unique natural areas, but it does provide a means of ensuring that areas of global significance are not lost because of a local lack of money or skills.

CITES

7. This convention has considerable potential, the key to which is its network of national management authorities and scientific authorities operating in direct communication with each other and the secretariat. The management authority is concerned with the mechanics of trade (such as permits); the scientific authority is concerned with the biological aspects and must therefore satisfy itself that the issuance of an import or export permit will not have a harmful effect on the species concerned. Developing countries often lack the personnel and financial resources to establish and maintain fully operational agencies for this purpose. Multilateral and bilateral development assistance agencies are recommended to provide assistance on request and to assist exchange of administrative and scientific experience among trading countries.

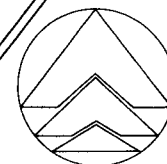
8. To make full use of the regulatory network established by CITES, certain improvements in its international standard-setting and national enforcement mechanisms are needed. At present, marine fishes, molluscs and crustaceans are inadequately represented in the CITES Appendices, and a further review of these groups is necessary. In addition, the administration of CITES at the national level needs to be linked much more closely with the existing customs, veterinary and phytosanitary inspection systems. Rather than inventing new bureaucracies, optimum use should be made of the available ones. Exploitation levels, trade, and response to regulations should be closely monitored, not only by governments but also by non-governmental conservation organizations. Conservation organizations should monitor the implementation of

Notes and references

1. In addition to the four global conservation conventions described in the text, there are several regional agreements, notably: the African Convention on the Conservation of Nature and

Natural Resources, the Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere, the Convention on Conservation of Nature in the South Pacific, and the Convention on the Conservation of European Wildlife and Natural Habitats.

2. There are several regional and bilateral agreements covering migratory species, notably: the Agreement on Conservation of Polar Bears; the US-USSR Agreement on Migratory Species; the Convention for the Protection of Migratory Birds between Canada and USA, later supplemented by a similar treaty be-



CITES by their national (scientific and management) authorities. They should monitor trading in shops and through newspaper and other advertisements; and they should ensure that the annual reports and any proposals submitted by national authorities to the CITES secretariat properly reflect conditions, informing the CITES secretariat should this not be the case. Conservation organizations with monitoring experience could provide a useful service to other organizations by helping them to set up their own monitoring systems.

Migratory Species Convention

9. Migratory species, as defined by the Migratory Species Convention, are "the entire population of any species or lower taxon [such as a subspecies] of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries". The Migratory Species Convention obliges parties to protect endangered migratory species and to endeavour to conclude agreements for the conservation of migratory species whose status is "unfavourable". Existing regional and bilateral agreements on migratory species² have demonstrated that international conventions are the only effective means of protecting animals that cross national boundaries. The Migratory Species Convention, which is potentially a strong one, is therefore of great importance. Governments should join the convention without delay and national and international organizations should assist them to implement it.

Development of new law

10. Because of their force, strong international agreements are very important for the implementation of the World Conservation Strategy. The more effective conventions need the constant, vigorous support of governments, non-governmental organizations, and international organizations; and the weaker ones need strengthening. Action should not be restricted to conventions, however. Attention should also be paid to some of the other ways in which international law develops: for example, the exploration of new concepts such as the application of environmental assessment procedures at the international level; and the elaboration of "soft law" such as the Declaration of the United

Nations Conference on the Human Environment. Although soft law is unenforceable it is of great value because it provides a set of generally agreed standards of international behaviour and paves the way for the codification of such standards in a more binding form.

International assistance

11. The funds spent by multilateral and bilateral development assistance agencies (more than \$27,000 million in 1976)³ can do a great deal towards restoring the environment, tackling environmentally induced poverty, and enabling countries to make the best use of their resources, if the projects they support are environmentally sound. It is recommended that such agencies make every effort to:

direct funds to reforestation, the restoration of degraded environments, and the protection of watersheds, of mangroves and other critical habitats for marine resources, and of genetic resources essential for development;

assess all projects for their ecological implications and ensure that they are ecologically sound;

assist governments to design ecologically appropriate policies and to establish and maintain effective conservation infrastructures.

12. Assistance should be made available to enable requesting nations to develop the capacity to carry out national conservation strategies, ecosystem evaluations and environmental assessments, and to implement cross-sectoral conservation policies through appropriate legislation, training and organization. Development agencies should assist governments on request to establish the laws, institutions and procedures to enable them to conserve their country's living resources. Developing industries based wholly or partly on living resources should be encouraged and equipped to ensure that the resources are exploited sustainably and that the genetic diversity on which ultimately they depend is preserved. Development assistance agencies have a special responsibility to help—through the provision of appropriate advice and technical assistance—the recipient nation ensure that financial assistance makes the best use of the living

resources it is likely to affect, and should endeavour to ensure that:

the proposed development is compatible with the recipient country's national conservation policy and strategy (if they exist);

the proposed development is the most appropriate response to the capabilities of the ecosystems concerned;

an environmental assessment is carried out.

13. Nations lacking the capacity to prepare or carry out national conservation strategies, ecosystem evaluations or environmental assessments or lacking adequate conservation laws, means of enforcing them, or organizations to effect the full range of required conservation measures, should seek appropriate multilateral or bilateral assistance.

How to join the four global conservation conventions

Membership in international conventions requires the deposit of appropriate diplomatic instruments (signed by the head of state or government, or by the minister in charge of foreign affairs) with the designated Depository of the Convention.

1. *Convention on Wetlands of International Importance, Especially as Waterfowl Habitat* (Wetlands Convention)

(concluded at Ramsar, 2 February 1971)

Depository: Director General of Unesco, Paris
Instruments: a. signature without reservation as to ratification; b. signature subject to ratification, followed by ratification; or c. accession.

2. *Convention Concerning the Protection of the World Cultural and Natural Heritage* (World Heritage Convention)

(concluded at Paris, 23 November 1972)

Depository: Director General of Unesco, Paris
Instruments: a. ratification or acceptance (by Unesco members); or b. accession (by all other states).

3. *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES)

(concluded at Washington, 3 March 1973)

Depository: Federal Department for Foreign Affairs of the Swiss Confederation, Bern
Instruments: a. ratification, acceptance or approval (by states having signed before 31 December 1974); or b. accession (by all other states).

4. *Convention on Conservation of Migratory Species of Wild Animals* (Migratory Species Convention)

(concluded at Bonn, 23 June 1979)

Depository: Foreign Office of the Federal Republic of Germany, Bonn
Instruments: a. signature (until 22 June 1980), followed by ratification, acceptance or approval; or b. accession.

tween the United States and Mexico; the US-Japan 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.

3. Stein, Robert E., and Brian Johnson. 1979. *Banking on the biosphere? Environmental procedures and practices of nine multilateral development agencies*. Lexington Books, Lexington.

16. Tropical forests and drylands

Tropical forests

1. Tropical forests are an important renewable resource, acting as a reservoir of genetic diversity, yielding a continual supply of forest products if managed sustainably, helping to regenerate soils and protect them from erosion, protecting areas downstream from floods and siltation, buffering variations in climate, and providing recreation and tourism. If tropical forests are exploited—as generally they are—with scant regard for their ecological characteristics, the resource cannot renew itself. Hence while temperate forests seem to have reached a state of equilibrium¹, tropical forests are contracting rapidly as a result of expanding shifting agriculture, spontaneous settlement, planned colonization, clearance for plantations and ranching, cutting for fuel, and logging. It has been estimated that tropical rain forests are being felled and burned at the rate of 110,000 km² a year; at this rate *all* of this forest type will have disappeared within 85 years². Tropical forests are not uniform, however; nor is their rate of disappearance. The most valuable, and the richest in species, are lowland rain forests—and these are being destroyed at a much faster rate. Many, like the lowland forests of Southeast Asia, are believed unlikely to survive to the end of this century³.

2. International action to conserve tropical forests is required most urgently in West and East Africa, South and Southeast Asia, Central America and Mexico, and parts of South America (see box on this page and map 1 in the map section for details). In West and East Africa the most important needs are:

establishment of fuelwood plantations and of industrial plantations (existing and planned plantations will not even approach compensating the region for the projected loss of its natural forests)⁴;

in those countries that have established national parks or nature reserves to protect genetic resources, strengthening of such parks or reserves, notably by allowing local people to benefit from buffer zones and by making surrounding areas priorities for rural development;

in those countries that have not established parks or reserves, or where they are insufficient, identification of areas of greatest genetic importance and where human pressure is least,

and establishment of parks and reserves in those areas;

strengthening of administrations responsible for protection and management of natural forests;

reforestation including well designed and strategically located forests to meet immediate needs for raw materials, to serve as model examples for the development of neighbouring areas, and to replace areas of forest already destroyed.

3. Madagascar, the relict forests of Ethiopia and East Africa's mountains, and Ivory Coast are Africa's priority areas for genetic resource preservation

through the establishment of protected areas; but this will not be possible without greatly accelerated rural development outside the protected areas. Hence what is needed is a combined rural development/protected area programme.

4. Similar measures are required in Asia, where priority should be given to the exceptionally rich lowland (below 300 metres) dipterocarp forests of Borneo, peninsular Malaysia, Sumatra and the Philippines, and in the Americas, where priority should be given to the western Amazon basin, the Pacific coast areas of Colombia and Ecuador, and coastal and southeastern Brazil. The softwood (coniferous) forests of south-

Priority tropical forest regions

Available estimates and projections of the global rate of tropical forest degradation and destruction are extremely unreliable and unsatisfactory. The most recent, and the only one based on a country-by-country analysis, was prepared for the timber industry in order to assess the area of forest likely to be available to it. It is not concerned with other uses (such as the preservation of genetic diversity) or the impact of logging operations on those uses⁴.

Accordingly, the study considers logged-over forests as closed forests "as long as they are not alienated for non-forestry purposes". Plantations established on clear-cut areas for purposes other than production of wood for industry are retained within the "natural forest" category. A distinction is made between "operable" or "productive" (for production of wood for industry) forests and "inoperable" forests. "Inoperable" forests include: protected forests (parks, wildlife reserves, and so on); forests on terrain that is too steep or wet; and forests, such as most mangroves, "permanently without industrial wood potential". It is assumed that depletion will not affect these "inoperable" forests very much because of their inaccessibility or their formal protection⁴. Experience suggests this assumption to be invalid.

Nevertheless, the study is valuable because its country-by-country analysis enables it to provide an approximate regional breakdown showing where rates of destruction are fastest. This shows that the regions listed in the table below are the most acutely affected by tropical forest depletion (for definition of the regions see map 1 in the map section):

	TOTAL CLOSED FORESTS		"OPERABLE" HARDWOOD FORESTS	
	area projected to be lost 1975-2000 1,000 ha	% of 1975 area	area projected to be lost 1975-2000 1,000 ha	% of 1975 area
West Africa	6,600	47.1	6,600	54.7
Centrally-planned tropical Asia	6,300	29.1	6,000	35.3
South Asia	16,400	23.0	13,600	27.9
East Africa and islands	3,300	17.8	3,200	50.4
Insular Southeast Asia	21,600	16.5	20,000	26.3
Central America	10,900	13.4	4,600	23.9
Tropical South America	64,200	12.0	57,300	13.3
Continental South-east Asia	4,100	10.6	4,000	13.3

Notes and references

1. In terms of area only. They are still undergoing genetic impoverishment.

2. Sommer, Adrian. 1976. Attempt at an assessment of the world's tropical forests. *Unasylva*, 28: 5-24.

3. Myers, Norman. 1979. *The sinking ark*. Pergamon Press, Oxford.

4. Lanly, J.P., and J. Clement. 1979. *Present and future forest and plantation areas in the tropics*. FO: MISC/79/1. FAO, Rome.

5. United Nations Conference on Desertification (UNCOD). 1977.



eastern Brazil are projected to decline from 5.8 million hectares in 1975 to 0.8 million hectares in the year 2000 (a loss of 86%)⁴. Softwood forest depletion is also serious in Central America (a loss of 20%) and the Caribbean (a loss of 22%). Since the pine species of these regions provide the genetic raw materials for the forestation programmes of many other tropical countries, urgent conservation measures are required⁴.

5. Regions where depletion pressures are less acute also need action, although its emphasis will be somewhat different. In such regions there is time to establish networks of protected areas designed systematically to safeguard a comprehensive range of the genetic diversity of tropical forests, especially of the tropical rain forests. These regions are: the Caribbean, Central Africa, developing Oceania, and parts of tropical South America and of continental Southeast Asia. In these regions also there should be greater scope for experimental research and management to develop productive, sustainable systems for the utilization of tropical forests.

6. In all regions there is an acute need to: protect areas of unusual genetic diversity; promote rural development based on production systems that enable a high proportion of forest cover to be retained; develop systems of commercial exploitation that utilize products other than timber (for example, drugs, gums and resins, natural silk); ensure that felling and planting programmes are sustainable. The cooperation of developed countries is required to make sure that their demand for tropical forest products does not exceed the capacity of tropical forest countries to supply them non-destructively.

7. Efforts should be continued: to develop more efficient means of using tropical woods and other forest products; to reduce waste and incidental destruction during exploitation; to stabilize markets in tropical timbers; to develop plantations (using areas already cleared) to meet forthcoming world needs for wood products. Suitable case studies are required 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. A code of practice should be drawn up jointly by the

forestry departments of the main tropical forest countries and representatives of the international timber trade to govern the granting of concessions and the conduct of all extraction operations.

Drylands

8. Drylands—areas where rainfall is low and evaporation and transpiration are high—cover about a third (50 million km²) of the earth's land surface⁵. Unless used with care and skill, they are extremely prone to desertification—the gradual destruction or reduction of the land's capacity for plant and animal production. Desertification threatens the future of some 628 million people, of whom about 78 million are now directly affected by a drop in productivity of the land on which they depend⁵. Regions already in the grip of desertification or at high to very high risk cover 20 million km²—an area twice the size of Canada⁶. The problem areas are arid and semi-arid lands, 95% of which are threatened with desertification (compared with 28% of sub-humid lands)⁵.

9. Desertification is a response to the inherent vulnerability of the land and the pressure of human activities. Pressure of human numbers and numbers of livestock, together with unwise development projects, the extension of rainfed agriculture into unsuitable areas, inadequate management of irrigated agriculture, overgrazing, and overcollection of firewood, have already degraded vast areas and caused great human suffering. These pressures continue.

10. The United Nations Conference on Desertification (Nairobi, 29 August–9 September 1977) synthesized into a Plan of Action⁶ a wide range of activities addressing the complex biological, social, economic and political factors involved, based on the development of proper land use, including conservation and enhancement of living resources and water resources. It envisaged the successful halting of desertification throughout the world by the end of this century through national programmes assisted by intergovernmental and nongovernmental organizations coordinated by UNEP. The funds necessary were seen as coming from enhanced levels of multilateral and bilateral assistance reinforced if possible by arrangements such as a special anti-desertification fund and an international taxation scheme. There is growing concern at the lack of implementation of this Plan of Action.

11. The problem, therefore, is not one of not knowing what to do but of getting agreed action done. National and international organizations should make special efforts to persuade multilateral and bilateral assistance agencies to support implementation of the Plan of Action. 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, however difficult, is mandatory. Some immediate reduction of firewood pressure is possible by use of more efficient wood stoves and better insulation of dwellings. The areas concerned are marked on the World Map of Desertification (see map 2 in the map section). 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.

12. Several international activities already under way should be encouraged and expanded:

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 by Iran and the USSR. Enlightened programmes such as these should be encouraged and expanded, and the results monitored, widely publicized and used for demonstration. Particular encouragement should be given to schemes that reflect concern for biological diversity.

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.

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.

Desertification: an overview. A/CONF.74/1; and: UNCOD. 1977. *World map of desertification*. A/CONF.74/2.

6. United Nations. 1978. *United Nations Conference on Desertification: round-up, plan of action and resolutions*. United Nations, New York.

Further reading
Unesco/UNEP/FAO. 1978. *Tropical forest ecosystems: a state of knowledge report*. Unesco, Paris.

17. A global programme for the protection

1. Programmes to preserve genetic resources tend to be conducted along narrow sectoral lines: crops, forage plants, timber trees, livestock, microorganisms, animals for aquaculture, wildlife, and so on. This is justifiable in the case of off site preservation since each sector does have different requirements and therefore needs different collecting programmes. However, it is not the best approach to the on site protection of wild species. Since only a small proportion of the earth's surface is likely to be available for long term protection, each protected area should be so sited and managed as to protect as much genetic material as possible. This requires co-ordination among all the sectors concerned, as well as accurate knowledge of the locations of the species, subspecies and varieties most in need of protection. As the basis of continuing evolution, wild gene pools are the common heritage of mankind. They therefore need an international cross-sectoral programme for their protection on site. This section outlines an approach to such a programme.

2. It is recommended that each sector identify those species, subspecies and varieties most in need of on site protection; their distribution; and those areas where their distribution overlaps. Such areas of overlap—or concentrations of priority species, subspecies and varieties—should be selected as priority areas for protection. In some cases the areas may be protected already. In all cases, governments should be encouraged to commit themselves to safeguarding the protected areas; and those commercial sectors which use the resources concerned should be persuaded to contribute to the financial costs of protection.

3. There are essentially three types of concentration of genetic resources:

concentrations of wild and weedy relatives of species of economic or useful value;

concentrations of threatened species (regardless of economic or useful value);

ecosystems of exceptional diversity.

In addition, ecosystems (regardless of their diversity) that are unrepresented or poorly represented in protected areas should also be given priority.

Concentrations of economic or useful varieties

4. Global priorities for crops have been established by the International Board for Plant Genetic Resources (IBPGR)¹ which has also determined regional priorities for South Asia and Southeast Asia². Although on site protection is seldom specified, several regional IBPGR reports recommend it and it is clearly essential for the wild relatives of many crops, these often being the major source of pest and disease resistance and other important adaptations. On site protection of such species and varieties preserves their ability to continue adapting to any change in the populations of the pathogens affecting them. The IBPGR has identified ten high priority regions for the collection and preservation of crop genetic resources: Mediterranean, West Africa, Ethiopia, Southwest Asia, South Asia, Southeast Asia, Central Asia, Mexico and Central America, the Andean zone, and Brazil. These, therefore, are also the priority regions for selecting protected areas. However, more detailed analysis of the distribution of the wild relatives of priority crops is needed before this can be done.

5. Priorities for trees have been proposed by the FAO Panel of Experts on Forest Gene Resources³. More than 130 tree species have been identified as in need of on site protection, most of them in six regions: Africa, Southeast Asia, Australia, Mexico, Caribbean and Central America, and Eastern USA and Canada. Priorities have not been established for aquatic animals, livestock, or microorganisms. In the case of livestock, however, traditional domesticated breeds are likely to remain more important for breeding than wild relatives; and microorganisms are unlikely to need special measures for on site protection, off site preservation in culture collections being entirely adequate.

Concentrations of threatened species

6. The most serious threat to plant species is habitat destruction. Plants threatened in this way are concentrated in the following ecosystem groups⁴:

islands, especially oceanic islands in the tropics and subtropics;

tropical rain forests;

drylands;

Mediterranean-type ecosystems;

wetlands, especially freshwater ones (notably in Europe).

7. Similarly, the three most serious threats to vertebrates are habitat destruction, overexploitation, and the effects of introduced species (respectively affecting 67%, 37% and 19% of threatened vertebrate species). Concentrations of species threatened by habitat destruction closely overlap concentrations of species threatened by the effects of introductions. Vertebrates threatened by habitat destruction are concentrated in the following ecosystem groups⁵:

fresh waters, especially in North America and in Africa;

islands, especially in the tropics;

tropical rain forests;

wetlands;

tropical dry or deciduous forests.

More than half the vertebrate species threatened by habitat destruction and 70% of the vertebrate species threatened by the effects of introduced species are concentrated in ten areas:

fresh waters in North America and Mexico, West and Central Africa, Southern Africa;

islands in Caribbean, Western Indian Ocean, South Pacific, Hawaiian Islands;

tropical forests in Southeast Asia, Madagascar, South America.

Ecosystems of exceptional diversity

8. Terrestrial ecosystems of exceptional diversity include tropical rain forests (especially those of peninsular Malaysia, Borneo, Sulawesi, Sumatra, Philippines, New Guinea, Central and South America, and Madagascar), the tropical dry forests of Madagascar, the Mediterranean-type ecosystems of South Africa and Western Australia, and very rich island systems such as New Caledonia and the Hawaiian Islands⁶. Marine ecosystems of exceptional diversity include the coral ecosystems of the Indo-Malay archipelago, the Western Pacific, the Northeast Pacific, the South-

Notes and references

1. IBPGR. 1976. *Priorities among crops and regions*. IBPGR, Rome.

2. IBPGR. 1978. *Report of IBPGR Workshop on South Asian Plant Genetic Resources*. IBPGR, Rome; IBPGR Regional Committee for Southeast Asia. 1978. *First meeting, hosted by*

the National Biological Institute, Bogor, Indonesia, 4-6 July 1978. Report. IBPGR, Rome; and IBPGR. 1977. *A cooperative regional programme in Southeast Asia: a proposed organizational framework and plan of action*. IBPGR, Rome.

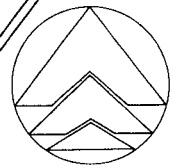
3. FAO. 1977. *Report of the Fourth Session of the FAO Panel of Experts on Forest Gene Resources (Canberra, Australia, 9-11 March 1977)*. FO:FGR/4/Res. FAO, Rome.

4. Lucas, Gren, and Hugh Synge. 1978. Threatened higher plants. IUCN General Assembly Paper GA.78/10 Add. 5. IUCN.

5. Allen, Robert, and Christine Prescott-Allen. 1978. Threatened vertebrates. IUCN General Assembly Paper GA.78/10 Add. 6. IUCN.

6. Goode, Ronald. 1974. *The geography of the flowering plants*. Longman, London.

of genetic resource areas



east Pacific, the Caribbean, and the Southeast and Southwest Atlantic. In addition, the Gulf of California, Gulf of Mexico, Red Sea, Sea of Okhotsk, Sea of Japan, and China Sea are important for their unique species⁷. Exceptionally diverse freshwater ecosystems include the rivers of Amazonia, the rivers of West and Central Africa, the lakes of East and Central Africa, the Caspian and Aral Seas and Lake Baikal in the USSR, the Mississippi drainage of North America, the rivers of India, and the fresh waters of Borneo, Java and Sumatra⁷.

Ecosystems that are unrepresented or poorly represented in protected areas

9. Review of the distribution of protected areas of the land⁸ shows that 35 of the 193 biogeographical provinces listed⁹ have no national parks or equivalent reserves and a further 38, while having at least one park or reserve, are inadequately covered (see map 3 in the map section). 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 the protection of many of them is inadequate. Special attention should be paid to concentrations of unique species within each province and to areas of exceptionally high diversity—notably lowland forests (those below 300 metres in tropical rain forests), tropical and subtropical cloud forests, and isolated mountains. It is not possible to indicate priorities for marine or freshwater ecosystems; but these are much more poorly represented in protected areas than are terrestrial ones and deserve a correspondingly higher priority.

10. Similarly, although the establishment of an international network of biosphere reserves has progressed well, there is still a long way to go before the network is complete. The 162 biosphere reserves so far designated occur in 76 of the 193 biogeographical provinces¹⁰. Some 50 biosphere reserves have been set up for mixed mountain and highland systems; about 30 are representative of temperate broadleaf forests; and only

a dozen exist for tropical rain forests. Nevertheless, the most critical gaps, with fewer than six biosphere reserves, are in the following ecosystem groups:

- subtropical rainforests;
- temperate needleleaf forests;
- cold winter deserts and semi-deserts;
- tropical grasslands and savannas;
- temperate grasslands;
- river and lake systems.

Financing the global programme

11. Protecting genetic resources is an international responsibility and the costs and benefits of doing so should be shared equitably. Many countries particularly rich in genetic resources are developing ones that can ill-afford to bear alone the burden of their on site protection. An international mechanism is needed by which those countries with an especially heavy responsibility can be compensated. The assistance provided by the IBPGR in the case of crop genetic resources is a start in this direction; but all types of genetic resources should be covered, and contributions should come not only from governments and international organizations but also from the commercial enterprises which benefit directly from living resources.

12. Commercial participation should be regarded not as conferring special rights of use but in recognition of shared responsibility. Unfortunately, commercial plant breeders and seed suppliers increasingly are patenting varieties and demanding royalties on their use even though the varieties are as much products of freely obtained genetic diversity as they are of commercial investment. As a result, many countries may have to pay twice over for genetic material—once for the new variety and once for protecting the material from which it is derived. Plant breeders' rights and the standardization of plant varieties should be so limited that neither has the effect of restricting the free exchange and use of genetic materials or of reducing genetic diversity.

Commercial sponsorship of on site genetic resource protection

13. Industries and other commercial enterprises based on, or regularly using,

particular plant or animal species should sponsor the establishment and maintenance of protected areas for the preservation of the relevant species, its relatives and varieties. Such areas should be regarded as crop and commodity banks on which the industrial sector concerned can draw for the development of new strains of plant or animal with whatever properties of productivity, pest or disease resistance, responsiveness to different soils and climates, nutritional quality, and so on, may be required.

14. Similarly, industries and other commercial enterprises that depend on naturally occurring chemical compounds either for raw materials or for product ideas should sponsor the establishment and maintenance of protected areas for the preservation of representative samples of ecosystem types, unique ecosystems, the habitats of unique and of threatened species, and other ecosystems essential for the preservation of genetic diversity. Such areas should be regarded as potential product banks on which the industrial sector concerned (for example, pharmaceuticals) could draw for the development of new or improved products.

15. Many businesses benefit from wild plants and animals, often in ways that may easily be overlooked. For example, alginate compounds from brown seaweeds are used in shampoos, soaps, cosmetics, paints, dyes, paper products, fire-extinguishing foams, building materials (insulation products, sealing compounds, artificial wood), and the lubricants and coolants used in drilling for oil¹¹. Every industry, therefore, should analyze its resource base to determine what living resources it uses and for what purpose, and the extent to which each resource's combination of desired properties, cost and availability is unique to that resource. Each industry should then work with the governments and the other commercial sectors concerned to ensure that the particular plants and animals are exploited sustainably, that their genetic diversity is preserved, and that the ecological processes of which they are part are maintained. Such measures would go some way towards ensuring the quality and availability, at reasonable prices, of valuable raw materials.

7. Swift, Camm Churchill, 1979. *World Conservation Strategy—Fishes: a report prepared for the International Union for Conservation of Nature and Natural Resources*. Mimeo. IUCN, Gland.

8. The review, made by IUCN's Commission on National Parks and Protected Areas (CNPPA), used IUCN's files and the following source documents: IUCN, 1980. *United Nations List of*

National Parks and Equivalent Reserves. IUCN, Gland: IUCN, 1977. *World Directory of National Parks and other Protected Areas*, Vols I and II. IUCN, Gland. The CNPPA has embarked 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 fully known. Similar reviews are needed for fresh waters, caves and cave systems, and the sea.

9. Udvardy, Miklos D. F. 1975. *A classification of the biogeographical provinces of the world*. IUCN, Gland.

10. As of September 1979. The 162 biosphere reserves occur in 40 countries and cover a total area of more than 1 million km².

11. Naylor, J. 1976. Production, trade and utilization of seaweeds and seaweed products. *FAO Fisheries Technical Paper*, 159.

18. The global commons

1. A commons is a tract of land or water owned or used jointly by the members of a community. The global commons includes those parts of the earth's surface beyond national jurisdictions—notably the open ocean and the living resources found there—or held in common—notably the atmosphere. The only land mass that may be regarded as part of the global commons is Antarctica, although several countries have claimed parts of it (the claims are currently frozen under the Antarctic Treaty)¹.

The open ocean and its living resources

2. Much of the open ocean remains frontier country in which people can exploit living resources as they please as long as they have the technology to do so. While the open ocean is not as biologically rich as continental shelf areas, it includes unique ecosystems and provides some (and in some cases all) of the critical habitats of several culturally and economically important groups of animals, notably whales and tunas. Species that are confined to the open ocean should be regarded as the common resource of all humanity; species that move between the open ocean and waters under national jurisdiction are shared resources. Special provision for the conservation of both groups of species is therefore needed, but no satisfactory mechanism exists.

3. Living resource exploitation in the open ocean is regulated only in the case of two groups of species: tunas and whales². There is no protection of the habitats of open ocean species and hitherto none has been needed. However, with the advent of deep sea mining and the increasingly intensive use of ocean space generally, protection is now required. The designation by the International Whaling Commission (IWC) of an Indian Ocean Sanctuary in which all commercial whaling is prohibited, while an encouraging step forward, needs to be matched by international measures to protect the habitats of the whales, dolphins and porpoises in that area³.

4. Means of ensuring the conservation of open ocean species and ecosystems—particularly ecosystems supporting the

feeding grounds of whales, salmon, and so on, the spawning grounds of tuna, unique areas and areas of unusual species diversity—should be devised, promoted and adopted. An appropriate international organization should prepare a discussion document, possibly as a prelude to an expert consultation, on priority species and ecosystems and on ways and means of conserving them. These might include the introduction of more effective measures to regulate exploitation and the establishment of sanctuaries where the habitats of cetaceans and other marine creatures are protected⁴ and exploitation is prohibited.

5. The International Whaling Commission has imposed a moratorium⁵ on the taking, killing, or treating of whales, except minke whales, by factory ships or whale catchers attached to factory ships. The moratorium should be extended to all commercial whaling until:

the consequences for the ecosystems concerned of removing large portions of the whales' populations, and such populations' capacity for recovery, can be predicted;

permitted levels of exploitation are safe, and an effective mechanism exists for detecting and correcting mistakes in the management of any stock;

member nations of the IWC are no longer purchasing whale products from, or transferring whaling technology and equipment to, or otherwise supporting, non-member nations, or pirate whaling ships.

6. The dumping of wastes at sea is regulated by the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter and by regional conventions for which it provides the framework⁶. Those states not yet party to this convention are urged to join it. It is also important to control the effects of deep sea mining (including oil exploitation); for this to be done it is necessary to learn what those effects are. Accordingly, an internationally agreed area should be established, in which deep sea mining is prohibited, as a baseline area to aid the long term evaluation of the effects of deep sea mining.

7. In addition, all nations engaged in, or considering, deep sea mining activities—or any other activities with currently unpredictable effects on open ocean ecosystems—should:

precede commercial mining operations or similar activities by commissioning a comprehensive ecological survey to determine the impact of such activities;

designate appropriate areas of the deep sea bed as baseline reference and resource zones in which no mining or other significant disturbance will be allowed, ensuring that the size and shape of each area is such that its stability will be maintained;

establish guidelines for scientific research to ensure minimum disruption of the natural state of such areas, and provide for full exchange of information on the results of research.

The atmosphere and climate

8. The behaviour of the atmosphere, like that of the ocean, is indifferent to political boundaries. Impacts on the atmosphere in one country can affect the living resources of other countries, both directly and by altering climate. Such impacts are increasing. Acid rain caused by excessive emissions of sulphur dioxide, mainly in Europe and North America, has reduced the productivity of many lakes, rivers and forests in countries other than the sources of the pollution⁷. The accumulation in the atmosphere of other gases—such as carbon tetrachloride and methylchloroform (used in industrial solvents), nitrous oxides from the decomposition of nitrogen compounds, the chlorofluoromethanes (used in refrigerators, air conditioners and aerosol sprays) and carbon dioxide—is potentially a still more serious problem because of its possible effects on climate. For example, it has been estimated that if chlorofluoromethanes continue to be released at current rates, the ozone layer could be reduced by up to 15% by the middle of the next century, which in turn could impair human health and the productivity of the biosphere⁸.

9. Major alterations of the land surface—such as forest clearance, massive water impoundments and irrigation sys-

Notes and references

1. Argentina, Australia, Chile, France, New Zealand, Norway and the United Kingdom have claimed parts of Antarctica. These seven claimants, and Belgium, Japan, South Africa, USA and USSR are the signatory powers of the Antarctic Treaty. Brazil, Bulgaria, Czechoslovakia, Denmark, the German Democratic Republic, the Federal Republic of Germany, the Netherlands, Poland and Romania have acceded to the treaty but do not have full consultative status.
2. 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). Whaling is regulated by the International Whaling Commission (IWC).

3. The Indian Ocean Sanctuary comprises the waters of the Northern Hemisphere from the coast of Africa to 100° E, including the Red and Arabian Seas and the Gulf of Oman; and the waters of the Southern Hemisphere in the sector from 20° E to 130° E, with the southern boundary set at 55° S. The prohibition on commercial whaling in this area applies for 10 years from 1979, with the provision for a general review after 5 years, unless the IWC decides otherwise.

4. Cetaceans are whales, dolphins and porpoises. A cetacean sanctuary is an area in which designated cetacean populations spend all or critical parts of their life cycles, where they are not subject to killing, capture or harassment by humans, and where other human activities affecting them are prohibited or controlled so that there will be no deterioration in those environmental qualities necessary for the welfare of the cetaceans. Priorities and technical, legal and management considerations for cetacean sanctuaries are reviewed in: IUCN/WWF/UNEP, 1979. Proceedings of a workshop on cetacean sanctuaries, Tijuana and Guerrero Negro, B.C., Mexico, 4-9 February 1979. Mimeo. IUCN.



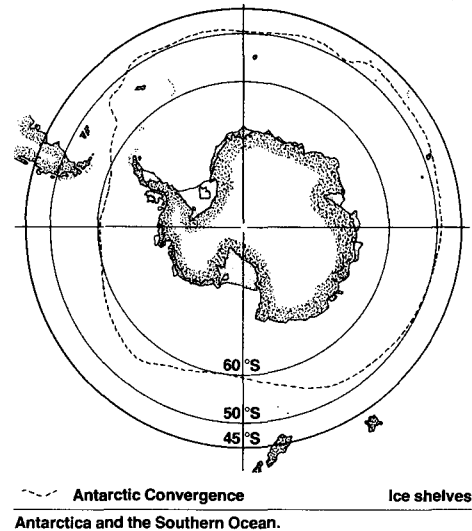
tems, and the expansion of urban areas—also have the potential to alter local or regional climates, for example by changing heat and moisture exchange between the surface and the atmosphere⁸. The most acute climatic problem, however, is carbon dioxide accumulation, as a result of the burning of fossil fuels, deforestation and changes in land use. At present rates of increase, the atmospheric concentration of carbon dioxide may produce a significant warming of the lower atmosphere before the middle of the next century, particularly in the polar regions. This warming would probably change temperature patterns throughout most of the world, benefitting some regions and damaging others, possibly severely⁸.

10. Since it would be necessary to redirect many aspects of the world economy, including energy production and agriculture, to halt or reduce further atmospheric carbon dioxide accumulation, accelerated research at the national and international levels is required to determine more precisely the likely climatic and other effects and their socio-economic consequences. There is also a general need for better climatic data, for clarification of the relative roles of human and natural influences on climate, and for improved understanding of the impact of climate change on human activities. Research into all these issues is the main thrust of the World Climate Programme sponsored by the World Meteorological Organization, and this programme deserves the strongest support of all nations. In addition, the immediate problem of acid rain requires not merely continued research but a reduction by European and North American countries of sulphur dioxide emissions. It is most important that states join and implement the Convention on Long-range Transboundary Air Pollution⁹.

Antarctica and the Southern Ocean

11. Antarctica and the Southern Ocean are defined as all land and sea south of the Antarctic Convergence (the well-defined but fluctuating line where the cold surface waters of the Southern Ocean sink beneath the warmer waters of the cold-temperate Atlantic, Indian

and Pacific Oceans—see map). 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.



Antarctica and the Southern Ocean.

Under this treaty, Antarctica may be used only for peaceful purposes—principally scientific research. Conservation of the living 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 ratified¹⁰.

12. Currently the potential of krill (*Euphausia superba*), a tiny shrimp-like creature, swarming in huge quantities in the Southern Ocean, is 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—thereby doubling the world’s current annual fish catch¹¹. However, krill are the major food of five species of great whales, including the endangered blue whale and humpback whale, and are also important for three species of seals, many seabird species and several species of fish. Unless krill harvesting is extremely carefully and conservatively regulated, its effects on other Southern Ocean species could be devastating. A convention to regulate the taking of the living resources of the Southern Ocean is being negotiated, and is expected to be followed by a regime for mining and oil exploitation.

13. Any regime for the exploitation of the living marine resources of the

Southern Ocean should so regulate the krill fishery as to prevent:

- irreversible changes in the populations of krill;
- irreversible changes in the populations of the baleen whales and those seal, fish and bird species which feed on krill, as well as in the Southern Ocean ecosystem as a whole;
- overcapitalization of krill fishing fleets, which could make it more difficult to agree on a reduction of the krill take should this prove necessary, and could have severe impacts on fisheries outside the Southern Ocean, due to the need to redeploy the krill fleets during the Antarctic winter.

An independent observer system should be provided for in such regulations.

14. 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. Baseline areas where no krill or other living or non-living resources may be taken should be set aside and given complete protection, so that impacts outside can be monitored and evaluated correctly. The dimension and location of these areas should be established according to the best available knowledge of the ecosystems concerned. Current research efforts should be strongly supported; and the collection, analysis and dissemination of biological information should be mandatory. An International Decade of Southern Ocean Research, focussing particularly on ecological processes, should be initiated as a matter of urgency. Investigation of the possible environmental impacts of tourism, scientific research, mining and oil exploitation, and so on, should be continued. 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.

5. The IWC agreed the moratorium at its 31st Annual Meeting, 9-13 July 1979.

6. The Convention, adopted in London on 29 December 1972, came into force on 30 August 1975. The depositary governments are Mexico, USSR, United Kingdom and USA. The Convention prohibits the dumping of certain substances (a “black list” of which includes organohalogen compounds, mercury, cadmium, persistent plastics, oil and high-level radioactive wastes) and strictly controls the dumping of other substances (a “grey list” of which includes arsenic, lead, copper, zinc, organosilicon compounds, cyanides, fluorides, and pesticides). Two regional

dumping agreements are the Oslo (European) Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft; and the Barcelona (Mediterranean) Protocol for the prevention of pollution of the Mediterranean Sea by dumping from ships and aircraft.

7. Likens, Gene E., Richard F. Wright, James N. Galloway and Thomas J. Butler. 1979. Acid rain. *Scientific American*, 241 (4): 39-47.

8. World Climate Conference. 1979. *Declaration and supporting documents*. World Meteorological Organization, Geneva.

9. The Convention, adopted in Geneva on 13 November 1979, obliges parties to make every effort to reduce air pollution, especially the discharge of pollutants carried by winds across frontiers.

10. 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.

11. Everson, Inigo. 1977. *The living resources of the Southern Ocean*. FAO, Rome.

19. Regional strategies for international river

1. The purpose of regional strategies is to stimulate national action where it is most needed, to help solve common problems, and in particular to advance the conservation of shared living resources (see box). Each regional strategy, which should be prepared along the lines of national strategies, should aim for at least four products:

agreements on the joint conservation of shared living resources;

model examples of how common problems can be tackled successfully; joint organizations where appropriate and where more cost-effective than several national organizations (for example, for training, for research and monitoring, or for the management of shared living resources);

improved information for national decision making.

Each "region" should be an ecological unit in which by definition many of the living resources will be shared. Obvious examples, and priority candidates for regional strategies, are international river basins and seas.

2. Soil and water conservation and the conservation of marine living resources not only require a cross-sectoral approach at the national level, they frequently demand international cooperation as well. This is certainly the case with international river basins and seas. International river basins are drainage basins or catchment areas shared by two or more states and communicating directly with the sea or inland lakes. International seas are either semi-enclosed seas shared by two or more states or more open seas in which areas under the jurisdiction of two or more states are closely linked by currents or by animal migrations. Both in international river basins and in international seas the living resources of one country are likely to be affected by events in another—such as pollution, alteration of habitats, or overfishing. Hence international cooperation is generally necessary for pollution control and for rational utilization of resources. Cooperation also provides opportunities to improve efficiency and achieve economies through joint action as well as for international technical and financial assistance to support that action.

International river basins

3. There are more than 200 international river basins: 57 in Africa, 48 in Europe, 40 in Asia, 36 in South America and 33 in North and Central America¹ (see map 4 in the map section). They include river basins experiencing the most severe soil erosion in the world (the amount of sediment load in relation to the size of the drainage basin is a measure of the intensity of erosion—see table below).

River	Drainage basin thousand km ²	Average annual suspended load	
		million tonnes	tonnes/ km ²
Huang (Yellow)	673	1,887	2,804
Ganges*	956	1,451	1,518
Brahmaputra*	666	726	1,090
Yangtze	1,942	499	257
Indus*	969	435	449
Ching	57	408	7,158
Amazon*	5,776	363	63
Mississippi	3,222	312	97
Irrawaddy*	430	299	695
Missouri	1,370	218	159
Lo	26	190	7,308
Kosi	62	172	2,774
Mekong*	795	170	214
Colorado*	637	135	212
Red*	119	130	1,092
Nile*	2,978	111	37

* International river basin.

Major rivers of the world ranked by sediment load. Source: 2.

4. Joint use of watercourses has always depended on cooperation among the riparian states, and some of the oldest international organizations were created to manage river navigation on the Rhine and the Danube. The use of international inland waters has steadily expanded: 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, hydroelectric installations, irrigation and water supply works and pollution in 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.

5. Failure to reconcile the competing interests of upstream and downstream users has generated considerable political friction in many parts of the world. 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 no-

table regional improvements, however—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 and the Lake Chad Basin Commission.

6. To evaluate these experiences, with a view to their adaptation in other regions, an appropriate international organization should undertake a review of the conservation needs and problems of international river basins, as a prelude to joint research and action plans by the riparian countries concerned, possibly along the lines of UNEP's regional seas programme (see below). Priority should be given to international river basins scheduled for major development or subject to severe erosion. Regions most susceptible to erosion are those in the tropics receiving medium to high rainfall; there is also a positive correlation between heavy sediment loads and close proximity of mountains to the sea³.

International seas

7. Most large maritime nations and several smaller ones have extended their national jurisdictions by declaring Exclusive Economic Zones (EEZs) for 200 nautical miles from their shores. Others are likely to do the same. These moves mean that the international agreements covering most regional fisheries commissions must be renegotiated. Several have been already. The new powers and resources of coastal states provide an outstanding opportunity to ensure that the new organizations necessary for the responsible exercise of those powers are designed and authorized to manage living resources as ecological entities, along the lines set out in section 11. There are signs, however, that ecological considerations are being given insufficient weight and that this opportunity will be missed.

8. The establishment of EEZs adds to the incentives for coastal states to protect the habitats critical for fisheries since they now control the fisheries—at least of non-migratory species—which the habitats support. By protecting the habitats, and by seeing to it that the fisheries themselves are exploited on a sustainable basis, they will assure both a regular high quality protein supply and often a substantial income. Many spe-

Notes and references

1. Centre for Natural Resources, Energy and Transport of the Department of Economic and Social Affairs of the United

Nations, 1978. Register of international rivers. *Water Supply and Management*, 2:1-58.

2. Holeman, N. 1968. The sediment yields of major rivers of the world. *Water Resources Research*, 4:737-747. Cited by: FAO, 1978. (see ref. 3).



cies, however, move between one EEZ and another, and between EEZs and the ocean beyond national jurisdiction. In addition, as the results of oil spills regularly demonstrate, currents carry pollutants from one EEZ to another. Therefore the need for international cooperation and for ecologically sound management remains unchanged.

9. New or improved bilateral and multilateral management agreements are needed to ensure that marine pollution is controlled and marine living resources exploited sustainably. Regional efforts to regulate pollution of the sea—notably those being made by governments in cooperation with UNEP's regional seas programme—should be intensified, and similar efforts should be initiated wherever groups of nations share common bodies of water. Experience with UNEP's regional seas programme has shown that there is great scope for regional agreements, elaborated by specific technical protocols, and backed up if necessary by the establishment of regional organizations.

10. Regional strategies should pay particular attention to: the status of fisheries and other living resources and measures to ensure they are utilized sustainably; the protection and maintenance of the critical habitats (feeding, breeding, nursery, and resting areas) of economically or culturally important species and of threatened or unique species; the preservation of genetically rich areas such as coral reefs; the protection and maintenance of the support systems of critical habitats and of genetically rich areas; measures to control pollution and as far as possible to prevent accidents such as oil spills; provision for a rapid and effective response to such accidents. The causes, magnitude and consequences of environmental problems should be evaluated; critical habitats, genetically rich areas and their support systems should be mapped (showing, where known, the rough timing and periodicity of the processes involved and the extent to which critical habitats have been observed to change with variations in climate and other environmental factors); and present and projected uses of and impacts on the ecosystems and species concerned should be analyzed so that compatibilities and conflicts may be revealed and decisions made accordingly.

11. Regions likely to benefit most from marine conservation strategies are: regions that depend heavily on marine living resources (whether for food or foreign exchange); regions in which countries have gained major fisheries (bigger than 50,000 tonnes per year) as a result of extending national jurisdictions to 200 nautical miles from shore; or regions where international conservation programmes have already begun. The first two are shown on map 5 in the map section; the last include the regions covered by UNEP's regional seas programme: the Mediterranean, the Gulf as defined by the Kuwait Action Plan, the Red Sea (with the Arab League Educational, Cultural and Scientific Organization—ALECSO), the Caribbean (with the United Nations Economic Commission for Latin America—ECLA), West African waters, East Asian waters, the Southwest Pacific, and the Southeast Pacific.

12. In addition, because the Arctic environment takes so long to recover from damage, the Arctic should be considered a priority sea. Within their Arctic territories the Arctic nations should systematically map critical ecological areas (terrestrial as well as marine), draw up guidelines for their long term management, and establish a network of protected areas to safeguard representative, unique and critical ecosystems. Since various conservation problems in the Arctic relate to areas or populations beyond national jurisdiction or which are of common concern to two or more of the Arctic nations, a meeting to identify and discuss such problems would probably facilitate conservation in the region. Among items of common concern are:

measures (including joint research) to improve protection of migratory species breeding within the Arctic and wintering inside or outside the region; studies of the impact of fisheries and other economic activities in the northern seas on ecosystems and non-target species;

the possibility of developing agreements among the Arctic nations on the conservation of the region's vital biological resources, based on the principles and experience of the Agreement on Conservation of Polar Bears.

Shared resources

Shared resources are defined here as ecosystems and species shared by two or more states (including species that move between one national jurisdiction and another) and ecosystems and species that depend on or are affected by events in another. They include ecosystems and species of international river basins and many coastal ecosystems and associated fisheries; and they also include migratory species. It is strongly urged that all states observe the Draft Principles of Conduct in the Field of the Environment for the Guidance of States in the Conservation and Harmonious Utilization of Natural Resources Shared by Two or More States, prepared by UNEP and recommended by its Governing Council to the General Assembly of the United Nations for adoption. These principles stress the need for states to:

cooperate in controlling, preventing, reducing or eliminating adverse environmental effects that may arise from the utilization of shared natural resources;

avoid environmental damage that could have repercussions on the utilization of the resource by another sharing state;

make environmental impact assessments before engaging in any activity with respect to a shared natural resource that may significantly affect the resource or the environment of another sharing state;

give other sharing states in advance the details of any plans to begin or change the conservation or utilization of a shared natural resource, and consult with them and provide additional pertinent information on request;

engage in joint scientific studies and assessments;

compensate for damage to shared natural resources or arising out of the utilization of such resources; and provide persons in other states who have been or may be harmed by such damage with equivalent access to and treatment in the same administrative and judicial proceedings as are available to nationals.

20. Towards sustainable development

1. Development and conservation operate in the same global context, and the underlying problems that must be overcome if either is to be successful are identical.

2. Much habitat destruction and over-exploitation of living resources by individuals, communities and nations in the developing world is a response to relative poverty, caused or exacerbated by a combination of human population growth and inequities within and among nations. Peasant communities, for example, may be forced to cultivate steep, unstable slopes because their growing numbers exceed the capacity of the land and because the fertile, easily managed valley bottoms have been taken over by large land-owners. Similarly, many developing countries have so few natural resources and operate under such unfavourable conditions of international trade that often they have very little choice but to exploit forests, fisheries and other living resources unsustainably. In many parts of the world population pressures are making demands on resources beyond the capacity of those resources to sustain. Every country should have a conscious population policy to avoid as far as possible the spread of such situations, and eventually to achieve a balance between numbers and environment. At the same time, it is essential that the affluent constrain their demands on resources, and preferably reduce them, shifting some of their wealth to assisting the deprived. To a significant extent the survival and future of the poor depends on conservation and sharing by the rich.

3. During the 1980s, the Third United Nations Development Decade, the efforts of the international community to remove the main obstacles to development and to raise the living standards of the poor in a sustained and rapid manner will focus on the new International Development Strategy. The ultimate aims of this strategy are "(a) to redress the inequities in the relations between richer and poorer nations; (b) to establish a more dynamic, more stable and less vulnerable world economy, in which all countries have opportunities to participate on a fuller and more equal basis; (c) to stimulate accelerated economic growth in the poorer countries of the world; and (d) to reduce and eventually overcome the worst aspects of poverty

by improving the lot of the hundreds of millions of people now living in abject poverty and despair"¹.

4. The lack of progress so far in achieving these aims thwarts conservation as much as it does development. Hence it is as necessary for conservation as it is for development that during the 1980s:

- a. trade be liberalized, including the removal of all trade barriers to goods from developing countries;
- b. the flow of finance and development assistance be increased, including as a minimum the renewal of the objective of 0.7% of the gross national product of developed countries as official development assistance;
- c. the proportion of development assistance going to low-income countries (those countries with per capita incomes of \$300 or less—in which live two-thirds of the poor in developing countries) be increased to at least two-thirds and preferably to three-quarters;
- d. the international monetary system be reformed;
- e. a code of conduct for transnational companies be adopted;
- f. there be much more rapid progress on disarmament (expenditure on arms and military activities currently absorbs \$400,000 million a year);
- g. economic and social growth be accelerated, especially in the poorest countries, ensuring that economic and social goals are mutually supporting, and emphasizing better health, better housing, and higher educational levels and skills¹.

5. Achievement of equitable, sustainable development requires implementation not only of the measures indicated above but also of the World Conservation Strategy. Accordingly it is strongly recommended that the objectives of the World Conservation Strategy—the maintenance of essential ecological processes and life-support systems, the preservation of genetic diversity, and the sustainable utilization of species and ecosystems—be included in the new International Development Strategy. National development plans and multilateral and bilateral programmes to assist them should provide for the requirements and actions listed in the box opposite.

6. Living resource conservation is essential for the achievement of several development targets, for example: increased growth in food production; development and efficient expansion of environmentally benign forms of energy; more efficient use of raw materials; prevention and reduction of desertification, of soil degradation and loss, and of living resource overexploitation; and attainment of an acceptable level of health for all. Conservation is entirely compatible with the growing demand for "people-centred" development, that achieves a wider distribution of benefits to whole populations (better nutrition, health, education, family welfare, fuller employment, greater income security, protection from environmental degradation); that makes fuller use of people's labour, capabilities, motivations and creativity; and is more sensitive to cultural heritage.

Coordination and follow-up

7. The organizations most involved in the preparation of the World Conservation Strategy (IUCN, UNEP, WWF, FAO and Unesco), recognize the need to carry out international action to implement the Strategy and to stimulate and support national action. For its part, IUCN will promote the implementation of the World Conservation Strategy, particularly of national strategies and of action at the international level; will monitor implementation as closely as possible; will publish regular news of implementation and will issue a full progress report every three years. The progress report will cover:

what governments and organizations are doing to implement the Strategy;

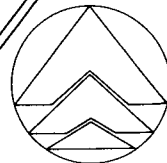
whether what they are doing is likely to alleviate the problem or achieve the objective concerned;

in due course, the extent to which the three conservation objectives have been achieved.

8. The problems posed by the destruction, degradation and depletion of living 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 seemingly divergent but basi-

Notes and references

1. Committee for Development Planning. 1979. *Report on the Fifteenth Session (26 March-5 April 1979)*. Economic and Social Council Official Records, 1979. Supplement No. 7. United Nations, New York.



cally compatible aims that would be better able to tackle the problems 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 means available to

much greater effect. If this is done, then the prospects for conservation—and for sustainable development—will be much enhanced.

Checklist of priority requirements, national actions and international actions

Numbers in parentheses refer to the sections and paragraphs in which the requirement or action is explained.

1. Priority requirements

- a. reservation of prime quality cropland for crops (5.1-5.2);
- b. adoption of management practices to maintain the productivity of cropland, grazing land and forests (5.3-5.5; 7.9; 7.11-7.12);
- c. prevention of soil degradation, and restoration of land where soils are already degraded (5.5);
- d. protection of watersheds, especially upper catchment areas (5.6);
- e. maintenance of the support systems of fisheries (5.7);
- f. control of pollution (5.8);
- g. prevention of species extinctions (6.1-6.3);
- h. preservation of as many varieties as possible of domesticated and other economic or useful plants, animals and microorganisms and their wild relatives (6.4-6.7);
- i. establishment of a comprehensive network of protected areas, securing the habitats of threatened, unique and other important species, unique ecosystems, and representative samples of ecosystem types (6.8-6.12);
- j. regulation of living resource utilization so that it is sustainable (7.1-7.4; 7.6; 7.8; 7.10);
- k. reduction of incidental take (7.5);
- l. maintenance of the habitats of utilized species (7.7);
- m. careful allocation and management of timber concessions (7.9).

2. Priority national actions

- a. preparation and implementation of national and/or subnational conservation strategies (8.1-8.10);
- b. adoption of anticipatory environmental policies (9.6-9.7; 9.13);
- c. adoption of a cross-sectoral conservation policy (9.8-9.12);
- d. inclusion of non-monetary indicators of conservation performance in national accounting systems (9.14);
- e. preparation of ecosystem evaluations (10.3-10.5);

- f. advance assessment of the likely environmental effects of all major actions (10.6-10.7);
- g. adoption of a procedure for allocating land and water uses based on ecosystem evaluation and environmental assessment (10.8-10.11);
- h. review and strengthening of legislation concerning living resources to ensure that it provides sufficiently for conservation, paying particular attention to enforcement (11.7-11.9);
- i. review and improvement of the status, organization, funding and staffing of agencies with responsibilities for living resources (11.10-11.12);
- j. establishment of a soil and water conservation body at the policy making level (11.13);
- k. establishment of new organizations or of special measures to coordinate existing ones for the comprehensive management of marine living resources (11.14);

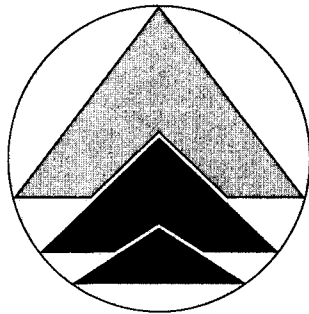
- l. review and strengthening of training facilities at the professional, technician and user levels (12.5-12.8);
- m. increased research to improve the management of living resources (12.9-12.13);
- n. greater public participation in decisions concerning living resources (13.4-13.5);
- o. environmental education campaigns and programmes, particularly for the users of living resources, legislators and decision makers, schoolchildren and students (13.6-13.14);
- p. rural development combining short term measures to ensure human survival with long term measures to safeguard the resource base and improve the quality of life (14.5-14.11).

3. Priority international actions

- a. review of the coverage and effectiveness of international law relevant to living resources, and development of new law to remedy any deficiencies (15.4-15.10);

- b. implementation of international conservation conventions (15.5-15.9);
- c. multilateral and bilateral assistance for reforestation, the restoration of degraded environments, and the protection of the support systems of fisheries and of genetic resources (15.11);
- d. multilateral and bilateral assistance for the design and implementation of ecologically appropriate policies and the establishment and maintenance of effective conservation procedures, laws and organizations (15.11-15.12);
- e. cooperative programmes for conservation of tropical forests (16.1-16.7);
- f. cooperative programmes for conservation of drylands (16.8-16.12);
- g. a cooperative programme for the on site protection of the wild relatives of economic or useful species, of threatened species, and of ecosystems of exceptional diversity (17.1-17.15);
- h. conservation of the species and ecosystems of the open ocean (18.2-18.7);
- i. implementation of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, of the Convention on the Regulation of Long-range Transboundary Air Pollution, and of analogous regional conventions (18.6-18.10);
- j. control of deep sea mining (18.7);
- k. support for the World Climate Programme (18.8-18.10);
- l. conservation of the living resources of Antarctica and the Southern Ocean (18.11-18.14);
- m. regional strategies for the conservation of the living resources of international river basins (19.1-19.6);
- n. regional strategies for the conservation of the living resources of international seas (19.1-19.2; 19.7-19.12).

WORLD CONSERVATION STRATEGY








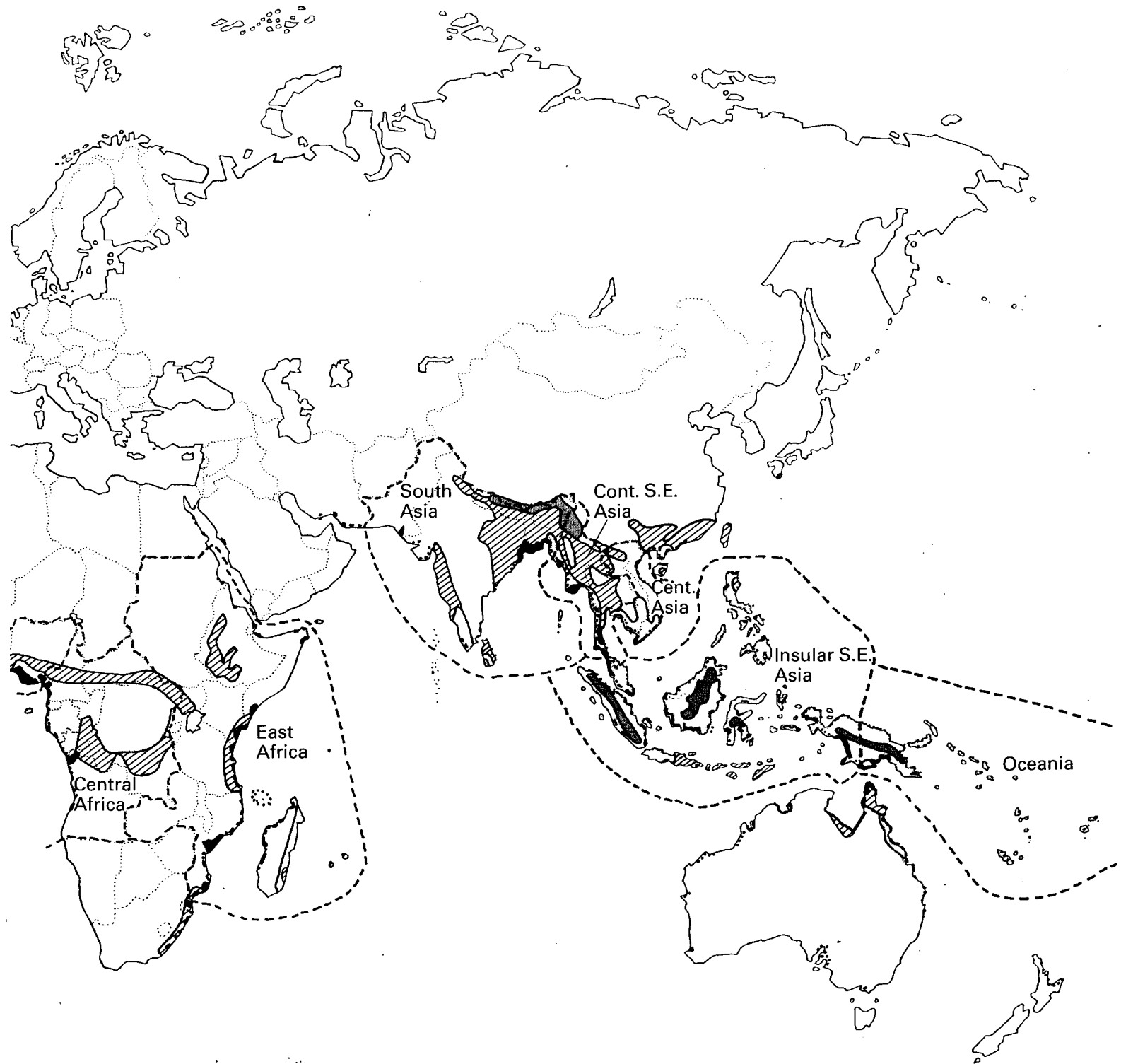
Map Section

The maps in this section are not precise but illustrative. The designations employed and the presentation of material in this section do not imply the expression of any opinion whatsoever on the part of IUCN, UNEP or WWF concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

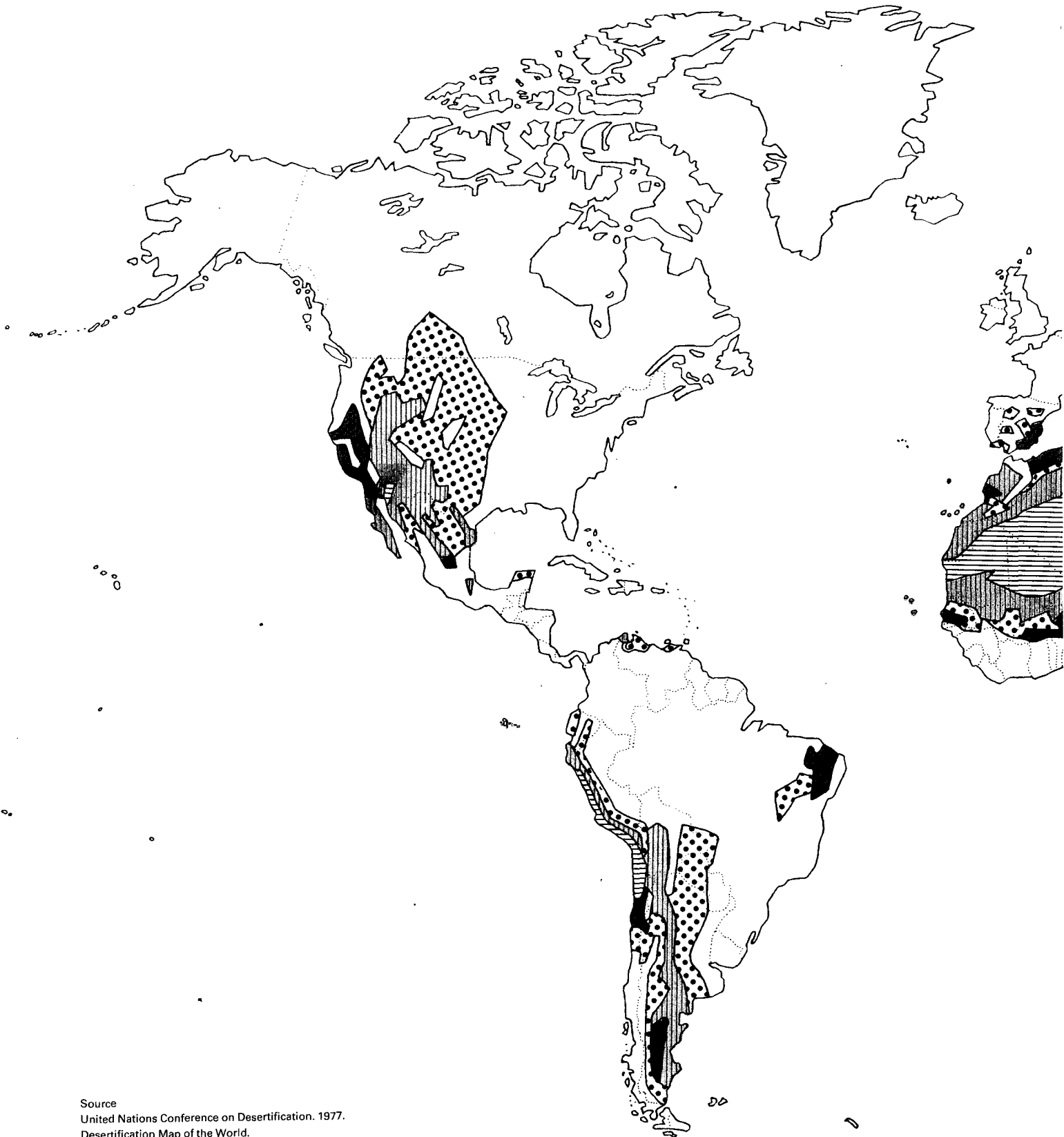
1. Tropical forests



-  Tropical lowland rain forest.
-  Tropical montane rain forest.
-  Tropical semievergreen and monsoon forest.
-  Mangroves.
-  Regional boundaries (see section 16).



2. Deserts and areas subject to desertification



Source
United Nations Conference on Desertification, 1977.
Desertification Map of the World.
UNEP/FAO/Unesco/WMO.

Risk of desertification.



Very High.



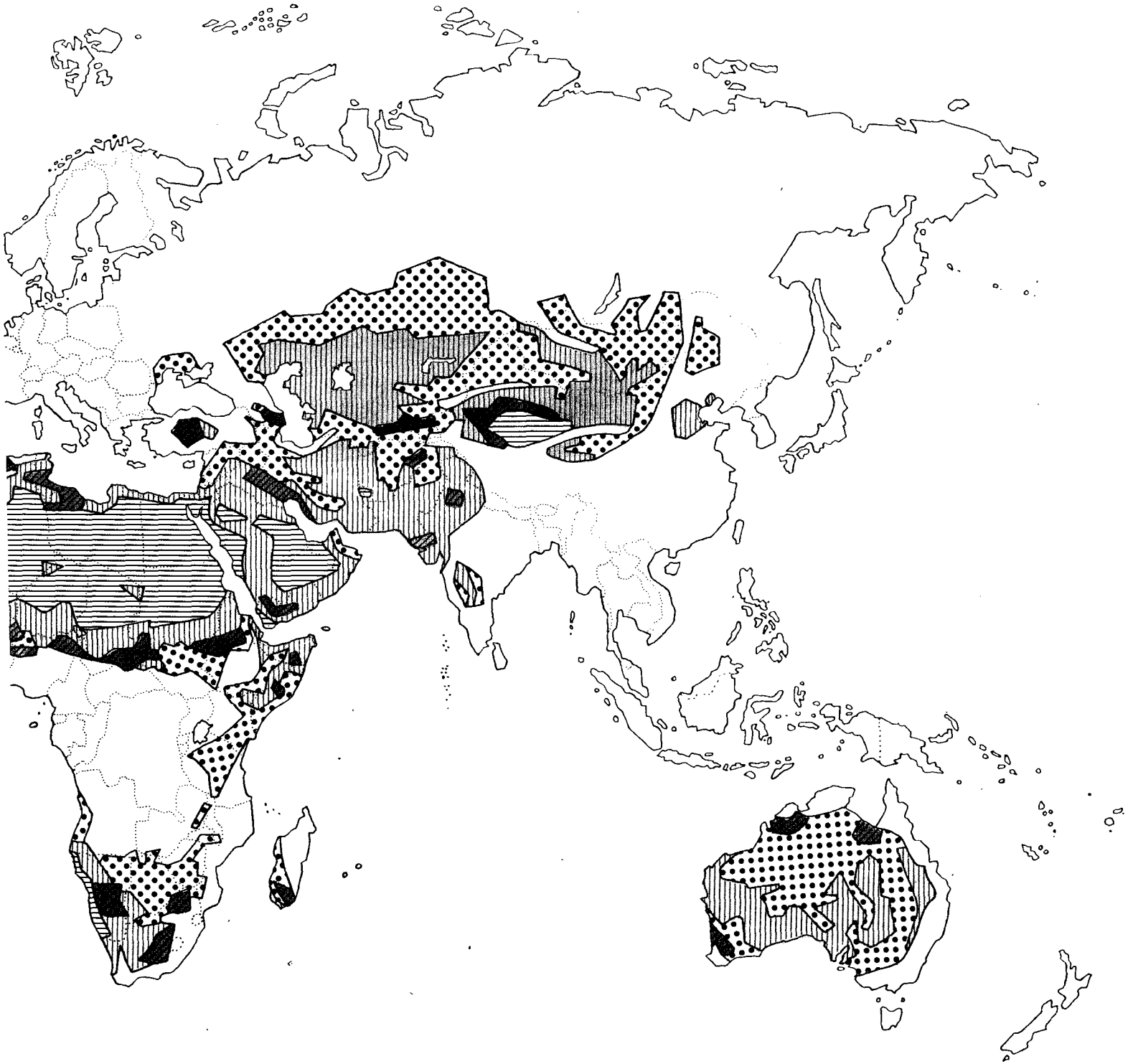
High.



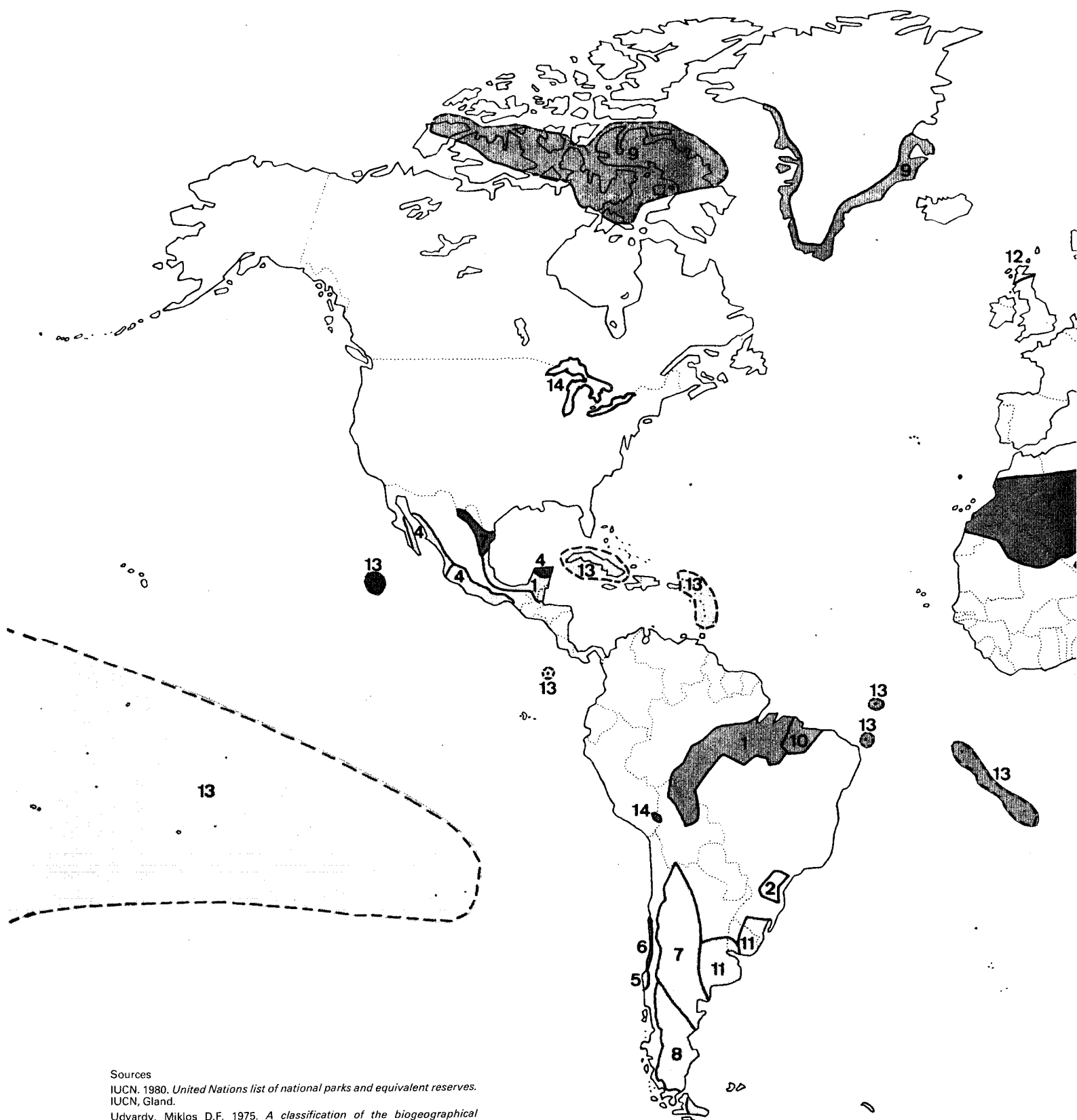
Moderate.



Hyperarid zones (deserts).




3. Priority biogeographical provinces of the land for the establishment of protected areas




Sources

IUCN. 1980. *United Nations list of national parks and equivalent reserves*. IUCN, Gland.

Udvardy, Miklos D.F. 1975. *A classification of the biogeographical provinces of the world*. IUCN, Gland.

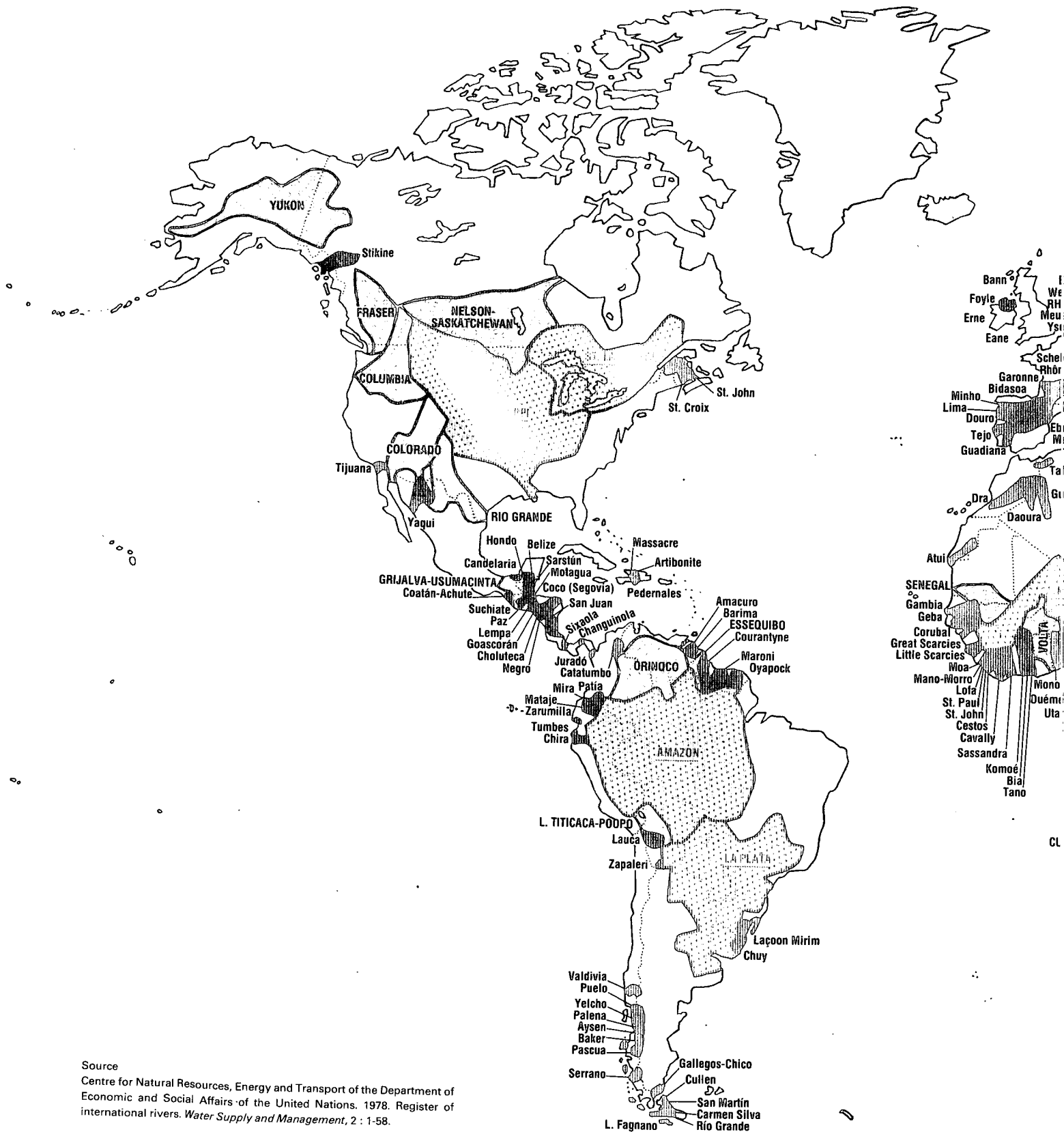
 High priority: biogeographical provinces with no national parks or equivalent reserves.

 Priority: biogeographical provinces in which national parks or equivalent reserves protect a total area smaller than 1000 km² (or smaller than 100 km² in the case of oceanic island provinces).





1. Tropical humid (rain) forests.
2. Subtropical and temperate rain forests.
3. Temperate needle-leaf forests.
4. Tropical dry or deciduous forests (including monsoon forests).
5. Temperate broadleaf forests (including subpolar deciduous thickets).
6. Evergreen sclerophyllous (Mediterranean-type) forests.
7. Warm deserts and semideserts.
8. Cold-winter deserts and semideserts.
9. Tundra and barren arctic desert.
10. Tropical grasslands and savannas.
11. Temperate grasslands.
12. Mixed mountain and highland systems.
13. Mixed island systems.
14. Lake systems.



4. International river basins

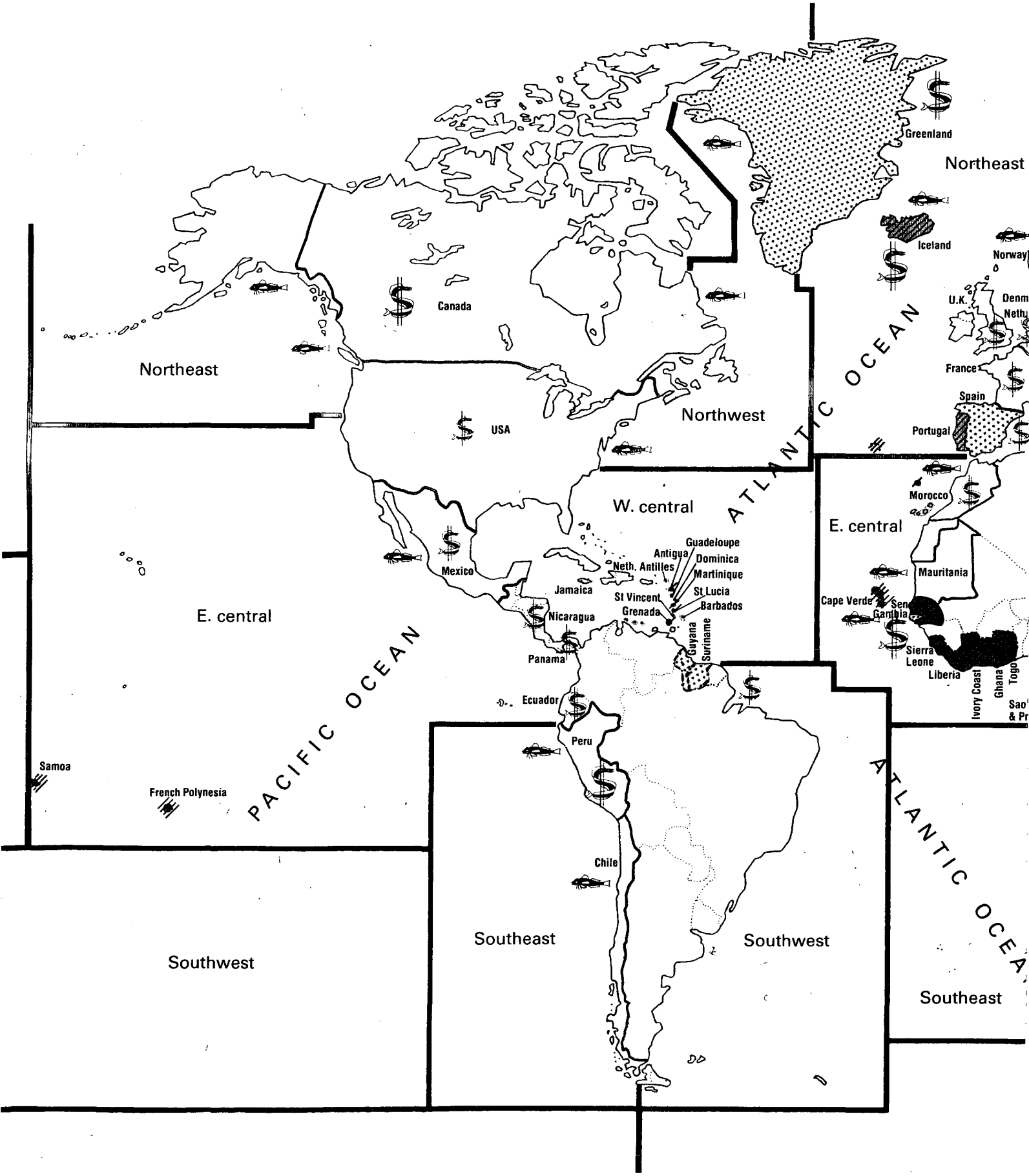



Source
 Centre for Natural Resources, Energy and Transport of the Department of
 Economic and Social Affairs of the United Nations. 1978. Register of
 international rivers. *Water Supply and Management*, 2 : 1-58.


-  **NILE** River basin more than 1,000,000 km².
-  **YUKON** River basin 100,000 - 1,000,000 km².
-  **Ebro** River basin less than 100,000 km².
-  Basin outline.





5. Major consumers and exporters of seafood and gainers of large fisheries





 Countries consuming 10 g or more of protein per person per day from seafood or deriving 15% or more of total protein supply from seafood or 30% or more of total animal protein supply from seafood (1972-1974 average).

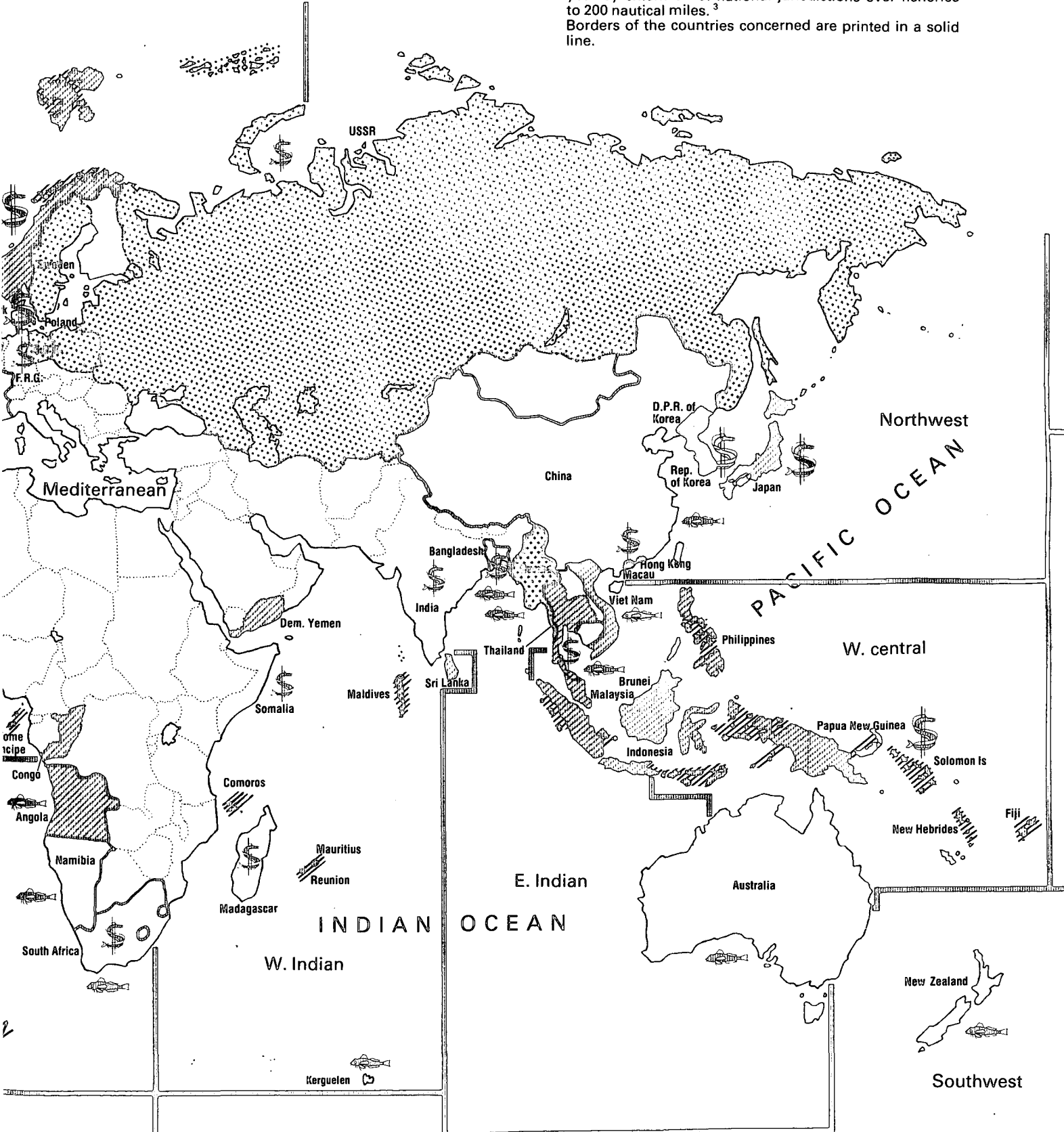
 Countries earning US \$ 300 million or more from seafood exports or deriving 10% or more of their export earnings from seafood exports (1975 figures).²

 Countries consuming 5-9.9 g of protein per person per day from seafood or deriving 10-14.9% of total protein supply from seafood or 20-29.9% of total animal protein supply from seafood (1972-1974 average).

 Countries earning US \$ 100-299 million from seafood exports or deriving 3-9.9% of their export earnings from seafood exports (1975 figures).²

 Marine boundaries are those of the FAO statistical regions.

 Countries gaining fisheries bigger than 50,000 tonnes per year by extension of national jurisdictions over fisheries to 200 nautical miles.³ Borders of the countries concerned are printed in a solid line.



Sources
 1. FAO. 1977. *Provisional food balance sheets, 1972-1974 average.* FAO, Rome.
 2. FAO. 1977. *FAO trade yearbook, 1976 (Vol. 30).* FAO, Rome.
 3. FAO. 1978. *Review of the state of world fishery resources.* Committee on Fisheries. Twelfth Session, Rome, 12-16 June 1978. COFI/78/Inf. 4.



IUCN (International Union for Conservation of Nature and Natural Resources) is a network of governments, nongovernmental organizations (NGOs), scientists and other conservation experts, joined together to promote the protection and sustainable use of living resources.

Founded in 1948, IUCN has more than 450 member governments and NGOs in over 100 countries. Its six Commissions consist of more than 700 experts on threatened species, protected areas, ecology, environmental planning, environmental policy, law and administration, and environmental education.

IUCN:

- monitors the status of ecosystems and species throughout the world;
- plans conservation action, both at the strategic level through the World Conservation Strategy and at the programme level through its programme of conservation for sustainable development;
- promotes such action by governments, intergovernmental bodies and nongovernmental organizations;
- provides assistance and advice necessary for the achievement of such action.



UNEP (the United Nations Environment Programme) was established in 1972. Its mandate is to keep the world environmental situation under review in order to ensure that emerging environmental problems of international significance receive appropriate consideration by governments, and to safeguard the environment for the benefit of present and future generations. It is the first global UN body with headquarters in a developing country (Kenya).

UNEP plays a catalytic and coordinating role with the organizations of the United Nations family and administers a fund, based on voluntary government contributions. The Fund of UNEP assists in promoting activities related to environmental assessment and management. Within UNEP's programme, the following priority areas have been identified: environmental health, terrestrial ecosystems, environment and development, oceans, energy and natural disasters.

The ultimate aim of UNEP's activities is to promote development that is environmentally-sound and sustainable.



WWF (World Wildlife Fund) is an international conservation foundation, based in Switzerland and with national organizations on five continents.

WWF's scope is the conservation of the natural environment and the ecological processes essential to life on earth.

WWF aims to create awareness of threats to the environment and to generate and attract on a worldwide basis the strongest possible moral and financial support for safeguarding the living world and to convert such support into action based on scientific priorities.

WWF ensures that its programme has a sound scientific basis by close collaboration with IUCN, with whom it shares a joint world headquarters.

Since its founding in 1961, WWF has channelled funds to more than 2,000 projects in over 130 countries, served as a catalyst for conservation action, brought its influence to bear on critical conservation situations, and provided a link between conservation needs, the scientific resources necessary to meet them, and the governments and other authorities whose action is needed.

WWF, with its distinguished international and national trustees, also provides a bridge for the conservation movement to the business community.

International Union for Conservation of Nature and Natural Resources
1196 Gland, Switzerland