



United Nations  
Environment  
Programme



Distr.  
GENERAL  
UNEP/GC/60  
21 January 1976  
Original: ENGLISH

GOVERNING COUNCIL  
Fourth session  
Nairobi, 30 March-14 April 1976  
Item 7(a) of the provisional agenda

REVIEW OF PRIORITY SUBJECT AREAS AND OF RELATED ACTIVITIES

Report of the Executive Director

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## Chapter I

### ACTION FOLLOWING THE THIRD SESSION OF THE GOVERNING COUNCIL

1. By its decision 27 (III) of 30 April 1975, "Review of the environmental situation and of activities related to the environment programme" 1/, the Governing Council took certain decisions regarding the content and presentation of future Level One reports, requested certain actions of the Executive Director, and invited the co-operation of Governments and international organizations in the preparation of the report.

2. The bulk of the present document comprises the reviews in the priority subject areas requested in paragraph 4(c) of the Governing Council decision, namely "Conservation of nature, wildlife and genetic resources" and "Oceans". These are divided into the following sub-areas in each of which an overview is presented:

- (i) Ecosystems, sites and samples
- (ii) Endangered species and wildlife
- (iii) Genetic resources
- (iv) Marine pollution
- (v) Marine living resources

These reviews are very abbreviated summaries of "Overviews" and "Activities related to the Environment Programme" which were prepared with the assistance of the agencies primarily concerned in the areas under consideration - FAO, UNESCO and its Intergovernmental Oceanographic Commission (IOC), and IUCN - and are published separately as background documents for this session of the Governing Council.

3. The Executive Director was also requested to prepare for this session a review in the priority subject area Environment and development. However, in view of the complexity and far reaching implications of the subject and the need to take into account the differing socio-economic structures in individual countries and the particular characteristics of different eco-regions, as recognized by the Governing Council in allocating a separate agenda item for this topic, the Executive Director considered that the document prepared for that item (UNEP/GC/76) would serve as a first "overview" of the subject. Only after the Governing Council has expressed its views and further refined the range of activity and interest to be included in this, at first sight, all-encompassing subject will it be possible to prepare a full review including information on related activities of organizations and Governments if the Governing Council feels that this is necessary after consideration of agenda item 4.

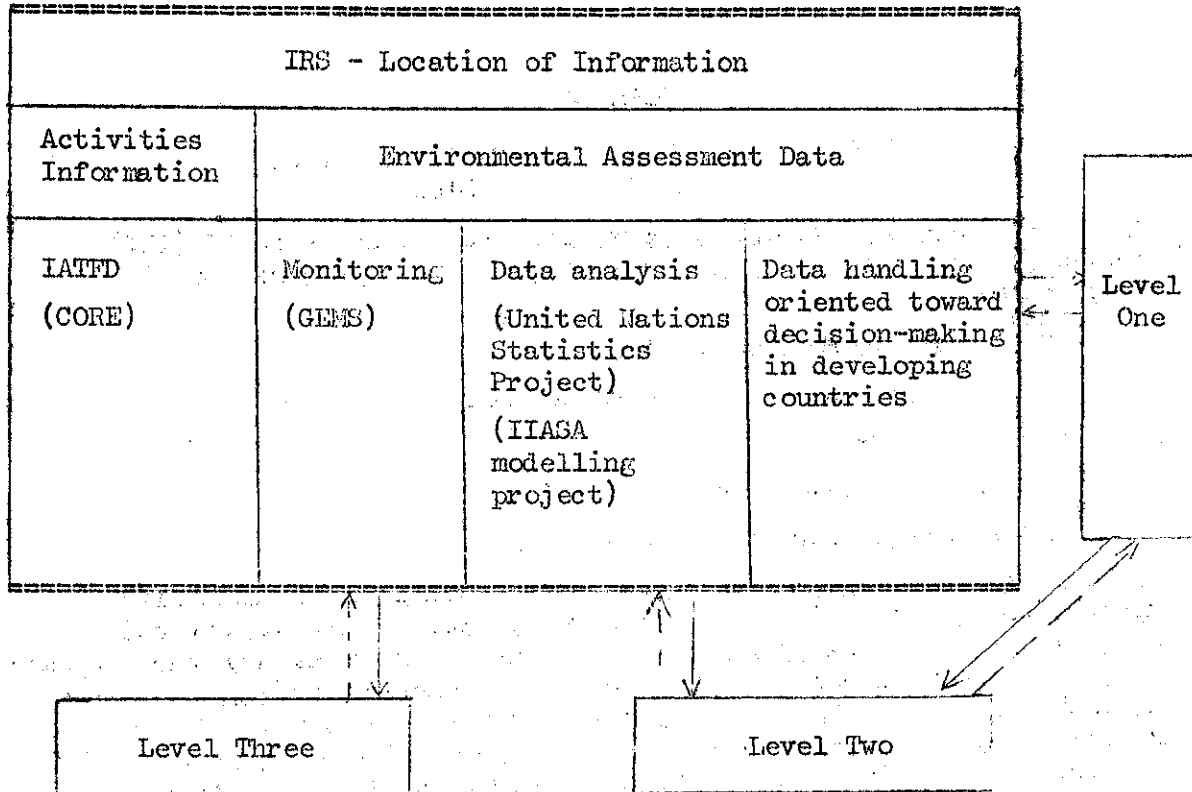
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1/ Official Records of the General Assembly, Thirtieth Session  
Supplement No.25, (A/10025), page 92.

4. The number of Governments responding to the request for information on their activities relevant to the subject areas under review was rather less than last year. However, from those Governments that did respond, some excellent and very comprehensive reports were received. The Executive Director considered that in most cases it would not do the reports justice to summarize them and decided to include them in toto in a separate publication presented in the language in which they were received. References to some of these national activities are, however, included in the following summary reviews.
5. A much greater effort was made to gather information on the activities on non-governmental organizations. Approximately 100 such organizations were identified as having activities or interest in the areas under review and of these 42 responded to the request for information. Thirty of them reported relevant activities and these are summarized in a descriptive form in the publication referred to earlier, with brief references to some of the most important activities given in the following reviews. Very little information was, however, provided on financial resources and expenditures.
6. In this connexion the Governing Council at its last session raised the question of the relationship between the resources of the United Nations system devoted to a particular activity and the actual needs. It is felt that this can be answered only by comparing the activities currently under way and planned (and the resources spent on them) with the identified gaps and proposed action plans contained in the reviews of each priority subject area. A common theme throughout this year's reviews is the need for a much greater understanding of how particular ecosystems and their component parts function and interact, of how and the extent to which man's activities influence them and their degree of resilience. One might therefore assume that the resources being devoted to research in this area need to be increased substantially. Quantifying this increase would, however, be extremely difficult, since by and large the resources of the United Nations system devoted to pure research represent only a very small proportion of the total research expenditure by Governments and national institutions. To take another example, a strong plea is made for training in all aspects of marine pollution monitoring and control. It is evident that the resources devoted to this area are far from sufficient, but to estimate if these should be doubled, tripled, or even more, would involve consideration of so many variable, and often unknown, factors (the significance of marine pollution in individual countries or regions, the numbers of trained personnel required at each level in each country, training costs in different countries, etc.) that it would provide little indication of the real state of affairs.
7. Further, it should be mentioned that the principal purposes of providing data on resources is to give an indication of existing priorities and emphasis within the United Nations system and to indicate the order of magnitude of resources devoted to a particular activity so that an appreciation may be made of the efforts required to change priorities or re-align objectives in accordance with UNEP's mandate to encourage the inclusion of the environmental dimension in any particular activity.

8. Paragraphs 1, 3 and 4(a) of decision 27 (III) relate to the establishment of a common environmental data base, the methods of collecting and presenting environmental data and their use in environmental models. In considering the concept of a common environmental data base, it has been found more efficient to deal with the various types and methodologies of handling data in parallel co-ordinated projects producing mutually related information, rather than to establish a single monolithic data bank. As the first step, a clear distinction is drawn between data for assessment purposes and data on activities for the purposes of the Level One exercise and for programme management.
9. The latter type of data were considered by the Inter-Agency Task Force on Data (IATFD), established pursuant to a decision of the second session of the Governing Council, at its second meeting in November 1975. The Task Force recognized that although it had been set up primarily to satisfy UNEP needs, its results could have benefits far beyond the purely environmental area. By providing a methodology for collecting information on activities, with sufficient flexibility, which could also be capable of satisfying such already-expressed requirements as those of UNEP, UNIDO and the Office of Science and Technology at United Nations Headquarters for activity information in their respective fields, an extremely useful tool for all agencies and Governments would be created. Although only a few agencies are actively considering mechanized systems, and although none of these are as yet operational, computerized programme management information systems are being developed in some agencies. The only fully computerized inter-agency system which now contains activity information is the Common Register of Development Activities (CORE), which was developed by the Inter-Organization Board on Information Systems (IOB). CORE is currently in a pilot operational phase, with the requirements of agencies being met on a case-by-case basis, and it is not expected to go into full operation until early 1977. Current contents of the pilot files include UNDP projects and WHO activities financed either from the regular budget or from extra-budgetary sources such as the Fund of UNEP. Agencies intending to make use of CORE are invited to make their requirements known as early as possible, particularly where these may affect the data collection procedures. For UNEP purposes, the inclusion of appropriate environmental references would be essential.
10. The Task Force considered, however, that CORE could be made capable of satisfying UNEP's needs if appropriate environmental references were added to CORE inputs so that information in terms of environmental parameters could be retrieved. The next step, therefore, was to set up a classification system, initially to satisfy UNEP's requirements, but ideally to take into account classifications used in other agencies and to meet their future needs also. The Executive Director has therefore set up a small unit for this purpose, which will work in close consultation with others, especially IOB, WHO, FAO and UNDP, and submit proposals to a meeting of the Task Force in 1976. The report of the Task Force was considered by ECB at its fifth session. The Board recommended that the Task Force should continue as long as necessary and be designated a subsidiary body of the Board.

11. The Executive Director has initiated several activities relating to the handling and use of data for assessment purposes. A project has been established with the United Nations Statistical Office on Environmental Statistics. The aim of this exercise is not just to cover clearly obvious gaps in current systems of national indicators, but also to ensure that environmental statistics are collected, together with other indicators, on a regular and internationally comparable basis.
12. A complementary project to develop methodologies for handling environmental data collection, storage and retrieval - on a national and/or sub-regional basis - and to assist in regional and national planning and decision making has been initiated. The methodologies developed will be implemented through pilot projects for the establishment of initially compatible individual environmental data banks in developing countries. The project will have a strong training component, providing manuals and textbooks on the handling and integration of environmental data. Initial efforts will concentrate on the handling of natural and physical data (on climate, hydrology, soils, vegetation, etc.) and their inter-relationships so that these can complement socio-economic data as a source of management information for Governments in preparing development plans and policies.
13. Finally, in connexion with the request in paragraph 4(b) of the decision to encourage and support the further development of global models as a basis for assessing particular environmental concerns, a project has been developed with the International Institute of Applied Systems Analysis (IIASA) in Austria, which is working on such models, to develop a coherent set of techniques appropriate for assessing the ecological consequences of alternate policies of development in a region. The techniques will be tested using six existing case studies in both developing and developed countries.
14. The whole system of data handling will be co-ordinated and mutually compatible with the International Referral System which will provide the means of locating environmental information. A schematic representation of how these various activities interact and provide the basic information for all levels of the programmatic approach might be as follows:



Chapter II

SUGGESTED ACTION BY THE GOVERNING COUNCIL  
AT ITS FOURTH SESSION

15. The Governing Council in paragraph 4(c) of decision 27 (III) requested that reviews in the following areas be prepared for its fifth session:

- Human settlements and habitat;
- Health of people and of the environment;
- Natural disasters;
- Environmental management;
- Environmental education and training.

To this should be added, if the Governing Council so decides after discussion of agenda item 4, the priority area of Environment and development. Several of these are very broad areas and for the purposes of the review will have to be divided in sub-areas requiring a review in each. In the light of this year's experience in preparing five reviews, the Executive Director has some reservations regarding the possibility of being able to prepare reviews in all the above areas in the next year and feels that an additional year should be taken to complete the reviews of all priority subject areas and functional tasks. The remaining areas fall conveniently into two groups - Human settlements, Health, and Natural disasters in one group and Environment and development, Environmental management and Environmental education and training in the other. It is therefore suggested that the Governing Council, taking into account the discussion and decisions under agenda item 4, may wish to reconsider its previous decision and request the Executive Director to prepare one of the above two groups of reviews in 1976 and the other in 1977.

16. Accordingly, the Governing Council may wish to consider taking a decision along the following lines:

"The Governing Council,

"Recalling decision 27 (III) of the third session of the Governing Council,

"Noting with gratitude the Level One report of the Executive Director,

"1. Endorses, subject to the comments made by delegations at the fourth session of the Governing Council, the action plans outlined in the reviews of the priority subject areas and notes with satisfaction that these have been taken into account in the preparation of Level Two of the environment programme;



"2. Notes the initiatives taken by the Executive Director towards the development of environmental statistics, environmental data banks as a source of management information for Governments, and the action of the Inter-Agency Task Force towards the development and co-ordination within the United Nations system of data information systems on environmental activities;

"3. Requests the Executive Director:

(a) Actively to pursue the initiatives in the field of acquisition and use of environmental data and to report on the progress made and on future prospects to the fifth session of the Governing Council;

(b) To submit to the Governing Council at its fifth session reviews in the following priority subject areas and/or functional tasks:

1.

2.

3.

and at its sixth session:

1.

2.

3.

"4. Notes with appreciation the response from Governments, United Nations organizations, other intergovernmental bodies, and non-governmental organizations to requests for information on their activities related to the environment programme;

"5. Reiterates its invitation to all Governments, organizations of the United Nations system, intergovernmental organizations and international non-governmental organizations, in accordance with General Assembly resolution 2997 (XXVII) of 15 December 1972, to co-operate fully with the Executive Director in the preparation of the review by providing the necessary data requested by him."

### Chapter III

## REVIEW OF THE PRIORITY SUBJECT AREAS "CONSERVATION OF MATURE, WILDLIFE AND GENETIC RESOURCES" AND "OCEANS"

### I. INTRODUCTION

17. Although for reasons of convenience and practicality the five topics dealt with in the following overviews are grouped in two separate priority subject areas of the environment programme, they are very closely interrelated; the problems and issues in each sub-area merge with and are inextricably bound up with those in the others. To take one of the topics as an example, marine living resources are essential components of the marine ecosystem which is subjected to serious degradation through pollution and over-exploitation, they are part of wildlife, including several endangered species, and they present a wealth of genetic diversity of great existing and potential benefit to man.

18. The central theme throughout the five overviews is the concept of conservation and protection as a part of planned ecologically sound management so that nature's resources and inherent diversity may be exploited for the greater benefit of man without in any way reducing or destroying them. The fact is, however, that this essential diversity which is fundamental to man's future is put at risk and lessened every day by thoughtless or ignorant acts of pollution and exploitation. It is now being realized that if there is to be any future benefit, we are going to have to learn to manage the environment, the resources of nature and ourselves according to the principles of biological systems rather than those of the market place.

19. Biologically speaking man has reached his present state of development largely through the exploitation of nature and wildlife; he has adapted and managed certain natural and wild species to meet his ever-growing needs. He still depends, however, on many unmanaged and unselected species to complete the transfer of energy and materials through ecosystems, for example in the degradation and decomposition of unwanted matter. The approach to managing nature must therefore be scientifically comprehensive; the fact that man cannot at present readily perceive the utility or necessity of a species within a given biological system is neither a guarantee, nor even an indication, of the true state of affairs. As our scientific appreciation of the complexities of these systems grows, so does the realization of how much more we need to know so as to understand how nature works.

20. Inevitably, most management and manipulation of nature simplifies the physical, chemical and biological features of an ecosystem, a field of maize, wheat or rice is just as much an ecosystem, although a very simple and impoverished one, as a tropical rainforest. But with increasing resource utilization by a growing world population, the area and scope of this simplification become larger. Thus the danger of losing the diversity in nature increases, and the opportunity to maintain it lessens.

21. This is made very clear in the overviews on Ecosystems, sites and samples and Endangered species and wildlife. The overview on Genetic resources emphasizes the dangers in the increasing selection and breeding of certain species at the risk of losing, through neglect or carelessness, species of plants and animals which apparently have no immediate use. This is especially true of species, wild or cultivated, which are tolerant of marginal or harsh environmental conditions and therefore provide a most valuable gene pool.
22. The overviews also refer to another important part of wildlife, the less obvious but ubiquitous population of micro-organisms in soil, sediments, fresh and marine waters. Without these organisms no known biological systems could exist for any acceptable length of time, yet little conscious use has been made of their enormous potential. The very extent of their distribution suggests that they are unlikely to disappear, but because they are integral parts of ecosystems, some may do so unless present practices change. We can assume that proper ecosystem conservation will lessen these dangers.
23. The undeveloped potential of micro-organisms may broadly be described as their planned use as degraders and decomposers to provide rapid recycling of nutrients, or, through heterotrophic production, new food substrates for organisms. Such developments would seem to be especially suited to application in estuarine and near-shore ecosystems. We must accept that for the foreseeable future rivers will be the pathway and estuaries and oceans the sinks of much of our unwanted wastes, a natural role in respect of material of geochemical origin and natural organic material. So far there has been little effort to develop these ecosystems as reproducers of man-made wastes, and unless care is taken they may be so overloaded and environmentally abused that both the means and the opportunity to do so will be lost.
24. Moreover, as pointed out in the overview on Marine pollution, estuaries and coastal waters, where pollution is the greatest, provide 90 per cent of the world's marine animal catch. It has been estimated that the harvest of marine living resources might possibly be doubled in the next decade or two, but this can only be sustained if we learn more about the marine ecosystem and manage it better to avoid the dangers of pollution and over-exploitation.
25. To conclude this introduction it might be appropriate, in the context of the following five overviews, to quote from the conclusions of the State of the Environment report (document UNEP/GC/30, chapter III, paragraph 59) presented to the third session of the Governing Council:
- "What is necessary is integrated environmental management rather than incremental ad hoc steps taken for environmental protection, and the realization that the ultimate self-interest of all nations is inevitably merged in the inescapable web of interdependences. An integrated co-operative approach is needed to manage the interacting relationships between resources, their development, distribution and use, technology, its orientation and use, and the minimal needs for sustaining decent standards of human life and protecting the natural systems on which life depends".
- The action plans presented at the end of each overview are largely designed to meet this requirement.

## II. CONSERVATION OF NATURE, WILDLIFE AND GENETIC RESOURCES

### A. Ecosystems, sites and samples (National parks and reserves)

#### 1. An overview

##### (a) Scope of the problem

26. As the earth's population increases beyond the figure of four billion and economic expectations rise, more and more of the earth's unexploited ecosystems become subject to exploitation, regardless of its ecological and long-term economic advisability. At the same time, a growing body of knowledge suggests the desirability of maintaining a certain percentage of the earth's ecosystems in a natural or semi-natural state in national parks or reserves. Opportunities to preserve ecosystems are, however, rapidly disappearing, especially in the tropics and sub-tropics.

27. Many outstanding national parks and reserves already exist but, excluding Greenland and Antarctica, they cover only 1 per cent of the earth's land surface and are not capable of meeting ecosystem preservation needs for the future. They are far from constituting a true network, with adequate representation the world's major ecosystem types, and adequate protection of animal and plant species. The analysis given by IUCN shows that over 25 per cent of the 198 terrestrial "biotic provinces" contain no adequately protected reserves at all and a further 15 per cent are represented by only one reserve. The world's national parks have generally been established for the purpose of protecting areas of great scenic beauty, and little attempt has been made at preserving representative ecosystem samples.

##### (b) The significance of national parks and reserves for man and the human environment

28. Preserved ecosystem samples have enormous potential scientific, educational, cultural, aesthetic, recreational and economic values for mankind. The importance of formally preserved areas increases as natural ecosystems outside formal reserves disappear. National parks and reserves, recognized by many as a natural heritage, make an important contribution to national pride. They are becoming increasingly important as sites for environmental education.

29. Ecological reserves are very important for their contribution towards preservation of the earth's flora and fauna. Animal and plant species - over 1,000,000 in number - are the product of millions of years of evolution. In addition to their intrinsic value, they constitute a resource of immense importance to mankind. Since wild animals and plants inhabit the earth together with man and contribute to the essential homeostasis of the earth's ecosystem, their fate is inextricably linked with that of man.

30. Preserved natural ecosystem samples provide essential standards against which man-modified ecosystems can be compared and understood. As sites for basic and applied ecological study, they will enable scientists to acquire essential information to fill serious gaps in man's present knowledge concerning his environment.

(c) Man's impact on ecosystems

31. The diverse ecosystems of the earth vary widely in their characteristics, and face a wide variety of problems resulting from man's impact. The greatest impact has been registered in the great temperate grasslands of Europe, Asia and North America, but destruction of overall fertility and ecological diversity have not been as high here as in some other biomes. The areas most vulnerable to change and ill-advised development have been the tropical and sub-tropical forests and grasslands (particularly in semi-arid lands), high mountains, tundra regions, wetlands, coastal and estuarine regions, mangrove and coral reef systems, and oceanic islands. Examples of some of the most important ecosystems and man's impact upon them follow.

32. Tundra ecosystems are highly susceptible to human impact because of their very slow rate of regeneration (due to a short growing season). Much mineral exploitation, with accompanying disturbance to their vegetational cover and fauna, is at present being undertaken in them.

33. Forests of the "temperate" and "Mediterranean" type include both some of the least altered ecosystem types on earth and some of the most seriously degraded through over-exploitation and mismanagement. The importance for forestry and agriculture of maintaining representative samples of these crucial ecosystems for ecological research and genetic preservation is obvious. Tropical and sub-tropical forests too are particularly susceptible to large-scale disturbances by man's activities, in this case because nutrients are held primarily in vegetation rather than soil, so that the removal of vegetation can often result in catastrophic nutrient depletion. The general ecological role of such forests is critical for the surrounding areas in terms of watershed protection, climatic stability, sustained protein production of native fauna, and genetic preservation.

34. Former natural grassland areas of the world are heavily exploited for agriculture, with accompanying ecosystem degradation in many instances. Conversion of these ecosystems to crop monocultures has resulted in serious problems of crop disease and in the need for the heavy use of artificial fertilizers to maintain soil fertility. Over-exploitation by man has also badly affected the earth's arid and semi-arid ecosystems, which in some parts of the world are losing their capacity to support human populations dependent on them for survival.

35. The earth's mountain ecosystems are highly susceptible, particularly where high-angle slopes are present, to poor land management practices resulting from cultivation, deforestation and overgrazing which follow increasing population pressure. Islands possess unique properties which make them particularly valuable as sites for scientific study. Their distinctive floras and faunas are extremely vulnerable to competition from species introduced from mainland areas: island biota comprise a large percentage of the earth's endangered and recently extinct species.

36. Freshwater ecosystems, including lakes, rivers, streams, and various types of wetlands (bogs, fens, marshes, swamps, etc.) occur in association with all terrestrial biome types. Their biota are so vulnerable to man's influence that preservation of their genetic material is in many instances entirely dependent upon reserve establishment. Marine and coastal ecosystems (including estuaries, mangrove ecosystems, sea grass beds, lagoons, coral reefs, etc.) are, perhaps more than any other, subjected to man's influence, and suffer from pollution, dumping, dredging, dynamiting, and exploitation of biota.

37. While protected samples of each of the above ecosystems do exist, they are in all cases far from sufficient or fully representative. Moreover, even in several of the "protected" areas pressure through agriculture, mineral and other exploitation, tourism, etc., is often serious.

## 2. Current activities of international significance

### (a) Co-ordination

38. The UNEP/UNCTAD Symposium on Patterns of Resource Use, Environment and Development Strategies (Cocoyoc, 1974) recognized the need for more detailed knowledge of natural ecosystems, and for application of such knowledge in order to include an environmental dimension in the reassessments of technology, and for a development strategy for "ecodevelopment".

39. Co-ordination of the activities of the major international organizations active in the field of ecosystem conservation has recently been assisted by the establishment of an Ecosystem Conservation Group sponsored by UNEP, and drawing its membership from the four major organizations concerned - UNEP, UNESCO, FAO and IUCN. This group meets periodically to examine general policy issues as well as to review specific projects, regional and national activities.

### (b) Salient features of current activity

40. The organizations of the United Nations system most deeply involved in ecosystem conservation are UNESCO and FAO, both individually and jointly, and also in association with UNEP and UNDP.

41. UNESCO's involvement in ecosystem conservation is primarily through the development of the Man and the Biosphere (MAB) programme especially project 6, "Conservation of natural areas and the genetic material they contain". This project is linked to the establishment of a world-wide network of "biosphere reserves" participating in an international co-operative programme of ecological research and genetic preservation. MAB projects 6 and 7 have begun research activities and planning for future research needs in critical mountain and island environments. Other MAB projects are concerned with tropical and sub-tropical forests, temperate and Mediterranean forests and other ecosystems.

42. FAO is active in ecosystem conservation particularly through its UNDP and Trust Fund financed field projects. The emphasis is on conservation as a form of land use. Support is also given to the conservation aspects of forestry programmes. FAO is co-operating with UNESCO on certain aspects of the Man and the Biosphere programme.

43. Prominent among non-governmental organizations directly concerned with the conservation of ecosystems are the International Union for the Conservation of Nature and Natural Resources (IUCN) and its sister organization the World Wildlife Fund (WWF). Their activities include ecological studies and surveys, the establishment and management of national parks, and steps for the safeguarding of threatened species, as well as environmental law, planning, education and conservation publications. IUCN is also involved in establishing criteria for the selection of candidate national areas under the Convention concerning the Protection of the World Cultural and Natural Heritage <sup>2/</sup> as well as those for biosphere reserves.

44. Non-governmental organizations involved in ecosystem conservation - including notably the International Council for Bird Preservation (ICBP), International Waterfowl Research Bureau (IWRB), International Geographical Union, the East African Wildlife Society, Sierra Club (United States) and the Marine Parks Centre (Japan) - are largely concerned with protection of particular elements of ecosystems.

45. Scientific aspects of environmental research and conservation, including the results of the International Biological Programme, are the concern of the International Council of Scientific Unions (ICSU). Its scientific committees on oceanic and Antarctic research, SCOR and SCAR, have particular interests in polar and marine ecosystem conservation. The International Union of Biological Sciences (IUBS), through its Division of Environmental Biology, is closely concerned with the development of ecological research.

46. Many Governments also support activities in this area. For instance, the United States has developed for research purposes a network of natural areas covering more than 15 million hectares of land. The Australian Government recently initiated a management plan for natural reserves the total area of which covers about 10 million hectares. Japan and Canada are conducting research programmes and surveys. Relevant new techniques in the application of remote sensing have been investigated in Canada. Several measures have been adopted in the United Kingdom and Switzerland to strengthen the representative series of natural reserves. The Iranian system of reserves constitutes one of the most comprehensive programmes for ecosystems conservation in Asia and the Middle East; particular attention is given in Iran to the conservation of the threatened mangrove forests.

(c) Review of major current activities

(i) Dissemination of information

47. UNESCO publishes a wide range of documentation arising from the Man and the Biosphere programme (MAB). These include reports of meetings of the MAB Co-ordinating Council, panel meetings, working groups, task forces and regional meetings and a new series of MAB Technical Notes.

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<sup>2/</sup> Adopted on 16 November 1972 by the UNESCO General Conference at its seventeenth session.

Other publications include regional maps of bioclimate, vegetation and soils, a manual for mapping the distribution and classification of vegetation and a quarterly journal, Nature and Resources.

48. FAO activities in information dissemination include publication of manuals on national park planning and management, guidelines on wildlife and national parks legislation. Journals include the quarterly UNASYLVA, and the Tiger paper issued periodically from the South East Asian Regional Office with the support of UNEP.

49. IUCN publications include a monthly bulletin and loose leaf directories on endangered species, protected areas and wetlands, as well as yearly publication of the "United Nations List of National Parks and Equivalent Reserves". IUCN and WWF support a wide range of information dissemination systems including visitor information centres in national parks.

50. Activities of regional organizations include the Environment Documentation Centre of the European Economic Community in Liège, Belgium, and publication of Nature Newsletter and the quarterly journal, Nature in Focus, by the Council of Europe.

51. Activities of non-governmental organizations include the EARTHCARE Conference on Global Protection of Natural Areas (1975) organized by the National Audobon Society and the Sierra Club, which brought together scientists, conservationists and Government officials to explore the problems and options faced in protecting the world's natural areas. The Marine Parks Centre of Japan organized an International Conference on Marine Parks and Reserves (1975) which dealt with relevant scientific and technical problems. Publications include a "Manual on Wetland Management" by IWRB which also sponsored an International Conference on the Conservation of Wetlands and Waterfowl in 1974. UNEP sponsored and participated actively in all three of these conferences.

#### (ii) Training

52. UNESCO activities undertaken jointly with UNEP and UNDP include the establishment of an international programme of environmental education and training in conservation and wildlife, regional training and research programmes in Africa and Asia, a conservation education programme in Venezuela and the establishment of an integrated ecological institute at Ife University, Nigeria. The MAB programme includes a training and education component through short-term training courses and roving missions of experts.

53. FAO activities include training courses for wildlife and national park management, national park rangers and fellowships. IUCN/WWF has a programme of environmental education in French-speaking countries, and in India and Zambia it provides training for national park personnel, educational guides and a mobile education unit. Other activities include seminars on environmental problems sponsored by the Council of Europe, and courses on ecology sponsored by the International Society for Tropical Ecology.



(iii) Research

54. The MAB programme focuses on the development of multidisciplinary ecological research, particularly through pilot projects on rational management of ecosystems. Current activities include surveys, short-term study grants and initiation of research on mountain, tundra and island ecosystems.

55. FAO is currently involved in surveys of ecosystems, wildlife and national parks, collection of data on problems of national park protection, studies of visitor impact and assessment of recreation potential of national parks.

56. IUCN research activities include regional surveys in Europe and Latin America, national park surveys in many countries, research on threatened species and their habitats and support for the Charles Darwin Research Station, Galapagos.

57. Ecosystems research is also sponsored by several foundations (Ford, Rockefeller Brothers) and non-governmental organizations such as the East African Wildlife Society and the African Wildlife Leadership Foundation.

(iv) Application of existing knowledge

58. UNESCO activities include short-term missions for specific ecological studies related to the creation of reserves, the establishment of a list of natural areas of outstanding value for the World Cultural and Natural Heritage Convention, the implementation of MAB project 8 and the convention on wetlands of international importance especially as Waterfowl Habitat 3/. The former convention entered into force in December 1975, and UNESCO is co-ordinating its implementation.

59. FAO activities include some 30 UNDP financed field projects on national parks planning and management in some 27 countries and over 80 IUCN/WWF projects are under way or projected.

60. Most of the activities under this heading are carried out by individual Governments. According to the latest "United Nations List of National Parks and Equivalent Reserves (IUCN 1975), ninety seven countries have 1,352 protected areas (meeting certain minimum standards) covering about 1.4 per cent of the land area of the earth (excluding Antarctica). One third of this is however contributed by one national park in North East Greenland.

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3/ Adopted at the International Conference on the Conservation of Wetlands and Water Fowl, held at Ramsar, Iran, from 30 January to 3 February 1971.

Table 1

ECOSYSTEMS, SITES AND SAMPLES: ALLOCATION OF RESOURCES BY ORGANIZATION (DOLLARS)

Agency	A. Dissemination of information		B. Training		C. Research		D. Application of existing knowledge		
	1974	1975	1976	1974	1975	1976	1974	1975	1976
UNESCO	57,000	18,000	15,000	3,000	67,000	116,000	106,000	331,000	736,000
FAO	22,000	15,000	21,000	8,000	19,000	19,000	23,000	26,000	22,000
ECLA	21,000	-	-	-	-	-	-	26,000	-
Total	100,000	33,000	36,000	11,000	86,000	135,000	129,000	383,000	758,000
IUCN	58,000	160,000	82,000	8,000	63,000	59,000	208,000	304,000	203,000
							531,000	1,014,000	1,372,000
							638,000	1,714,000	1,511,000

Table 2

ECOSYSTEMS, SITES AND SAMPLES: APPLICATION OF EXISTING KNOWLEDGE BY REGION (DOLLARS)

Agency	1. Africa		2. North Africa and the Near East		3. Asia and the Far East		4. Central and South America		5. Europe			
	1974	1975	1976	1974	1975	1976	1974	1975	1976	1974	1975	1976
UNESCO	39,000	36,000	50,000	-	-	-	45,000	193,000	124,000	19,000	4,000	151,000
FAO	177,000	343,000	548,000	33,000	131,000	47,000	169,000	220,000	316,000	41,000	58,000	106,000
Total	216,000	379,000	598,000	33,000	131,000	47,000	214,000	413,000	440,000	60,000	62,000	257,000

Table 3

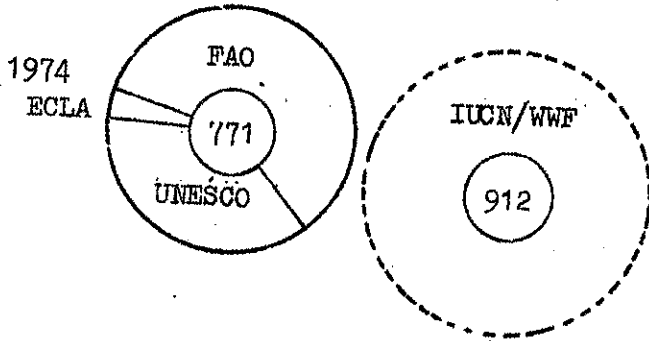
ECOSYSTEMS, SITES AND SAMPLES: TOTAL ALLOCATION OF RESOURCES BY  
ORGANIZATION (DOLLARS)

Agency	1974	1975	1976	TOTAL
UNESCO	278,000	678,000	1,222,000	2,178,000
FAO	472,000	812,000	1,079,000	2,363,000
ECLA	21,000	26,000	-	47,000
Total	771,000	1,516,000	2,301,000	4,588,000

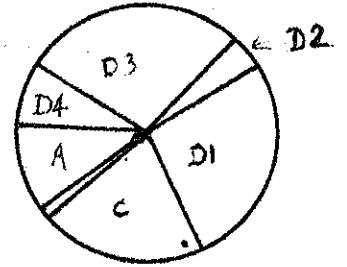
BREAKDOWN OF EXPENDITURES IN THE UN SYSTEM DEVOTED TO ECOSYSTEMS, SITES AND SAMPLES

BY ORGANIZATION (with expenditure of IUCN/WWF shown for comparison)

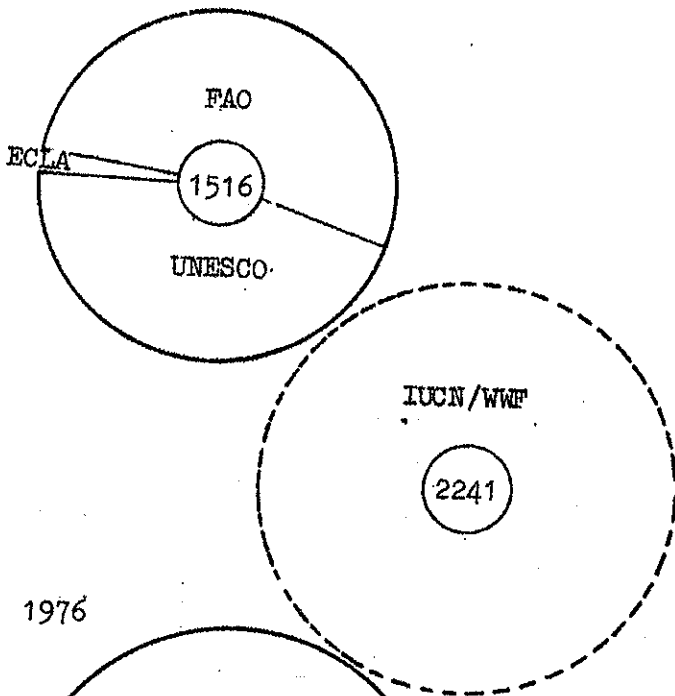
BY FUNCTION AND REGION



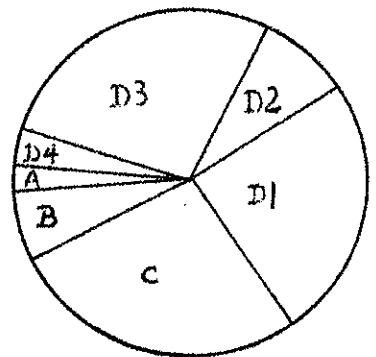
1974



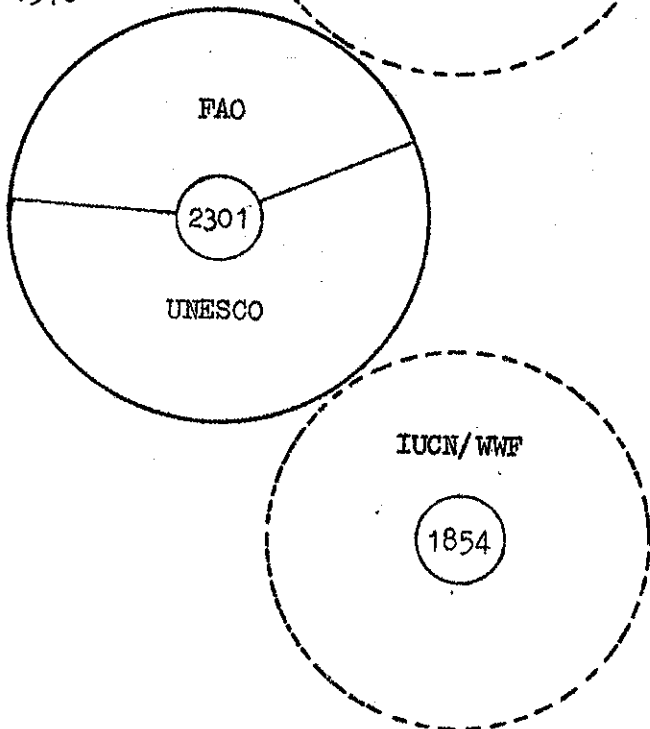
1975



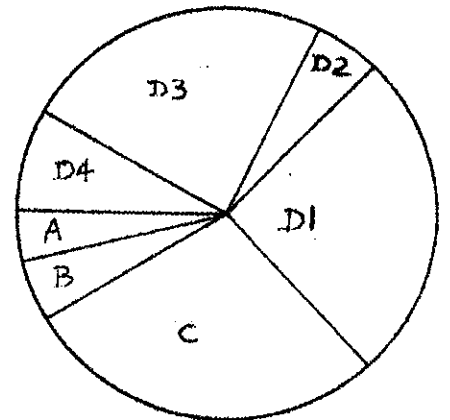
1975



1976



1976



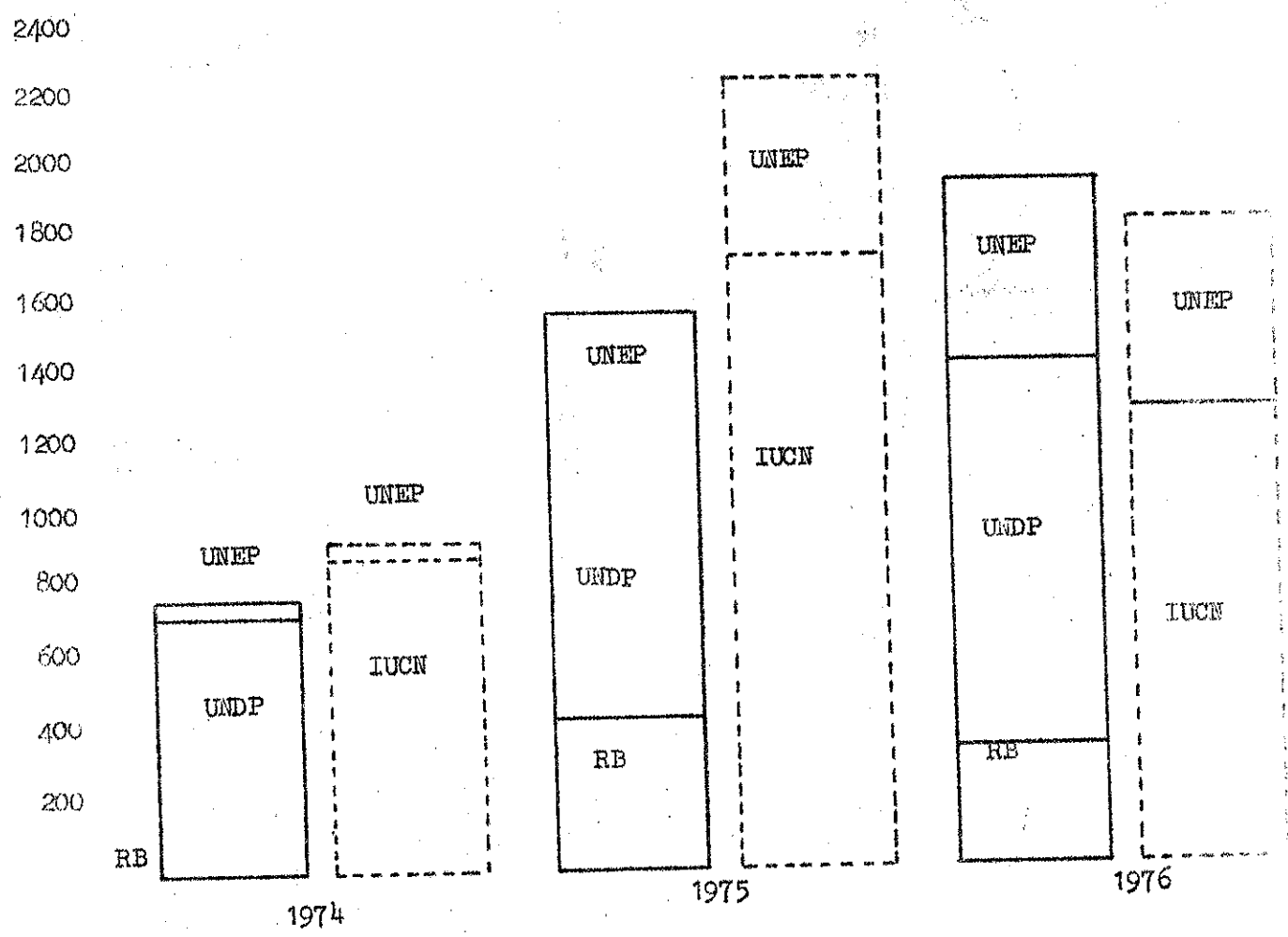
- A - Dissemination of information
- B - Training
- C - Research
- D - Application of existing knowledge
  - 1 - Africa
  - 2 - North Africa and Near East
  - 3 - Asia and the Far East
  - 4 - Central and Southern America
  - 5 - Europe

Figures in small central circles represent expenditure in thousands of dollars

By source of finance:

Expenditure in thousands of US dollars

RB = Regular budget



### 3. Proposed plan of action

#### (a) Objectives

61. Establishment of new national parks and reserves must be rated as the highest priority for action. Realistically, the short-term objective must be to keep options open for the future as much as possible through preservation of natural ecosystem samples wherever the opportunity arises.

62. An equally important objective is to ensure the future integrity of national parks and reserves. Creation of national parks and reserves is no guarantee of their continued protection.

63. Concurrent objectives are the proper utilization and management (including minimal management where appropriate) of existing reserves. Reserve management must be improved by strengthening the legal basis of reserves, by training management personnel, and through acquisition of new knowledge. Ecological research and public education programmes must also be strengthened.

64. Land-use planning which takes into account the need for preservation of biotic diversity, the ecological role of ecosystems, through the interactions between water, soil, vegetation and animal resources which maintain sustained productivity, is essential.

#### (b) Outline of plan of action

##### (i) Exchange of information

65. An improved flow of information regarding national parks and reserves is necessary if there is to be significant progress in expanding the "network" of national parks and reserves. The United Nations List of National Parks and Equivalent Reserves should continue to be updated together with the World Directory of National Parks and Protected Areas. To supplement these, an international technical periodical publication concerning management of national parks and reserves and related activities appears to be highly desirable.

66. Regional and international meetings on specific topics, such as those sponsored by UNEP and IUCN in recent years, are an important means of exchanging information and stimulating activity. As the biosphere reserve programme develops, forms of communication must be devised to allow for a true network involving international co-operation with exchange of information, data, results, and personnel.

##### (ii) Research and monitoring

67. Basic ecological research, because of its potential for guiding resource management, must be accelerated in as many ecosystem types as possible. Some priority ecosystem types include: tropical moist forest of South and Central America, Africa, and South East Asia, arid and semi-arid zones with problems of over-exploitation due to human population pressure, especially the Sahelian region, mountain ecosystems threatened by expanding agriculture/deforestation and tourism, and oceanic islands.

Knowledge of some ecosystems (for example, the very complex tropical forest ecosystems) is so rudimentary that great efforts will be required simply to determine what organisms are present.

68. Representative natural ecosystems should be utilized as baseline areas for research and monitoring activities to provide an early warning system for significant environmental problems. The greatest priority here is to decide on what parameters should be monitored in various ecosystem types and to initiate a network of sites.

69. National and regional surveys to identify new potential areas for preservation must be continued.

(iii) Application of existing knowledge

70. The establishment of high-quality national parks and reserves in ecosystems where they do not exist at present rates as the highest priority. The most important ecosystems that should be represented include various types of tropical moist and seasonally dry forest in South and South East Asia, Africa, South and Central America and on various islands (especially in the Caribbean, the South Pacific and the Indian Ocean); wetlands on all continents; various other island ecosystems, temperate and tropical grasslands. Establishment of coastal and marine national parks with adequate external safeguards is also an important priority.

71. Since the key to ecosystem conservation throughout the world will continue to be the enactment and enforcement of appropriate legislation at the national level, it is highly important that technical assistance in the formulation of legislation be made available through international channels to countries desiring it.

(iv) Education and training

72. Public information and education. Citizens must be kept informed of developments in this field and the reasons for action taken or not taken, since misunderstanding often has unfortunate consequences. Increased public awareness will usually lead to increased support for national parks and reserves. National parks and reserves can serve effectively as sites for encouraging "environmental awareness". Primary and secondary school curricula throughout the world should be encouraged to include the teaching of ecological principles.

73. Higher education and training of specialists. Continued support should be given to university programmes and research in developing countries. Field research stations associated with ecological reserves are needed to train specialists for field work. Specialized training colleges for students in management of national parks and reserves should be encouraged, particularly in Latin America, Asia and the Pacific. Regional and sub-regional training courses should be encouraged.



## D. Endangered species and wildlife

### 1. An overview

#### (a) Scope of the problem

74. Wildlife - including all animals and plants occurring in the wild state - is of profound significance to human survival, whether as a resource measured in terms of economic, nutritional or cultural values, as an indicator of environmental health or for the ecological role it plays in ecosystems. Unfortunately, this fact has been insufficiently appreciated, and considerable erosion of wildlife species has taken place, with consequent loss of potentially valuable genetic material which can never be replaced.

75. The pace of animal extinctions in the world continues to accelerate despite current conservation efforts. In the last 500 years 320 vertebrate species or subspecies have become extinct, 256 of them in the last three centuries. In much more recent times, the past ten or fifteen years have seen 49 species and subspecies become probably extinct, with a further 1,032 recognized as in danger of extinction. Regarding plants, one estimate is that a staggering 20,000 species are in danger of extinction <sup>4/</sup>.

76. The single most important cause of this deteriorating situation is the continuing attrition of suitable habitat. Moreover, numerous species, including many lower forms, are likely to disappear from some highly exploited or altered habitats before they are even recognized as endangered. Ironically, it is these very species that are often the most valuable.

#### (b) Significance of wild plants and animals for man and the human environment

77. Wildlife species are an important component in the balance of ecosystems on which man's survival depends. They therefore provide valuable indicators of environmental degradation. Agriculture and horticulture rely on micro-organisms, insects, etc. for their most essential processes, and as these are degraded, so the ecosystems which sustain man are made less productive, less efficient and less stable. The presence of natural forest cover, for example, is valuable in preventing erosion and flooding, and has a pronounced influence on local climates and water supplies.

78. Wild species are important for their contribution to the world diet. Wild and semi-wild relatives of cultivated crops and livestock form important reservoirs of genetic material through which conventional varieties can be improved in quality or suited to the local environment. They also contribute to the world's material needs as commodities (furs, horns, skins etc.), as leisure objects, or for purposes of medical research. Some of these uses bring little harm to wildlife populations, but many, through abuse, cause them severe stress. If these species are

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<sup>4/</sup> IUCN and Royal Botanic Gardens, New, United Kingdom.

to be of continuing use, as a source of protein, in medical research, as indicators of dangerous degradation of the environment, or simply for tourism and other non-consumptive uses, stringent management measures must be implemented so that exploitation, where appropriate, can be sustained indefinitely.

79. The presence of wild species in natural situations is an important educational tool in scientific studies for which the use of captive or cultivated specimens would lead to inadequate or misleading information (for example behavioural and ecological studies). Many such scientific studies of natural communities have direct relevance to man, and indicate how he should live in and look after terrestrial ecosystems. Only through dissemination of the knowledge they provide can a generation be formed which values and understands the precepts of the natural world and appreciates the place of humanity in nature.

80. The least tangible, and yet important, benefit mankind derives, either consciously or unconsciously, from wilderness and wild creatures, is mental solace. This is recognized in several cultures and religions, and as population pressures and urbanization increase, this aesthetic, soothing value of nature and natural beauty will increasingly be appreciated.

#### (c) Man's impact on wildlife

81. Man's principle negative impact on wildlife has been in the field of habitat destruction. Owing to his increasing numbers, man is gradually converting the surface of the land to satisfy his growing material needs. Inevitably, wildlife has been the loser in the competition with man for land, but, unlike man, wildlife does not destroy the environment on which it subsists. More knowledge of the degrees of "flexibility" of the various biomes are needed as well as of the rate at which biological curative processes can cope with change. Otherwise, rapid, irreversible changes will be brought about exceeding the capacity of natural systems to recover.

82. Similarly, many species of value to man have been subject to indiscriminate exploitation with little regard for their ability to sustain a yield or to withstand disturbance. Hunting, both for profit and for fun, has contributed greatly to the attrition of several wildlife populations. Systematic eradication of supposedly competitive animals, such as wolves, birds of prey, and crocodiles, or of disease vectors such as bats and foxes in rabies control and of ungulates in tsetse fly areas, has made serious inroads into numerous wild species populations, often in a way that has not been to man's benefit. Other animals and plants are declining because of their inability to withstand competition, through grazing or predation, by species introduced by man into an environment where they could proliferate unchecked. An expanding human population is compounding the problem of species survival by increasing pressure on space and resources as well as pollution of soil, water and air, which in turn creates imbalance and instability in ecosystems.

83. The main need at the present time is to reverse these disruptive trends through land-use programmes for the conservation and restoration of representative biotopes and biomes by promoting protection and reintroduction of indigenous species outside reserves. International co-operation and agreement is essential for the conservation of species such as migratory birds, mammals, reptiles and fishes which move seasonally from one area of national jurisdiction to another.

## 2. Current activities of international significance

### (a) Co-ordination

84. The United Nations Conference on the Human Environment, 1972, in a series of recommendations 5/, urged Governments to expand activities to protect wildlife and its habitat and to foster research, the collection of data and the training of personnel in wildlife management. UNEP itself has attempted to improve regional and international co-operation in the field of wildlife conservation, notably in the improvement of co-ordination and in the regular exchange of information on current and planned activities. Co-ordination meetings have been organized on a regional basis for Africa, the Mediterranean, South West Asia and adjacent regions, the South Pacific and Central America; further meetings are planned for other regions. The UNEP/IUCN/UNESCO/FAO Ecosystem Conservation Group is also active in relation to wildlife. UNEP's participation in a number of international conferences on ecology and conservation has contributed to a constructive dialogue with the scientific community of the world.

### (b) Salient features of current activities

85. The organizations of the United Nations system most deeply involved in wildlife conservation are FAO and UNESCO. FAO essentially responds to requests from Governments, on a country and intercountry basis, for advice on the protection and management of wildlife resources, for training of middle and lower level personnel in wildlife management and in establishing an institutional framework within Governments to deal with this field. Most of FAO's field activities are funded by UNDP.

86. UNESCO's commitment to the conservation of wildlife has rapidly increased since the Conference on the Biosphere in 1968 which led to the establishment of the MAB programme. UNESCO is also involved in wildlife matters through its work on sites of historic, cultural and scientific interest (World Heritage Programme) as well as in the field of environmental education and scientific research.

87. Many regional intergovernmental organizations sponsor wildlife-related activities, for example, the Organization of American States, the Organization of African Unity, the European Economic Community, the Council for Mutual Economic Assistance, the South Pacific Commission and the Council of Europe.

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5/ United Nations publication, Sales No.: E.73.II.A.14, chapter I.

88. The chief international organization outside the United Nations system concerned with the conservation of wildlife is IUCN. With the help of its Survival Service Commission, it formulates and executes programmes of research, management and protection for groups of animals and plants which are internationally at risk. WWF is the campaigning and fund raising arm of the same operation, supplying a substantial part of the financial resources of IUCN for its project operations. Among other non-governmental organizations active in this area are the ICBP, IWRB, the Charles Darwin Foundation for the Galapagos Isles, the East African Wildlife Society, the Sierra Club, the Scientific Committee for Antarctic Research (SCAR) and the African Wildlife Leadership Foundation.

89. A number of bodies also provide funding for projects involving endangered species (the Fauna Preservation Society of the United Kingdom, New York and Frankfurt Zoological Societies), as do several major foundations. Bilateral aid from developed countries is also an important source of funding for conservation projects in many countries.

90. Many countries, both developed and developing, finance and implement their own wildlife programmes without, or in addition to, external aid; these programmes are, however, too numerous to detail. Those countries with major conservation programmes and from which information has been received, include Australia, Iran, Japan, the United Kingdom and the United States.

(c) Review of major current activities

(i) Dissemination of information

91. IUCN collects and publishes information on the subject of endangered species through the Red Data Book scheme. This scheme records information on endangered species of vertebrate animals and registers changes in their status.

92. FAO and the IUCN Environmental Law Centre maintain up-to-date computerized records of all national and international legislation relating to wildlife, its protection and management.

93. Many other non-governmental organizations sponsor public information programmes both as components of field projects and through wildlife clubs, publications and media coverage.

(ii) Training

94. Courses in wildlife and wildland management are available at various levels - in the universities of most developed nations, as part of certain FAO or UNESCO projects and in four specialized training schools in Cameroon, Indonesia, Iran and the United Republic of Tanzania.

95. Environmental education at lower levels and public information are primarily national responsibilities. UNESCO and UNEP have, however, jointly undertaken the establishment of an international programme of environmental education and training, including conservation and wildlife aspects. In-service training of counterparts and other personnel is

included in all FAO and UNESCO field projects. In addition, short roving seminars are planned by UNESCO in co-operation with MAB National Committees to introduce new ecological ideas and techniques and to promote research projects within a region.

(iii) Research

96. Current research activities of relevance to wildlife and endangered species fall into five categories:

(a) The acquisition of information on the distribution, status, population structure and ecological requirements of wildlife species is largely carried out by FAO through country wildlife resource surveys, through the ACMRR Working Party on Marine Mammals, and by IUCN's specialist groups. ICBP and IWRB conduct similar studies on bird groups of particular concern;

(b) The identification of key ecosystems has recently received important reinforcement from MAB project 3, "Conservation of natural areas and the genetic material which they contain". IUCN, often supported by UNEP, has begun to identify the currently most vulnerable biomes, and is presently pursuing a number of projects relating to the identification of key areas and potential reserves in tropical rain forests and oceanic islands. Together with IWRB and ICBP, it has carried out conservation-oriented research on wetland ecosystems which has led to the "Convention on Wetlands of International Importance" especially as Waterfowl Habitat;

(c) Feasibility studies on the methods of utilization appropriate to wildlife populations under consideration (optimum sustainable yields of harvestable species, threshold levels of disturbance by tourists) have been a key part of FAO's programme, particularly in arid and semi-arid regions of Africa. IUCN/WWF has undertaken an investigation of game-ranching methods in Southern Africa, and UNESCO and FAO have been conducting a study of tourist impact on the Galapagos Islands,

(d) UNEP and IUCN have developed ecological guidelines for development in the humid tropics as well as in arid regions, and more are planned for high mountains and coasts. Components of the MAB programme and of the activities of the Scientific Committee on Problems of the Environment (SCOPE) are oriented to assessing environmental impact.

(iv) Application of existing knowledge

97. Activities of international significance in wildlife conservation fall into the following categories:

(a) The protection, management and sustained use of wildlife. The greater part of FAO's field programme on wildlife and national parks is devoted to promoting the wise utilization of wildlife. FAO has also formulated a large-scale programme on "Natural Resources for Food and Agriculture". IUCN and ICBP co-ordinate conservation programmes for threatened groups of wildlife, including leather-bearing reptiles, land gamebirds and waterfowl, aquatic mammals, fur-bearing mammals, threatened hoofed mammals and primates. IUCN/WWF has over 100 such projects throughout the world;

(b) Last-resort protection, undertaken when a species has reached such a critical level that only cultivation, the collection of surviving individuals into a small number of local reserves or captive breeding can save it. Important in controlling breeding of endangered species in captivity have been the IUCN Zoo Group and the Wild Animals Propagation Trust in the United States. FAO's Genetic Resources Unit is organizing a global network of plant genetic resources centres for crop plants and their primitive and wild relatives and IUCN's Threatened Plants Committee aims to set up a complementary network to handle natural-source plant material not already covered through the FAO system;

(c) International legislation. Currently in force are a number of agreements of regional importance and a few international conventions with, as yet, few adherents. The Convention on International Trade in Endangered Species of Wild Fauna and Flora 6/ recently came into force, as have the Convention on Wetlands of International Importance especially as Waterfowl Habitat, and the Convention concerning the Protection of the World Cultural and Natural Heritage, 1972.

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6/ Concluded in Washington, D.C., on 3 March 1973.

Table 4

ENDANGERED SPECIES AND WILDLIFE: ALLOCATION OF RESOURCES BY ORGANIZATION (DOLLARS)

	A. <u>Dissemination of information</u>		B. <u>Training</u>		C. <u>Research</u>		D. <u>Application of existing knowledge</u>		
	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>
Agency									
UNESCO	2,000	6,000	2,000	3,000	6,000	3,000	-	40,000	32,000
FAO	10,000	25,000	30,000	521,000	451,000	315,000	45,000	67,000	183,000
Total	12,000	31,000	32,000	524,000	457,000	318,000	45,000	67,000	183,000
(IUCN/ WWF)	65,000	130,000	186,000	19,000	58,000	97,000	281,000	183,000	502,000
							55,000	473,000	1,185,000

Table 5

ENDANGERED SPECIES AND WILDLIFE: APPLICATION OF EXISTING KNOWLEDGE BY REGION (DOLLARS)

Agency	1. Africa		2. North Africa and the Near East		3. Asia and the Far East		4. Central and South America		5. Worldwide & Interregional Programme				
	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1976		
UNESCO	-	-	3,000	14,000	-	-	-	-	-	-	36,000	29,000	19,000
FAO	648,000	809,000	-	2,000	200,000	302,000	404,000	28,000	307,000	27,000	-	-	-
Total	648,000	809,000	3,000	16,000	200,000	302,000	404,000	28,000	307,000	27,000	36,000	29,000	19,000

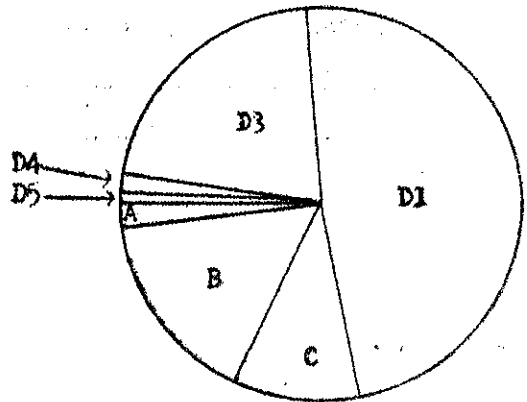
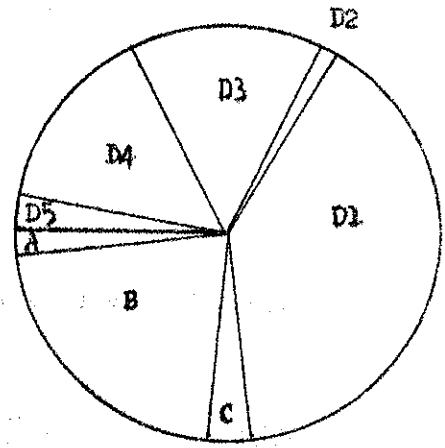
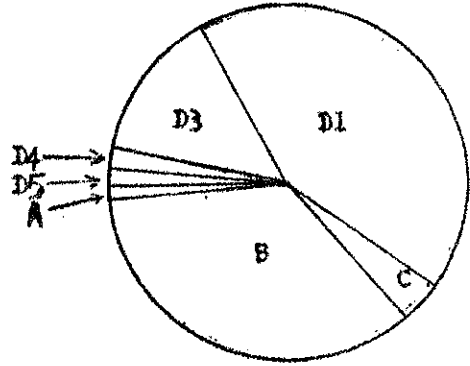
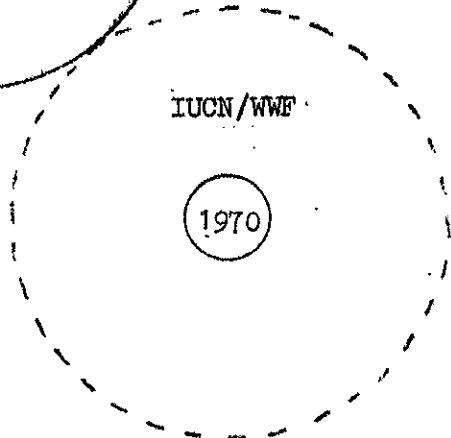
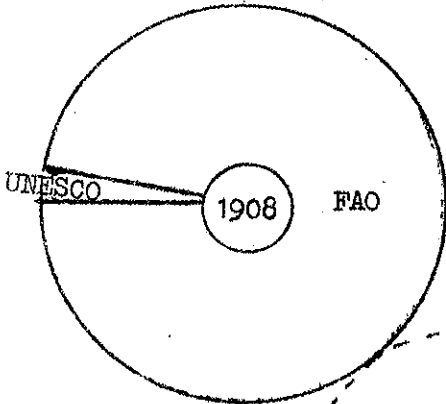
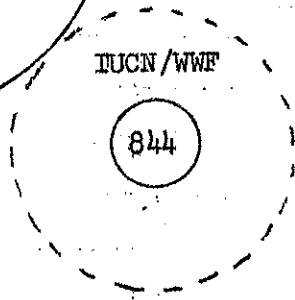
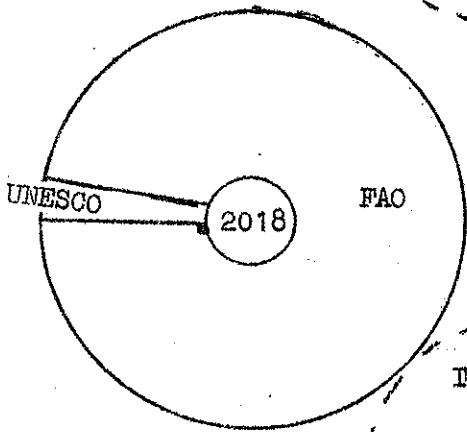
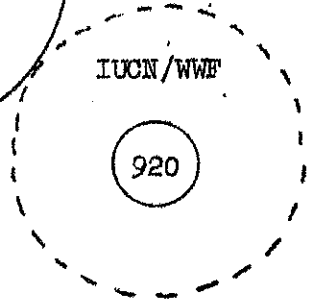
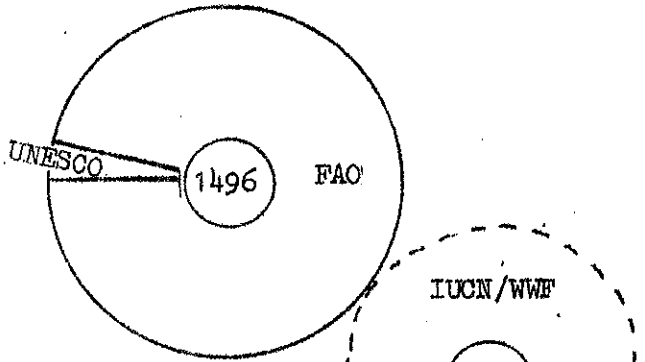


Table 6

ENDANGERED SPECIES AND WILDLIFE: TOTAL ALLOCATION OF RESOURCES BY  
ORGANIZATION (DOLLARS)

<u>Agency</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>TOTAL</u>
UNESCO	45,000	55,000	36,000	136,000
FAO	1,541,000	1,963,000	1,872,000	5,286,000
<b>Total</b>	<b>1,496,000</b>	<b>2,018,000</b>	<b>1,908,000</b>	<b>5,422,000</b>
IUCN	920,000	844,000	1,970,000	3,734,000

BREAKDOWN OF EXPENDITURES IN THE UN SYSTEM DEVOTED TO ENDANGERED SPECIES AND WILDLIFE



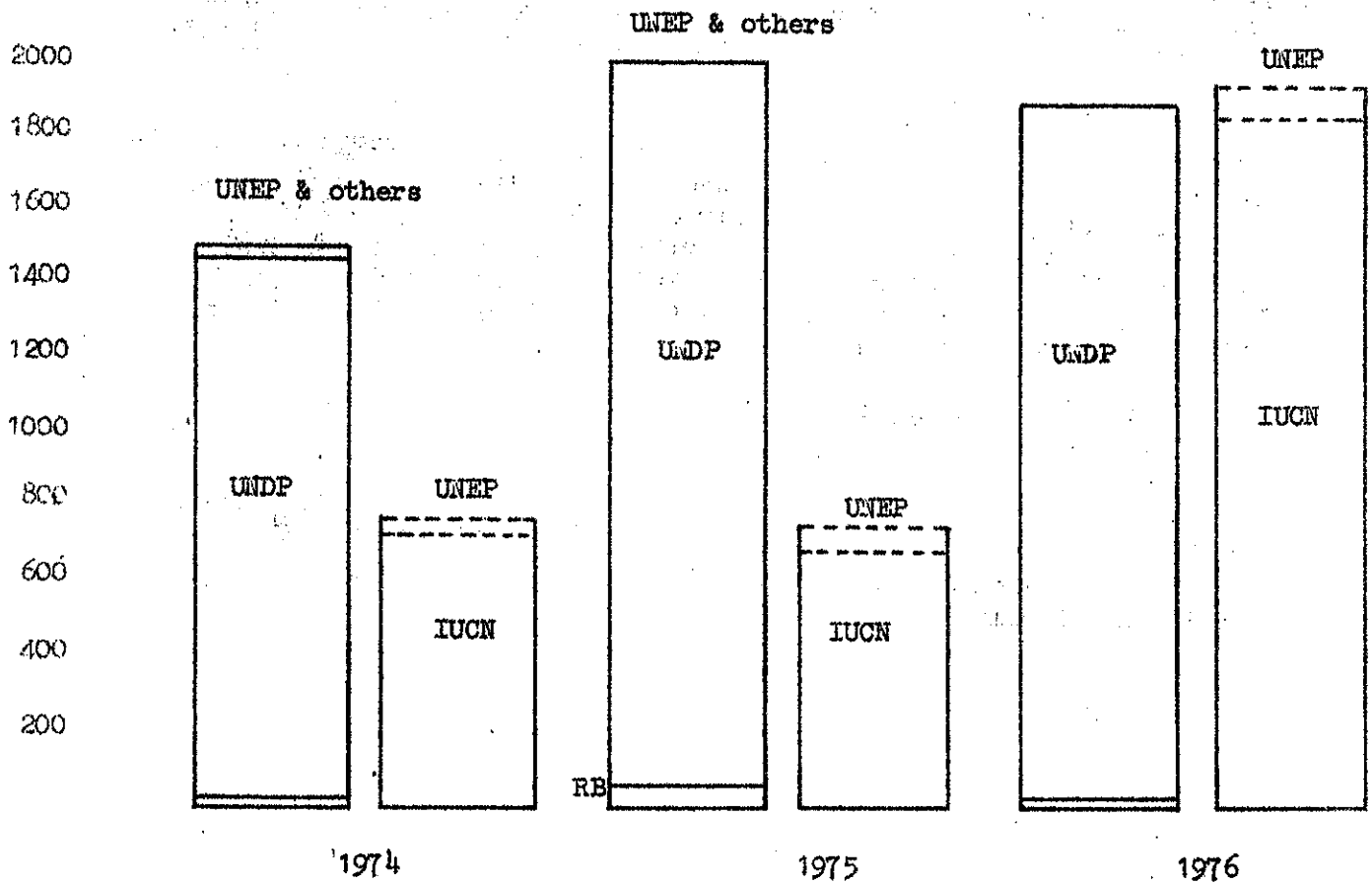
- A - Dissemination of information
- B - Training
- C - Research
- D - Application of existing knowledge
  - 1 - Africa
  - 2 - North Africa and Near East
  - 3 - Asia and the Far East
  - 4 - Central and Southern America
  - 5 - Europe

Figures in small central circles represent expenditure in thousands of dollars

By source of finance:

Expenditure in thousands of US dollars

RB = Regular budget



### 3. Proposed plan of action

#### (a) Objectives

98. The primary objective of wildlife conservation is to preserve self-maintaining populations of wild plants and animals to contribute to the welfare of mankind. This can be achieved only by setting aside samples of ecosystems as reserves and by the wise management of the remainder. Both are necessary and complementary.

#### (b) Outline of action plan

99. The emphasis in any international plan of action must rest upon building up national land-use planning efforts region by region, based upon sound national action. With this in mind, the following points for action are proposed:

##### (i) Collection and exchange of information

100. The exchange of information on wildlife matters on a regional basis is greatly facilitated by regular conferences such as the biennial East and Central African Wildlife Conference. Efforts should therefore be made to initiate similar meetings in the countries of other zoogeographical regions. At the same time further regional meetings to formulate action plans within regions should be organized.

101. Regular subject meetings and conferences on specific groups of plants and animals are equally essential for the exchange of data, the co-ordination of joint research and management activities and for recommending specific action requirements to meet changing situations.

##### (ii) Training and education

102. Efforts are still urgently needed to improve environmental education at all levels, in order to foster the understanding and appreciation of wild plants and animals and their ecology, stimulate greater recruitment into wildlife-based activities and industries and train these recruits for work at various levels. Encouragement must also be given to developing programmes of out-of-school and adult education, including courses for decision-makers.

##### (iii) Research and development

103. The principal requirements are for:

(a) Regional and national wildlife surveys to define distribution and conservation status and to identify threats and critical areas;

(b) Research related to the management and protection of wild plants and animals.

104. Topics under this general heading of (b) include: (i) the life history and ecological requirements of individual species; (ii) the interaction of different species as components of the ecosystem as a whole; (iii) management and methods of utilization appropriate to the populations under consideration; (iv) the actual and potential economic and social values of wildlife protection and utilization; (v) ensuring that conservation areas are of adequate size, have the correct boundaries, and perpetuate all the animals and plants they contain; (vi) taxonomic studies on tropical animals and plants and identification of institutions in the various biomes that should concentrate on such research.

(iv) Application of existing knowledge

105. Development of national strategies for the wise use of wildlife resources, co-ordination of management and protection activities for species of international occurrence (e.g. migratory species), and promotion of international agreements and conventions related to wildlife and protected areas are all required. In this latter, there is urgent need for:

(a) Efforts to promote adherence to the conventions which are in force;

(b) A worldwide convention or a co-ordinated series of conventions of a general nature calling on countries to protect wild habitats and species;

(c) The proposed Migratory Species Convention, which must establish the principle that migratory species are common resources shared by all the States within their range of distribution and migration.

106. The status of threatened plants and animals and of protected areas must be kept under review in order to record ecological trends within them and, in the case of protected areas, to ensure that they continue to serve the functions for which they were created, including the protection of individual species. The monitoring of biotic communities on a global basis must continue and be expanded so that any new threat or disquieting development which may require action by one or several countries may become immediately apparent.

C. Genetic resources

1. An overview

(a) Scope of the problem

107. The genetic diversity of primitive races and varieties of animals and plants enabled a significant proportion of their populations to survive a variety of adverse weather conditions, pests and diseases. Since the advent of scientific breeding only four human generations ago, new plant varieties, breeds of animals and strains of micro-organisms have and still are being developed in response to the needs of modern intensive production systems. The search for high performance generally requires a greater genetic uniformity from each of these modern varieties and breeds. Consequently, many of them may be more vulnerable

to new pests and diseases, and their narrow genetic base limits their use as gene pools for further improvement through breeding. The development of these modern varieties, breeds and strains has created a number of problems:

(a) Special evaluation and control measures have to be undertaken recurrently to maintain, improve and/or renew the homogeneity and quality of the seeds, breeds and other genetic material. Otherwise, the modern races created by man tend to develop further diversity and lose the specific qualities obtained by breeding.

(b) The old primitive races and traditional local varieties are being abandoned in favour of modern ones with higher performance. These modern varieties and breeds provide restricted gene pools for further breeding.

(c) The introduction of these improved varieties and breeds in crop monoculture and in intensive animal production systems leads to the development of large populations of a few genotypes which are extremely vulnerable to attack on a large scale by pests and pathogens (e.g. the disastrous corn leaf blight of 1970 in the United States).

The chance of obtaining the wild relatives of these varieties and breeds as potential breeding material is also increasingly limited by the degradation and destruction of their natural habitats and by their inter-breeding with domesticates.

(b) The significance of genetic resources for man and the human environment

108. The reservoirs of genetic variability in animals and plants constitute an invaluable heritage of nature, and of man, which is being squandered at an ever increasing rate. The limited gene pool of a few advanced varieties and breeds can, given high inputs, produce high yields at a given time on a given site, but is clearly inadequate as an insurance against the unpredictability of the needs and conditions of future generations. New diseases can arise suddenly, new sites will need to be used and new techniques of management and processing will evolve, all of which will demand new, adapted genotypes.

109. Man tends at present to rely on an increasingly limited number of species, varieties and breeds for his food and the same trend is also developing for fibre and timber. At the same time, the present rate of scientific and technological progress and the rapid economic and social changes create a higher demand for plants and animals able to adapt continually to new conditions. Although the development of "genetic engineering" foreshadows the possibility of transferring or even creating gene combinations, it is clear that, along with modern varieties and breeds, the major sources of useful breeding material for the foreseeable future remain within the natural ecosystems and the remnants of traditional agriculture, where the largest genetic diversity now occurs. It is therefore urgent to take measures for genetic resources conservation.

(c) Man's utilization of genetic resources

110. The intensity of utilization of genetic resources by man varies greatly according to the type of material and the species.

(i) Crop plant genetic resources

111. Crop plant genetic resources of actual or potential use to men can be grouped in the following broad categories:

(a) The advanced cultivars - those varieties or cultivars produced since the advent of scientific breeding. They require some of all components of modern agriculture - intensive cultivation, fertilizers, plant protection and irrigation. They are a valuable resource but constitute a limited gene pool,

(b) The traditional or primitive cultivars - those varieties which have evolved over centuries as a result of migration, introduction and natural selection in the various environments in which crops are cultivated. There is great diversity both between and within these varieties allowing them to survive unfavourable environments and provide low but steady yields in subsistence agriculture,

(c) Wild species which are (i) related to crop species or other economic plants, (ii) used for food, feed and fibre, or (iii) of potential use. They stretch from plants which are now gathered as major vegetable food or as condiments in many parts of the world, in the forests of Southern Asia or in the wasteland and scrub in Mediterranean countries, to potential raw materials for chemical and medico-chemical industries. Indications that a species is worthy of attention come either from past use, from taxonomic or other associations with species now used or from new requirements by industry.

(ii) Forest genetic resources

112. The area of man-made forests in the world amounts to about one fiftieth of the area of forest land. Forestry is where agriculture was ten thousand years ago, wild populations predominate, but there are some primitive cultivars of great promise established in most countries. This situation confers big advantages in flexibility of action on forest genetic resources.

113. On the one hand, an accelerated rate of domestication is inevitable and justified. Efficient methods of evaluation (species, provenance and progeny trials) are essential to achieve the greatest and quickest possible benefits from domestication. On the other hand, there are still good possibilities in some areas for conservation of forest genetic resources as part of the conservation of natural ecosystems. In others certain gene pools are threatened by pressure to divert the land to agriculture or other purposes. The threat is imminent in some tropical areas, such as the natural pine forests in Central America, that whole populations will have been lost in this way before the material can be incorporated in a breeding programme.

(iii) Farm animal genetic resources

114. There are very few species of domesticated animal involved in the production of the bulk livestock products, conservation of animal genetic resources therefore refers to the preservation of the many breeds which have been developed within these species. Equally important is the maintenance of genetic variation within these breeds.

115. Livestock improvement, on the other hand, has as its aim the reduction of variation within breeds by selecting the highest producers, and at the same time the replacement of low-producing local breeds by high-performance breeds. This process has proceeded farthest in the developed countries. It is also most conspicuous in the species which are kept in the most artificial environments (dairy cattle, pigs, poultry) and whose breeders therefore disregard the characteristics involved in local adaptation.

(iv) Wildlife genetic resources

116. The conservation of wild animals and plants is considered in the overviews on Ecosystems, sites and samples, and Endangered species and wildlife.

(v) Genetic resources of fish

117. Aquaculture has been going on for centuries, and yet very little is known of the genetic qualities of the culture species used. Concern has been expressed over the effects of transplantations and hybridization and of experiments being undertaken in various parts of the world without control or regulation, which may already have resulted in the loss of valuable original strains used for aquaculture. Undesirable side effects of transplantations also include possible competition between introduced species and indigenous stocks which could upset the natural balance of aquatic populations, and the accidental introduction of diseases and parasites.

(vi) Microbiological genetic resources

118. Microbes comprise bacteria, micro-algae, micro-fungi (including yeasts), protozoa, and viruses with a total combined biomass of the same order of magnitude as that of animals, including man. Microbes are perhaps most widely known as producers of diseases, and therefore exert a negative effect on man, plants, and animals. In fact, however, most micro-organisms are either essential or beneficial to man, animals, and plants. Through the ages man has learned to isolate mixed or individual strains of microbes and use them to his benefit for specific purposes. Food preservation and production, fermented beverages, industrial chemical processes, and the improved or accelerated breakdown of wastes are only a few examples of applied microbiology.



119. The new and improved uses of micro-organisms by isolation of fresh strains from nature, are far from exhausted. To this a new dimension is added by the progress being made in microbiological engineering, i.e. the man-induced mutations by irradiation and mutagenic chemicals, genetic gene improvement and gene transfer. From this research may come new industries to improve the environment and human health.

120. Although it is doubtful that a microbial species will ever disappear from the earth, it may be lost to mankind by virtue of the inability to re-isolate it. Moreover, many highly profitable mutant strains tend to be genetically unstable. Hence, conservation of microbiological genetic resources is safeguarded by nature itself, but man, for the sake of easy accessibility must make special provisions to preserve valuable strains.

## 2. Current activities of international significance

### (a) Co-ordination

121. In the report of the Stockholm Conference, various recommendations were made concerning genetic resources, including inter alia recommendations concerning surveys, inventories, programmes of exploration and collection, documentation, evaluation and utilization and conservation. Co-operation and co-ordination were urged with FAO, the MAB programme, IUCN and various national organizations and Governments. Subsequently, the Governing Council of UNEP has repeatedly stressed that the preservation of the diversity of genetic resources should be a high priority and has requested the Executive Director to direct efforts towards the establishment of adequate networks for their conservation.

### (b) Salient features of current activities

122. The member of the United Nations system carrying major responsibility in the field of the conservation of genetic resources is FAO. UNESCO is concerned with the subject, mainly through the MAB programme.

123. The emphasis of FAO's activities in the field of crop plant genetic resources is on the establishment of a global genetic resources network, the implementation of a computer-based system of communication, information and documentation, and the organizing of symposia. In collaboration with UNEP, training courses are held and exploration and collecting activities are undertaken.

124. In forest genetic resources FAO's activities are limited mainly to establishing priorities and publishing information on species of forest importance which are endangered.

125. FAO has issued several publications describing livestock breeds in various parts of the world and has originated a series of expert consultations on the evaluation, conservation and use of animal genetic resources. Little actual conservation work is being attempted as yet in the field of genetic resources of fish.

126. More actual conservation of genetic resources is taking place in the area of microbiological genetic resources than any other. The United Nations agencies most involved are UNESCO, WHO and UNEP. The World Federation of Culture Collections (WFCC) has, with aid from UNESCO, WHO, UNEP and the Commonwealth Scientific and Industrial Research Organization (CSIRO), developed a World Culture Data Centre in Australia which collects, stores, retrieves, and distributes information about cultures of micro-organisms.

127. Several projects co-sponsored by UNESCO and UNEP have aimed at strengthening the World Data Centre and at establishing Microbiological Resources Centres, primarily in developing countries. One large project, started in July 1975, aims at developing an integrated programme in the use and preservation of microbial strains for deployment in environmental management.

128. Conferences on culture collections and training courses on culture collection techniques are held periodically under the auspices of the WFCC with the aid of UNESCO, UNEP and IUBS.

(c) Review of major current activities

(i) Crop plant genetic resources

129. The International Board for Plant Genetic Resources (IBPGR) was established in 1974 by the Consultative Group on International Agricultural Research (CGIAR) to promote, in close collaboration with FAO, a genetic resources network on a global scale.

130. Regional programmes are being developed for South East Asia, the Mediterranean and the Near East. International and national institutes are starting to assume co-ordinating responsibilities for a number of major crops.

131. Much progress has been made since 1974 in advancing a computer-based Genetic Resources Communication, Information and Documentation System (GR/CIDS) in a project jointly established by FAO, IBPGR and the University of Colorado for the storage, retrieval and analysis of genetic resources data.

132. Collection and sampling procedures for seed-reproduced crops have been defined. Missions to collect cereals, millets, food and forage legumes and rice have been supported by FAO, in co-operation with UNEP and IBPGR. Exploration and collection priorities, for crops and areas, have been determined by the FAO Panel of Experts on Plant Exploration and Introduction. Crop priorities designated by two or more meetings are as follows: wheat, rice, sorghum, millet, barley, beans (*Phaseolus*), soya, groundnut, pea, cowpea (*Vigna*), potato, cassava, sweet potato, yam, banana, sub-tropical and tropical fruits, sugarcane, cotton, coffee, cocoa, rubber, forage species and cucurbits.

133. Standards, procedures and an organizational structure for the conservation and distribution of seed have been established by the FAO Expert Panel and space has been offered by institutions for international storage.

134. Graduates of the training course pioneered by Birmingham University (United Kingdom) are playing an increasing part in genetic resources work. Some short training courses have been given at national and international centres.

(ii) Forest genetic resources

135. Recent progress in field work has been mainly in exploration, collection, distribution and evaluation. Important genera covered by these activities are Pinus Picea Pseudotsuga Araucaria and Eucalyptus.

136. Field action in conservation has been negligible, but there is now much greater public awareness of the need for action. Guidelines to conservation methods are included in the UNEP/FAO study on the methodology of conservation of forest genetic resources.

137. The FAO Panel of Experts on Forest Gene Resources has prepared proposals for a global programme for improved use of forest genetic resources which relate the action needed in conservation to that in other operations such as exploration, evaluation and utilization. International dissemination of information is effected through the FAO publication "Forest Genetic Resources Information".

(iii) Farm animal genetic resources

138. The specimens of the low-productive local breeds which still remain in Europe and, to a much smaller extent, in North America, are preserved in special herds and flocks maintained for scientific, cultural or historic reasons in farm parks or zoological gardens, in national or regional environmental parks, and in private estates or Government farms. A joint FAO/UNEP project in 1974 prepared a preliminary list of breeds of farm animals which are in danger of becoming extinct.

(iv) Wildlife genetic resources

139. FAO, through its field projects, UNESCO through its MAB project 8, and IUCN, as the compiler of the United Nations List of National Parks and Equivalent Reserves and the "Red Data Book" have been closely linked with action and information on the in situ conservation of wildlife genetic resources which are detailed in the overview on endangered species and wildlife.

(v) Genetic resources of fish

140. No significant activity in the field of conservation of fish genetic resources has been undertaken during the period under review.

(vi) Microbiological genetic resources

141. Concern that valuable strains of microbiological genetic resources might be lost to mankind has led to the establishment of a number of culture collections, and considerable research effort has been expended on developing suitable techniques for the long-term storage of living microbes.

142. In addition to UNESCO, a number of non-governmental organizations are active in this field, notably the World Federation of Culture Collections, the International Committee on Taxonomy of Viruses (ICTV), and the International Cell Research Organization (ICRO). The former holds training courses in modern techniques in culture collection in maintenance at the Data Centre in Australia. ICTV acts as an international body for classification and nomenclature of all viruses and stimulates research in virology. ICRO, through the UNEP/UNESCO/ICRO Panel on Microbiology, has sponsored a number of symposia, including one on enzyme engineering, co-sponsored by the International Federation of Institutes of Advanced Study, in October 1975; a further symposium on environmental microbiology is planned for March 1976.

143. ICRO and UNESCO have also organized several training courses (two in Africa, six in Asia, three in Latin America, one in the Middle East and one in Australia) during the period 1974-76.

144. A regional network for microbiology has been formed in South East Asia as part of a UNESCO/Japanese National Commission programme.

145. From the information received, indications are that very few Governments carry out independent activities in the conservation of genetic resources. UNESCO MAB project 3 "Conservation of natural areas and of the genetic material they contain" provides a framework of action for Senegal, France, Peru, Iran, Australia, Canada, the United States, Kenya, the United Kingdom and India. An Introduction Centre was created with SIDA funds in Turkey in order to study genetic possibilities of wild species of plants. Afghanistan, Iran, Iraq, Pakistan and Syria also participate in this project.

Table 7

CONSERVATION OF GENETIC RESOURCES: ALLOCATION OF RESOURCES BY ORGANIZATION (DOLLARS)

	A. <u>Dissemination of information</u>		B. <u>Training</u>		C. <u>Research</u>		D. <u>Application of existing knowledge</u>					
	<u>1974</u>	<u>1975</u>	<u>1974</u>	<u>1975</u>	<u>1974</u>	<u>1975</u>	<u>1974</u>	<u>1975</u>				
FAO	157,000	734,000	816,000	29,000	221,000	160,000	15,000	12,000	14,000	261,000	938,000	2,063,000
UNESCO (3)	117,000	165,000	133,000	188,000	164,000	177,000	70,000	47,000	45,000	94,000	94,000	88,000
Total	274,000	899,000	949,000	217,000	385,000	337,000	85,000	59,000	59,000	355,000	1,032,000	2,151,000



Table 9

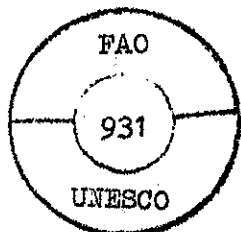
CONSERVATION OF GENETIC RESOURCES: TOTAL ALLOCATION OF RESOURCES  
BY ORGANIZATION (DOLLARS)

Agency	1974	1975	1976	Total
UNESCO	469,000	470,000	443,000	1,382,000
FAO	462,000	1,905,000	3,053,000	5,420,000
Total	931,000	2,375,000	3,496,000	6,802,000

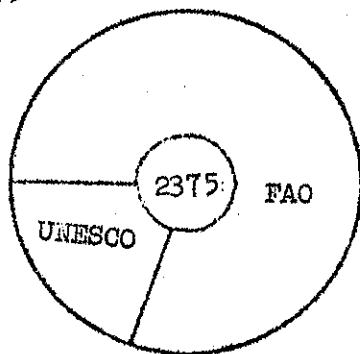
BREAKDOWN OF EXPENDITURES OF THE UN SYSTEM DEVOTED TO GENETIC RESOURCES

BY ORGANIZATION

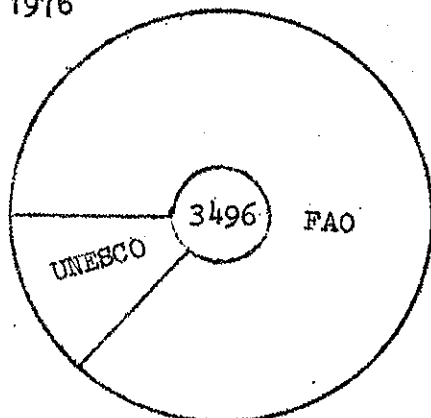
1974



1975



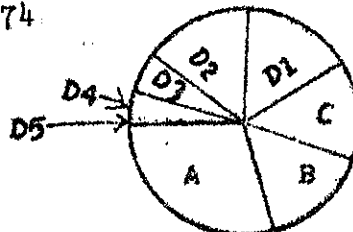
1976



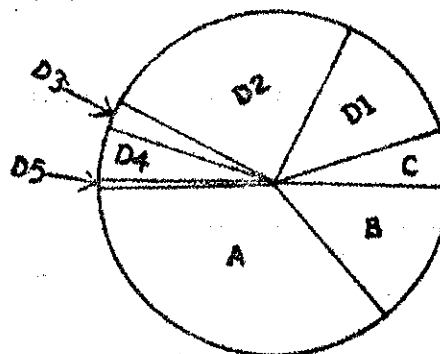
Figures in small central circles represent expenditure in thousands of dollars

BY FUNCTION AND REGION

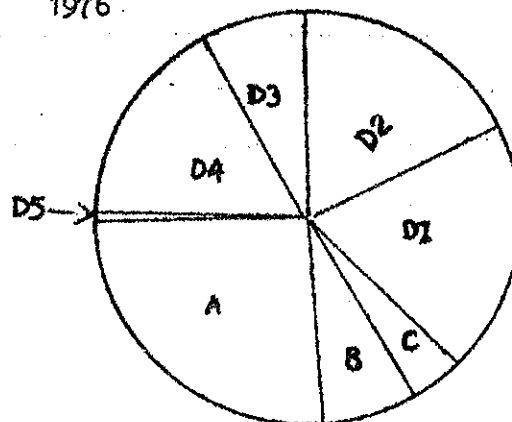
1974



1975



1976



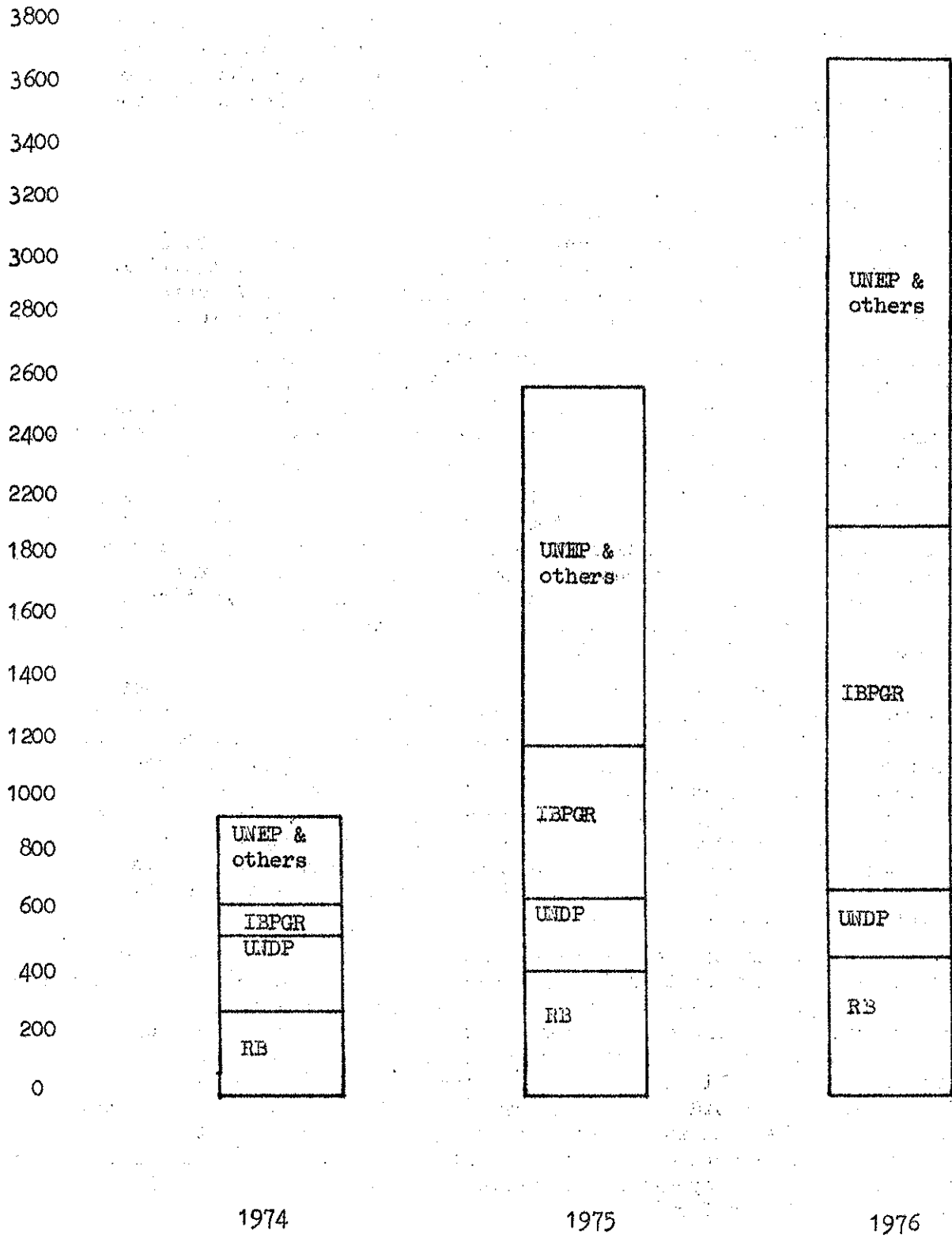
- A - Dissemination of information
- B - Training
- C - Research
- D - Application of existing knowledge
  - 1 - Africa
  - 2 - North Africa and Near East
  - 3 - Asia and the Far East
  - 4 - Central and Southern America
  - 5 - Europe



By source of finance:

Expenditure in thousands of US dollars  
RB = Regular budget

IBPGR = International Board for Plant Genetic Resources



### 3. The proposed plan of action

#### (a) Objectives

146. The objectives of the action programme are to survey and collect remaining genetic resources and to classify, evaluate, conserve, and utilize them for the benefit of present and future generations. The relative importance of each operation varies greatly according to the type of organism. All the above operations involve essential research, training and documentation components.

#### (b) Outline of plan of action

147. Conservation activities should therefore not be considered in isolation, but closely co-ordinated with the whole range of activities leading to their utilization, e.g. introduction, screening/testing, selection, breeding, multiplication and large-scale application.

148. In situ conservation of whole ecosystems is the ideal way of conserving wild species of plants and animals. It is not however always possible in practice; in such instances, ex situ conservation measures should be developed for species of potential economic importance. Ex situ conservation of varieties, races and breeds is also needed.

149. It is essential also to facilitate access to the genetic material already collected. This implies the multiplication of existing collections, the development of additional centres for conservation of genetic resources, especially in developing countries, the dissemination of information on the genetic material available and the facilitation of international exchange of genetic material under appropriate legislation and regulations for each category of genetic material.

150. A larger effort should be made to collect, assess and use genetic resources which are capable of introducing into difficult environments new possibilities for development. This may include, for instance: wild plants and animals for arid range land development; plants for sand dune fixation and reclamation of saline lands; plants and animals for development of high-altitude and cold areas; plants for protection of water-sheds, reclamation of open-mined areas and development of green areas within and around urban/industrial concentrations; fish and aquatic mammals to control excessive growth of aquatic vegetation in certain inland water bodies.

151. Genetic resources, for micro-organisms in particular, should be more widely used for controlling or avoiding problems of disease, pollution and waste disposal. Examples of areas of particular interest are: micro-organisms and insects for pest control; varieties and breeds resistant to diseases and pests (for instance trypano-tolerant cattle); micro-organisms capable of degrading persistent pollutants such as oil and pesticide residues; micro-organisms, plants and animals capable of recycling urban and industrial wastes (agro-industrial wastes in particular); application of biological nitrogen fixation (especially the legume/Rhizobium symbiosis) to reduce the need for industrially produced nitrogenous fertilizers.

152. In order to promote the utilization of genetic resources, a major effort needs to be made in conservation, collection and evaluation through the establishment of networks of conservation centres.

(i) Crop plant genetic resources

153. The major gap is the exploration and collection of crop genetic resources, in which little progress has been made. In addition, urgent attention is required in conservation (a) to safeguard the long-term survival of seeds, and (b) to preserve and maintain living collections of species which cannot be preserved as seeds.

154. Collecting the greatest possible diversity of a range of crop plants should take priority over highly-selective "mission-oriented" collecting, which contributes little towards general salvage of vanishing genetic resources.

155. Conservation of seeds requires urgent attention to safeguard their long-term survival. Seed storage facilities are needed where none exist, in South East Asia, Central America and Africa. The conservation of living collections of species which cannot be preserved as seeds should be strongly supported. Wild species are best preserved within their natural communities. Inventories of nature reserves, such as biosphere reserves, should be indexed for species of actual or potential economic value.

156. Training courses should be established in developing countries. Short courses should be highly specific and directed towards urgent priority projects in the exploration of threatened primitive cultivars, to generate interest in regional activities.

157. Extensive research should be directed to increasing the efficiency of genetic conservation, through research on meristem and tissue culture storage, the preservation of "recalcitrant" seeds and seed storage at very low temperatures.

(ii) Forest genetic resources

158. The major gap lies in conservation. Nothing has been done to establish ex situ conservation stands of populations endangered in their natural range, though seed has been collected in a few cases. Vigorous action is required both to improve the efficiency of protection and to include additional representative samples of forest types. Seed storage of a number of tropical species is difficult because of lack of seed dormancy, and research on this problem, and on the testing of seeds, is urgently needed.

159. The priorities for research and international action relate predominantly, though not exclusively, to species in tropical, sub-tropical, Mediterranean and arid zones.

160. Exploration, collection and evaluation of new species and provenances, as a basis for large scale introduction and utilization, should be intensified.

161. Conservation methods for forest genetic resources must be accompanied by training programmes and by the exchange of information about these resources and thus by the development of a system of gathering, storing and retrieving information.

(iii) Farm animal genetic resources

162. Action requirements in this area relate mainly to the preservation of breeds in developing countries. A systematic survey of the local breeds of livestock (e.g. the trypano-tolerant breeds of West Africa) would be desirable, together with international action to compare their performance as both purebreds and cross-breds in specific environments. To co-ordinate such a programme a series of regional networks is needed, linked by a central organization.

(iv) Wildlife genetic resources

163. The action requirements in this area are identical to those outlined in the overview on "Ecosystems, sites and samples".

(v) Genetic resources of fish

164. The major gap in the present knowledge of fish genetic resources at global level is the lack of information on genetic materials and on genetic qualities of the species involved. In addition, the existing experience in conservation methods and techniques has never been assembled on a world-wide basis. The priority actions recommended, therefore, are:

(a) Cataloguing of existing genetic resources of fish and shellfish with potential use in aquaculture,

(b) Establishment of a registry of fish introductions made around the world and development of guidelines for the exchange of exotic species;

(c) Consultation of experts on conservation techniques and preparation of conservation programmes (including setting up of gene pools and storage of gametes).

(vi) Microbiological genetic resources

165. In general, the technologically developed countries have made, and are continuing to make, adequate use of micro-organisms. It is in the developing world that ways must be found to exploit the microbe more efficiently. There is a strong case for establishing high-quality culture collections on a regional level in the less developed areas, some of which possess great microbiological genetic diversity. One of the most essential prerequisites is the adequate training of personnel.

166. It is imperative that the system of cataloguing of the known and available microbiological genetic resources be expanded and the liaison between existing documentation centres be strengthened.

### III. OCEANS

#### A. Marine pollution

##### 1. An overview

###### (a) Scope of the problem

167. The world oceans, covering 71 per cent of the earth's surface, have been used indiscriminately in the past to receive man's wastes. Their volume of 1,400,000 cu km is so large that were these wastes to be evenly dispersed throughout, the anthropogenic impact would be barely detectable even with the most sophisticated measuring techniques. In fact, however, the coastal processes of transport and mixing with the open ocean are comparatively slow and, in some cases of enclosed seas such as the Mediterranean, almost non-existent. Moreover, the ocean is so stratified that a long time is required for a substance to be transferred from the surface to lower depths by vertical currents and mixing. Consequently, pollution problems are largely manifest in estuaries, coastal areas and enclosed seas. On the other hand, those substances which float, such as oil and litter, can be seen in virtually all the world's oceans.

168. That coastal waters are usually polluted before, and much more seriously than, the open sea, is particularly significant when viewed in the light of the knowledge that 90 per cent of the total world marine catch comes from coastal areas. The following table illustrates the significance of the different ocean regions from the point of view of effects and duration of pollution on marine resources.

Categories of ocean areas and types of pollution, with effects on uses and their duration

Ocean area	Types of pollution	Effects on uses	Duration of effects
Coastal waters (10% of total area; 99% of total fish production, including that from upwelling areas)	Sewage; industrial waste, litter	Living resources destroyed or rendered unusable	Short-term, mainly during period of discharge
Open ocean (90% of total area, 1% of total fish production, excluding that from upwelling areas)	Synthetic organic substances, metals, petroleum hydro-carbons	Increasing concentrations in water and organisms may indicate dangerous trends	Long-term, duration depends on the residence time

(b) Man's impact on the marine environment and the significance of marine pollution

169. Minamata disease in Japan, due to mercury poisoning from contaminated fish and shellfish has led to deaths and tragic neurological disorders of consumers of these seafoods. Fish, particularly tuna, swordfish, halibut and dogfish, contaminated by mercury beyond a certain concentration (0.5 ppm) have therefore been banned by a number of Governments. Utilization of fisheries resources has been further adversely affected by tainting and discoloration with various other pollutants, e.g. a kerosene flavour in mullet contaminated by oil, and a green colour and metallic taste in oysters having a high concentration of copper. The molluscan filter feeders can concentrate most metals to high levels - oysters have a concentration factor (the ratio of concentration of a substance in the organism to that in ambient water) of more than 100,000 for zinc. Moreover, they can concentrate bacteria and viruses from human sewage, and this can transmit such diseases as viral hepatitis to humans.

170. The worldwide distribution of certain synthetic chemicals, such as the chlorinated hydrocarbon pesticide DDT and the PCBs (polychlorinated biphenyls), the industrial chemicals used in transformers, heat exchangers and copying paper, is now well known. DDT and its degradation products have been found in Arctic polar bears and Antarctic penguins, and in seals and whales, far removed from sources of this pesticide. Similarly, PCBs have occurred in fishes and plankton of the open ocean. There is strong evidence that these ubiquitous substances are transported from continents over the oceans by air currents and then washed out by rain, but some input also occurs from dumping both directly and into rivers.

171. DDT, and its degradation product DDE, has caused reproductive failure through eggshell-thinning in fish-eating birds. DDT has also caused heavy mortalities in young Atlantic salmon, and at very low concentrations affected adult migration patterns. Concentrations of 20 ppm of DDT have been found in the tissue of coho salmon rendering them inedible as they exceed the allowable 5 ppm of DDT in human foods.

172. Fish kills have repeatedly occurred in many local coastal areas because of the introduction of toxic chemicals, such as sodium hypochlorite from a chlor-alkali plant or sodium pentachlorophenate from spraying wooden structures against fungus rot. But more often, fish kills are recorded because the water characteristics have been acutely altered. This is due to the action of a particular waste, such as a pulp mill effluent rich in organic substances which, when decomposing, depress the oxygen level in the water.

173. In some areas, too, wildlife has been acutely affected by oil spills. Birds, which not only have an aesthetic appeal but also serve as food for some populations of the world, seldom survive coating with oil.

174. The estuaries are some of the first aquatic habitats that succumb to the insults of man. Anadromous species of fish, which pass part of their life cycle in estuaries, and which are particularly sensitive to pollution, are often the first fisheries resource to disappear. This has happened in varying degrees in estuaries on both sides of the North Atlantic, where domestic sewage and industrial wastes have poured in large quantities during the last century into the rivers upstream. While the productivity of the estuaries, measured in terms of biomass, appears to have remained undiminished in many cases, the community structure of the flora and fauna has substantially changed. "Weed" species tend to increase, while the species useful as forage for higher organisms, and as food for man, decline.

175. The most acute forms of coastal pollution result from the introduction of highly toxic or highly biodegradable substances and large volumes of floating material such as solid refuse or oil. These substances have a high impact, usually of short-term duration, and there may be little effect in the global sense because of pollutant degradation. However, introduction of such substances as metals and non-biodegradable synthetic chemicals can have a long-term impact on the global ocean because of accumulation. Acute local pollution problems are important, but it is the global manifestations that have serious long-term implications. Once trends of increasing mercury, cadmium or lead are evident in the open sea, it may take a long time to reverse them.

(c) Critical pollutants and modes of entry

176. Pollutants may be classified in five categories: (a) metals; (b) synthetic chemicals; (c) petroleum hydrocarbons; (d) radionuclides; and (e) solid wastes. These enter the marine environment in four basic ways: (a) river discharge; (b) atmospheric transport, followed by wash-out with rain; (c) ocean dumping; and (d) coastal discharges.

2. Current activities of international significance

(a) Co-ordination

177. At present, no specialized agency or intergovernmental organization has sufficiently wide terms of reference to provide overall competence and co-ordination in marine pollution, although UNEP has a clear responsibility in this area as outlined by General Assembly resolution resolution 2997 (XXVII) of 15 December 1972. At its second session, the Governing Council, by decision 8 (II), paragraph A.I.4(a) 7/, recognized that:

"In view of the many activities of numerous other agencies in this field [Oceans], the United Nations Environment Programme should concentrate on the co-ordination of these activities and on the protection of the marine environment".

Moreover, IOC devotes a substantial proportion of its effort to this field.

7/ Official Records of the General Assembly, Twenty-ninth Session, Supplement No.25 (A/9625), page 63.

178. A first major attempt at providing global scientific guidance on the subject was the General Assembly resolution 2467 (XXIII) of 21 December 1968 which established Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). The Group was initially composed of IICO, UNESCO and FAO, later joined by WHO, WMO, IAEA and the United Nations. In 1972 an International Co-ordination Group (ICG) was established to prepare a comprehensive plan for the implementation of a Global Investigation of Pollution in the Marine Environment (GIPE). The GIPE plan relies heavily on existing regional programmes in marine pollution research, such as that in the North Sea co-ordinated by the International Council for the Exploration of the Sea (ICES).

179. The establishment in 1969 of the Intersecretariat Committee on Scientific Programmes Relating to Oceanography (ICSPRO), comprising several United Nations bodies, provided a further co-ordinating mechanism to assist these organizations in discharging some of their functions relating to ocean affairs, including marine pollution.

180. The Declaration 3/ of the United Nations Conference on the Human Environment (1972) represents a widely accepted statement of principles and guidelines for further collaboration between United Nations bodies and Governments. Responding to this Declaration, Economic and Social Council resolution 1802 (LV) of 7 August 1973 set forth the elements of a coastal development programme, including coastal pollution, and invited the Administrative Committee on Co-ordination to prepare a report on International Co-operation and Co-ordination within the United Nations system on marine sciences (document E/5676, May 1975).

31. Several non-governmental organizations are making valuable contributions towards an integrated approach to marine pollution studies, particularly the Scientific Committee on Oceanic Research (SCOR), which acts as an advisory body to IOC.

(b) Salient features of current activities

182. Several organizations of the United Nations system, in addition to the United Nations itself, are dealing with aspects of marine pollution. Their individual activities are oriented according to the particular specialization of each. Increasingly, however, the agencies are working in concert through joint groups and programmes as described above.

183. GESAMP holds annual sessions and in addition carries out a substantial amount of intersessional work, with UNEP support, through its six expert working groups. A pilot project on oil pollution monitoring in the Atlantic has been undertaken through the Integrated Global Ocean Station System (IGOSS) co-ordinated jointly by IOC and WMO. As a first stage in the comprehensive plan for the implementation of GIPE a series of regional scientific workshops is being organized.

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3/ United Nations publication, Sales No. 73.II.A.14, Chapter I.



184. IMCO, through its Marine Environment Protection Committee, has the responsibility of co-ordinating and administering activities concerning the prevention and control of marine pollution from ships. IMCO is organizing a symposium on all technical aspects of this topic, sponsored by the Government of Mexico and UNEP, to be held in 1976.

185. WHO and the United Nations Department of Economic and Social Affairs are mainly concerned with the pollution of coastal waters. The Department has recently initiated a comprehensive inter-disciplinary study of coastal area management and development. WHO's activities are directed mainly at the control of land-based pollution through its many projects in sewage disposal and water quality.

186. The IAEA activities are directed towards the establishment of limits for the safe discharge of radionuclides into the marine environment and the development of improved monitoring techniques and procedures for waste disposal. FAO is mainly concerned with marine pollution as it affects fishery resources and operations and as a threat to human health through fish contamination.

187. Among organizations outside the United Nations system, the International Council for the Exploration of the Sea sponsors studies and publishes reports on pollution, primarily in the North Atlantic and adjacent seas. The European Economic Community is active in developing legislation for pollution control in the European region.

188. Various bodies of the International Council of Scientific Unions (ICSU) are interested in the scientific aspects of marine pollution, particularly SCOPE, which is interested mainly in monitoring, and SCOR, which has among its many sub-groups a working group on river inputs to ocean systems and leads a joint working group on marine pollution research. A number of other non-governmental organizations are active in this field. Among them are the International Association for Meteorology and Atmospheric Physics (IAMAP), SCAR (both of ICSU), the European Oceanic Association, the International Ocean Institute (Malta) and the Sierra Club.

189. Many individual Governments are also engaged in activities of global significance. Extensive information has been received regarding research programmes conducted by Australia, Canada, Japan the United Kingdom and the United States. Iran is developing strategies for the protection of the Persian Gulf and the Sea of Oman, and has signed a protocol for the protection of the Caspian Sea with the Soviet Union.

(c) Review of major current activities

(i) Dissemination of information

190. Workshops/Symposia. As part of the implementation plan for GIPM, regional scientific workshops have been or are being organized by FAO and IOC, with UNEP support, for the Mediterranean (1974) for the Caribbean (1975) and for East Asian Seas (1976). IOC and WHO, with the assistance of the United States Department of Commerce, organized a Symposium on Marine Pollution Monitoring (United States, 1974) and IMCO plans a symposium on the technical aspects of pollution from ships (Mexico, 1976).

191. FAO organized a Government Consultation on the protection of living resources and fisheries from pollution in the Mediterranean (Rome 1974) while WHO held a workshop on coastal pollution and other environmental health problems in the same region in 1974.

192. The Economic Commission for Europe has conducted two seminars (1974, 1975) on the pollution of coastal and estuarine waters from land based sources. A workshop on hydrocarbons in the marine environment was held by ICES in Aberdeen, United Kingdom in 1975.

193. Reports. Working Groups of GLSAMP have produced or will soon produce reports on:

- (a) Review of harmful substances which is updated and elaborated annually;
- (b) Scientific basis for the disposal of wastes into the sea;
- (c) Guidelines for an open ocean monitoring system;
- (d) Scientific aspects of pollution arising from the exploration and exploitation of the sea bed;
- (e) Principles for developing coastal water quality criteria;
- (f) The impact of oil on the marine environment.

194. Within the framework of the comprehensive plan for GIPME, IOC has published a report on the "Health of the Oceans". IMCO is developing in stages a comprehensive antipollution manual providing technical assessments for intervention under the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 9/ and the 1973 Protocol Relating to Intervention in Cases of Marine Pollution by Substances Other Than Oil 10/.

195. WHO has produced reports of the WHO/IOC task team on the methodology for monitoring pollutants entering the sea from the atmosphere, and a report on the "Determination of the atmosphere contribution of petroleum hydrocarbons to the ocean". Reports on marine pollution caused by off-shore mineral development and by the discharge of river waters have been published by the United Nations Department of Economic and Social Affairs. Among several reports on radionuclides in the marine environment, IAEA has produced a report on intercalibration for the measurement of heavy metals and chlorinated hydrocarbons in the aquatic environment.

(ii) Research and monitoring

196. Regional studies, co-ordinated by the joint group for technical co-ordination (IOC/International Council for the Scientific Exploration of the Mediterranean/General Fisheries Council for the Mediterranean), are being carried out in the Mediterranean region. Other regional studies

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9/ 29 November 1969. Deposited with IMCO.

10/ ST/LEG/SER.B/13/Add.2, paragraph 314.

(the Kuroshio, the Caribbean, the Northern part of the East Central Atlantic, and the tropical Atlantic), co-ordinated by IOC within the framework of its programme of co-operative investigations, include components in marine pollution. IICO plans three regional projects to identify and assess the incidence and effects of pollution from ships in co-operation with the Riparian States of the Mediterranean, the Persian Gulf and the Red Sea.

197. WHO has sponsored a study on hydrocarbons entering the sea through the atmosphere and is associated along with IAMAP in the SCOR working group on the tropospheric transport of pollutants. Jointly with IOC, and with UNEP support, WHO has begun a pilot project on marine pollution monitoring (petroleum) in the Atlantic.

198. Within the framework of MAB project 5 (Ecological effects of human activities on the value and resources of lakes, marshes, rivers, deltas, estuaries and coastal zones), the behaviour and effects of industrial wastes on aquatic ecosystems are to be studied. WHO's studies on the ecological aspects of pollution in specific geographical areas include studies on the effects of pollutants on marine organisms.

199. Biological aspects of marine pollution are studied by various international groups, including:

- (a) The ACMRR/IABO Working party on ecological indices for measuring the state of living resources as affected by environmental stresses;
- (b) The ACMRR/IABO Working party on biological effects on pollutants;
- (c) The WHO Group on sub-lethal effects of pollutants on marine mammals;
- (d) The International Commission on Radiological Protection.

200. An important example of activities of national institutions is the "Controlled Ecosystem Pollution Experiment" (CEPEX) which started in 1973. This is an interdisciplinary programme of investigation by chemists, zoologists, botanists, microbiologists and mathematical modellers on heavy metals and hydrocarbons in the food chain of the sea under controlled experimental conditions, maintained in situ, as similar as possible to the natural environment. It involves several United States, Canadian and United Kingdom institutions.

### (iii) Training

201. With the assistance of the Swedish International Development Agency, FAO is organizing regular training courses (Peru, 1975; Sweden, 1976; Malaysia, 1976) in aquatic pollution in relation to the protection of living resources. Training courses in coastal pollution control are organized regularly by WHO with the assistance of the Danish International Development Agency. One was held in 1975 and another will be held in 1976.

202. Training courses will also be held within the framework of the IGOSS project on marine pollution monitoring. Many of UNESCO's inter-regional training courses in marine sciences include components in marine pollution.

203. IMCO is planning a training programme in the Arab Maritime Academy (Alexandria), together with 14 Arab Governments. As part of the United Nations Coastal Area Development Programme, regional seminars will be organized to train personnel in developing countries in the scientific and technical disciplines of coastal management.

(iv) Application of existing knowledge

204. Field projects. FAO, WHO, IMCO and UNESCO all have field projects designed to support developing countries on pollution problems lying within their areas of expertise. Most of these projects are funded by UNDP.

205. Legislation. IMCO has a number of activities related to those international conventions which it administers. These include: amendment to the Bulk Chemical Code; establishment of provisions and requirements for noxious solid substances carried in bulk; and revision of international specifications for performance of oily water separating equipment and oil content meters according to the new requirements contained in the 1973 protocol. The various treaties, agreements, conventions and protocols for the control of marine pollution, or related thereto, are listed in document UNEP/GC/61/Add.2 "Status of Conventions and Protocols in the field of the environment".

206. Three conventions came into force in 1975: the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, the International Convention on Civil Liability for Oil Pollution Damage 11/, and the Convention for the Prevention of Marine Pollution by Dumping of Wastes and other Matter 12/.

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11/ 29 November 1969. Deposited with IMCO.

12/ Done in quadruplicate at London, Mexico City, Moscow and Washington, D.C. on 29 December 1972. For the text, see A/AC.130/SC.III/L.29.

Table 10

MARINE POLLUTION: ALLOCATION OF RESOURCES BY ORGANIZATION (DOLLARS)

Agency	A. Dissemination of information		B. Training		C. Research		D. Application of existing knowledge		
	1974	1975	1976	1974	1975	1976	1974	1975	1976
UNESCO/ IOC	191,000	245,000	170,000	34,000	94,000	101,000	34,000	39,000	28,000
FAO	41,000	17,000	7,000	-	229,000	196,000	-	-	-
WHO	98,000	38,000	49,000	9,000	74,000	77,000	47,000	36,000	2,000
IMCO	134,000	169,000	260,000	100,000	135,000	200,000	100,000	135,000	200,000
WMO	11,000	12,000	21,000	-	-	-	15,000	-	-
ECLA	43,000	-	-	-	-	-	-	53,000	-
IARA	8,000	-	-	-	-	-	88,000	152,000	-
Total	526,000	481,000	507,000	143,000	532,000	574,000	284,000	415,000	230,000
							640,000	869,000	1,069,000

Table 11

MARINE POLLUTION: APPLICATION OF EXISTING KNOWLEDGE BY REGION (DOLLARS)

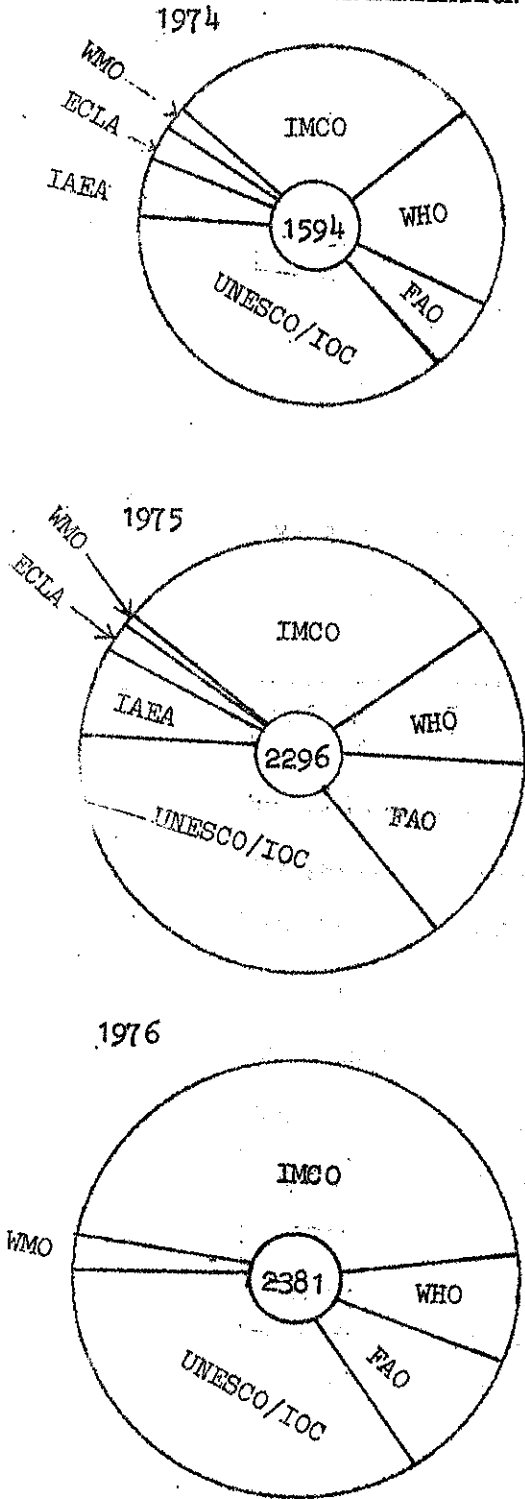
Agency	1. Africa		2. North Africa and the Near East		3. Asia and the Far East		4. Central and South America		5. Europe and Interregional Programme				
	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975			
UNESCO/ IOC	-	-	174,000	17,000	37,000	292,000	289,000	73,000	69,000	32,000	-	73,000	118,000
FAO	-	-	27,000	31,000	-	-	-	-	-	-	8,000	9,000	9,000
WHO	-	-	-	-	26,000	52,000	33,000	2,000	2,000	1,000	28,000	68,000	29,000
IMCO	29,000	62,000	30,000	64,000	30,000	64,000	105,000	30,000	64,000	106,000	1,000	2,000	-
Total	29,000	62,000	231,000	112,000	93,000	408,000	427,000	104,000	135,000	139,000	137,000	152,000	156,000

Table 12MARINE POLLUTION: TOTAL ALLOCATION OF RESOURCES BY  
ORGANIZATION (DOLLARS)

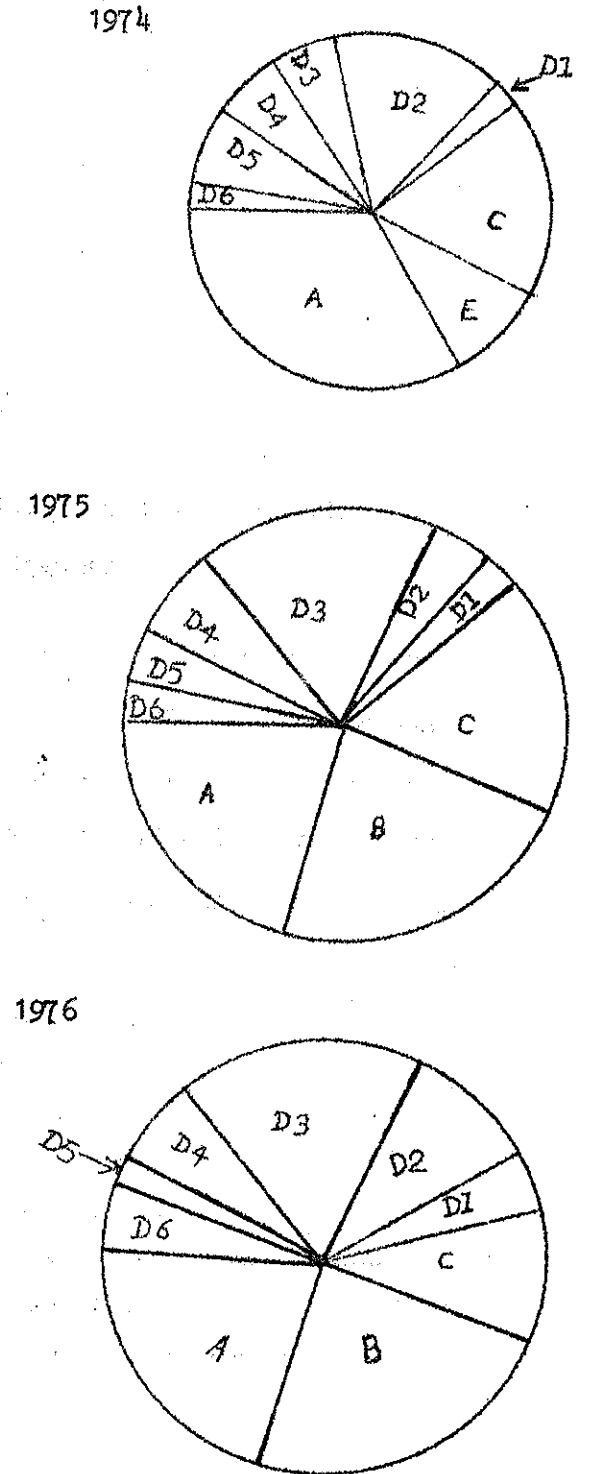
Agency	1974	1975	1976	Total
UNESCO/IOC	589,000	829,000	856,000	2,274,000
FAO	103,000	315,000	230,000	648,000
WHO	283,000	240,000	192,000	715,000
IMCO	454,000	695,000	1,082,000	2,231,000
WMO	26,000	12,000	21,000	59,000
ECLA	43,000	53,000	-	96,000
IAEA	96,000	152,000	-	248,000
TOTAL	1,594,000	2,296,000	2,381,000	6,271,000

BREAKDOWN OF EXPENDITURES IN THE UN SYSTEM DEVOTED TO MARINE POLLUTION

BY ORGANIZATION



BY FUNCTION AND REGION



Figures in small central circles represent expenditure in thousands of dollars

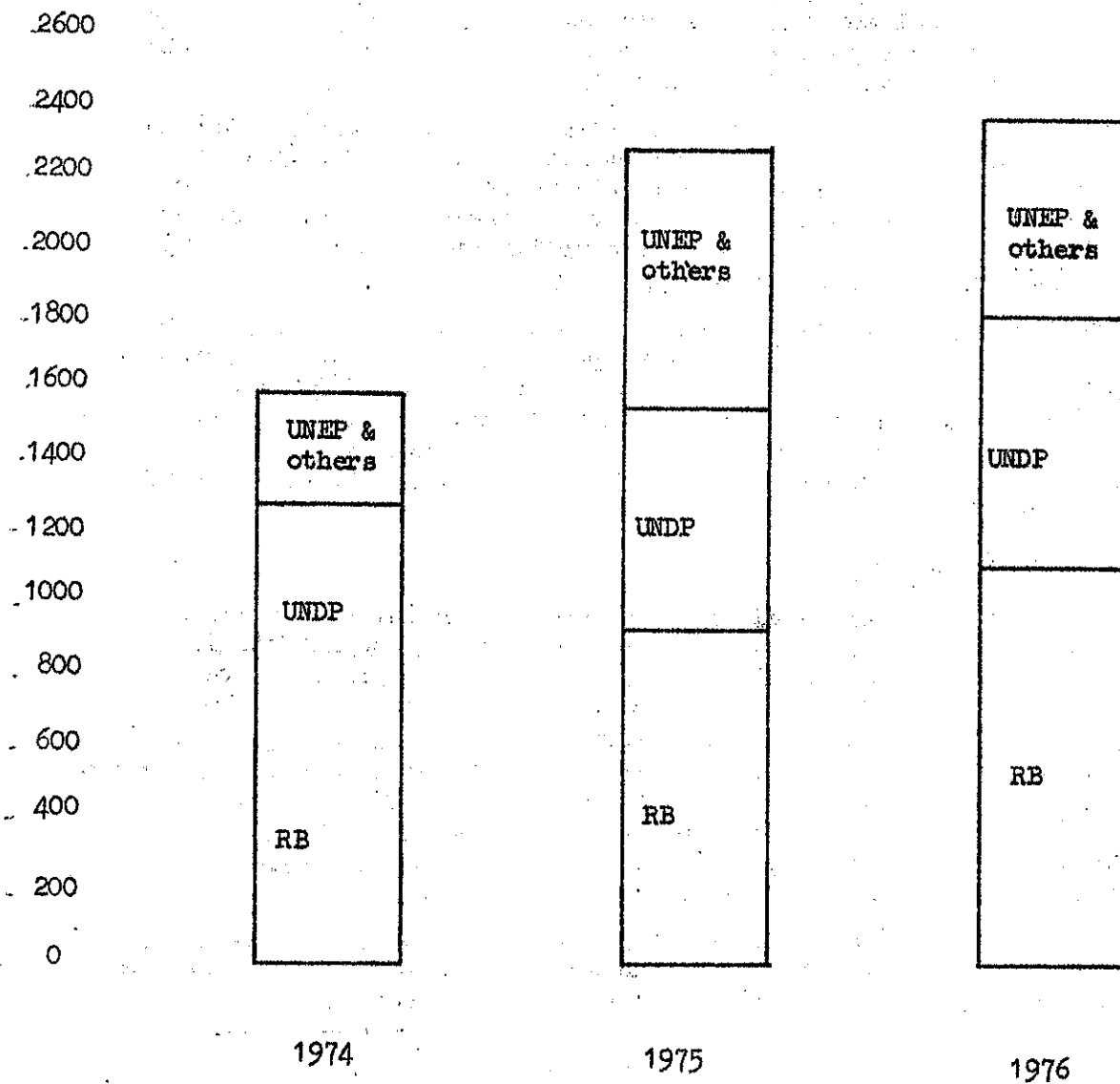
- A - Dissemination of information
- B - Training
- C - Research
- D - Application of existing knowledge
  - 1 - Africa
  - 2 - North Africa and Near East
  - 3 - Asia and the Far East
  - 4 - Central and Southern America
  - 5 - Europe
  - 6 - Global



By source of finance:

Expenditure in thousands of US dollars

RB = Regular budget



### 3. Proposed plan of action

#### (a) Objectives

207. The primary objectives in a programme of assessment and control of marine pollution are:

- (a) To preserve the marine environment as a habitat for living marine resources;
- (b) To preserve the biological activity in the marine environment as an essential component of the biosphere as a whole;
- (c) To preserve the marine environment as a place of recreation so as to improve the quality of life.

#### (b) Outline of plan of action

##### (i) Collection, dissemination and exchange of data

208. Progress in the past three years in setting up national and especially regional monitoring programmes has been good, and efforts to establish further programmes as planned for the Caribbean and the South East Asian seas should be pursued.

209. There is a need for a representative number of baseline stations in the world oceans where critical pollutants can be assayed in water, biota and sediments. The resultant data would serve as a basis for comparison with data from coastal areas and enclosed seas. Further information is also needed on specific pollutants entering the marine environment through routes other than rivers.

210. The dissemination and exchange of marine data and study reports is effected smoothly through existing publications and data exchange channels. However, there is a need to improve the quality and consistency of marine pollution data, and the work in this regard of IOC and the inter-agency Joint Task Team on Interdisciplinary and Inter-organizational Data and Information Management and Referral should be pursued.

##### (ii) Training

211. There is an urgent need for education and training of skilled analysts and researchers. Sampling and analysis of pollutants in the marine environment and in the biota requires skills that are available in relatively few laboratories. For any kind of global investigation of marine pollution, there is a need for highly trained technicians, but also for marine scientists who have a deep appreciation of environmental and ecological problems. Training for technicians can be given through intensive courses of two months to two years duration, but scientific expertise can only be gained through graduate training at a reputable centre of higher learning.

212. A further requirement is for an inventory of available facilities for such studies throughout the world so that guidance can be given to Governments, agencies providing fellowships and students.

(iii) Research

213. There are many areas of marine environmental/ecological understanding in which knowledge is insufficient and, in some cases, minimal. Research is needed on estuarine ecosystems to develop verified models suitable for predicting environmental impact of specific events or developments. The effects of pollutants, particularly of large volume effluents, such as cooling waters, on the behaviour of coastal and anadromous fisheries need to be known.

214. All species have an optimum range of temperature, salinity and dissolved oxygen in which the effect of a pollutant is minimized. Outside this range, there is a synergistic effect of the pollutant and unfavourable environmental conditions, which causes organisms to succumb more quickly than under the preferred environmental conditions. More must be learnt about this effect in order to improve management and control of waste disposal in widely varying coastal environmental conditions.

215. There are few good bioassay data on which to base water quality criteria for protecting living marine resources. Simple bioassay techniques are badly needed.

216. The increasing recreational use of beaches demands that a full-scale study be conducted on health risks from sewage pollution and industrial wastes in bathing areas. The epidemiological data obtained so far on the health effects of bathing in sewage-polluted waters are insufficient to develop acceptable water quality criteria.

217. The pathways of persistent materials through the marine ecosystem and the mechanisms of bioaccumulation in marine living resources are poorly understood. Moreover, the effects of the bioaccumulated substance on the organism itself and the extent of detoxification mechanisms is largely unknown.

218. Finally, the whole subject of degradation processes of pollutants in the marine environment, whether through physico-chemical means or by biological activity, requires urgent research.

(iv) Application of existing knowledge

219. International conventions have dealt quite effectively with control of pollution from ships and with dumping of wastes at sea. However, there are major gaps that must be bridged before control of marine pollution can be dealt with fully. The following sources of pollution are not covered in existing conventions and require urgent international action:

- (a) Shore-based pollution sources, including river discharges,
- (b) Atmospheric emissions;
- (c) Pollution from exploration and exploitation of the sea-bed and its subsoil.

220. It is presumed that some of these problems will be resolved by the third United Nations Conference on the Law of the Sea, where the question of pollution from sea-bed, exploration and exploitation have been particularly examined in detail. In the absence of international agreement through this forum, some other mechanism will be required to bring about control of these sources of pollution.

B. Conservation and protection of living marine resources

1. An overview

(a) Scope of the problem

221. Marine living resources, consisting of plants, invertebrates, fishes, reptiles (marine turtles), birds and mammals, form essential components of the marine ecosystem. Marine living resources outside the pelagic region also form part of biomes and/or ecosystems of great productivity and usefulness to man, for instance, tidal estuaries, mangrove forests and swamps, sea-grass beds, kelp beds, lagoons and coral reefs. Since fish (used here to include marine invertebrates which are regularly harvested) constitute the most important part of man's utilization of marine living resources, they are dealt with here in more detail than other living resources.

222. The present total world catch of 65 million tons of fish (including freshwater fish) provides some 15 per cent of the global supply of animal protein used directly for human consumption. The reviews of world marine fish landings collated by FAO show that total catches increased annually by about 5 per cent from 1948 until the late 1960s, since when they have levelled off. There is however, strong evidence of declining stocks in several areas, indicating that the previous catch increases were in some cases the result of overfishing. Several major resources have decreased markedly in recent years: the anchoveta catch has decreased from over 11 million tons in 1971 to 2 million tons in 1973; the decline in the North Sea herring has been such that the relevant regional fishery body has proposed the FAO International Commission for the North West Atlantic Fisheries (ICNAF) a fishing ban, as it did in 1974 with respect to the Atlantic salmon. Whether or not these declines are due to human factors is still not clear.

223. Certain other resources such as marine turtles and whales have shown a massive drop in numbers and in some cases are approaching extinction. At least one sub-species of whale, the western gray whale, has become extinct due to over exploitation, and several others have approached this state despite protection measures. The blue whale, which in 1962 in the Antarctic had been reduced to 10 per cent of its 1946 level and 1 per cent of its number before 1920, was not protected until 1967 and after eight years is showing no visible signs of recovery. World-wide the blue whale was in 1973 down to 6 per cent of the original numbers. Of the species still being harvested the fin whale is already seriously depleted (in 1963/64 its number

in the Antarctic had dropped to some 8 per cent of its level in the 1920s; in 1973 it was down to 23 per cent worldwide 13/ and quotas set for 1974-75 could not be caught.

(b) The significance of marine living resources for man

224. The natural stocks of plants and animals in the sea constitute one of the major resources of the world, and the only one based on the natural production of an ecosystem that is still relatively undisturbed. They are important both because of their utilization as food or other products, and as part of the ecosystem in which the basic biological production takes place.

225. The implied limit to resource potential is governed by the biological basis of marine production. The estimated initial plant production of some  $2 \times 10^{11}$  tons each year is transferred, by animals grazing on plants or preying on one another, to culminate in an estimated potential annual harvest of almost 100 million tons of conventional fish products. Fluctuations in the resources harvested by man in turn affect him by the quantity of protein available, its value, and by the cost of harvesting in terms of energy, finance and manpower. Radical change in the resources may also influence the biological stability of particular areas and with it the other human activities which give that resource its intrinsic value.

(c) Man's impact on and interaction with living marine resources

226. The impact of harvesting is reasonably well understood, and general principles are applicable to all living marine resources. Catches from a resource may remain low for a very long initial period, but at some point increased demand is associated with improved technology and industrialization, leading to a rapid expansion. A balance will finally be established between the level of exploitation, the resulting size of the stock, and the catches, which may or may not realize the full potential of the resource. There is a time lag in the response of the resource to increased exploitation, with the risk that the latter exceed a desirable level before its full effects can be detected. If exploitation becomes too intensive, or animals are caught at an early age, they may be unable to fulfil their growth potential leading to a shortfall in potential yield. In some instances (blue whale, North Sea herring) severe over-exploitation has reduced the rate of renewal of the resource leading to a subsequent collapse. These developments are associated with increased harvesting, leading to increased costs, which culminate in over-investment and a reduced rate of return on investment. This in turn stimulates the search for new resources to maintain the cycle.

13/ Data from the International Bureau of Whaling Statistics, the International Whaling Commission, FAO Year Book of Fishery Statistics; Slijper, E.J., Whales (London, 1962), Mackintosh, W.A., The Stocks of Whales (London, 1955). Slijper, E.J. 1965: A Hundred Years of Modern Whaling (Mededelingen. 19:29-61); Curry-Lindahl, K., Let Them Live. A Worldwide Survey of Animals Threatened by Extinction. (New York, 1972); Schevill, W.E. (ed). The Whale Problem, A Status Report (Cambridge, Mass., 1974).

227. Exploitation of a living marine resource influences the abundance of this resource, and with it the relative abundance of other species within the ecosystem; this may have profound effects on its structure and productivity, particularly amongst marine mammals which are at present endangered by extinction through over-exploitation.

228. Besides the environmental effects of over-exploitation, man's impact through changes in the marine environment falls into four categories:

(a) Pollution which has an adverse effect on the survival of fish and invertebrates in the vulnerable young stages of the life cycle, e.g. in coastal nursery areas, and on mammalian embryos which may be killed before birth although their mothers survive. Pollution may also have lethal effects on adult animals;

(b) Pollution which has an adverse effect on the value of the products or constitutes a hazard to human health if they are consumed;

(c) Pollution which influences the structure of the ecosystem and disturbs the intrinsic balance between species;

(d) Restructuring of the environment itself (e.g. regulation of river flow, gravel extraction) which may permanently displace resources or destroy habitable areas.

229. The effects on resources of changes so far detected in the physical and chemical environment have been very local, and relate mainly to loss of value rather than loss of production. The possibility of lasting resource damage and the potential for habitat destruction are considerable, but these have not so far occurred on any major scale except in the case of whales and marine turtles.

230. Man's influence may also be felt through marine culture and the introduction of alien species into the marine environment. The culture of marine organisms is at present restricted to a small number of countries. It is expected to increase, but limitations on the availability of sites and the economics of the industry at present indicate that its overall contribution to global food production will remain small, though locally important. At the same time it must be developed with care, especially if it involves the introduction of alien species or the possibility of their carrying alien organisms into new areas where they may proliferate rapidly with undesirable consequences.

231. Taking the broad view of these three separate aspects of human activity in relation to living marine resources, it is clear that exploitation for food or other products is and will remain of paramount importance. Other activities may have negative and positive effects, but these have not yet reached significant proportions on a global scale, again except in the case of whales and marine turtles, and can and must be carefully managed locally where they occur. Given that the risks associated with environmental degradation have been recognized and that the environment will be monitored on a widening scale, the main cause for concern remains in the area of conservation and management to mitigate the effects of excessive exploitation.

232. The discovery and development of new resources cannot continue indefinitely. With the estimated potential of traditional resources limited to rather less than 100 million tons, the limit could be reached within two decades. Thereafter, maintenance of yield against the influence of fishing will depend on careful management to match the rate of exploitation to the resources, and further growth will depend on new technological approaches to bring currently unfamiliar resources into production.

## 2. Current activities of international significance

### (a) Co-ordination

233. Co-ordination of activities related to the marine environment itself is considered in the overview on pollution. So far as the living marine resources are concerned, those exploited by man fall within FAO's sphere of competence; it co-ordinates activities at the global level, and has established regional bodies to co-ordinate on a regional basis.

234. General Assembly resolution 3133 (XXVIII), "Protection of the Marine Environment", requested UNEP to direct special attention to the environmental protection of the seas and oceans, in particular its living resources.

### (b) Salient features of current activities

235. FAO carries a major responsibility for monitoring aquatic resources, scientific and technical advice, dissemination of research information and data, and co-operation with other organizations. Its Committee on Fisheries provides a forum for review of global affairs related to marine food production and through it FAO has been concerned in the preparation of material for the third United Nations Conference on the Law of the Sea, with the development of co-operation with international organizations concerned with fisheries and with co-ordination in aquaculture.

236. Assessment and management activities are largely carried out on a regional basis. There are 25 regional fisheries commissions, covering almost all areas of the world ocean. Their main functions consist in reviewing periodically the state of exploitation of the major living aquatic resources of the world and formulating conservation measures to be enacted by Member States. These include such measures as net and gear regulations, minimum landing sizes for fish, quota schemes, industrial fishery regulations, closed periods and closed areas, once agreed on, these measures are recommended to and introduced by member countries in their domestic legislation (though many countries implement additional regulations for their own fishermen or in national waters which need not be agreed internationally).

237. The majority of the regional and international regulatory bodies are concerned with fish resources, but there are other commissions or conventions responsible for whales (International Whaling Commission) and seals in particular areas (Pribilof Fur Seal Convention, Convention on Antarctic Seals). Some of these have been successful, but in general the implementation of management measures at the international level has not so far provided adequate protection for many of the resources to which they have been applied.

(c) Review of major current activities

(i) Dissemination of information

238. FAO has a major role in co-ordinating the collection and dissemination of information on a global scale which is based on an infrastructure of documentation, ad hoc meetings of specialists or symposia convened by FAO/UNESCO and also conducted at the regional level by the appropriate regulatory body or associated scientific councils.

239. Symposia and meetings:

(a) FAO's Committee on Fisheries meets annually to review global affairs relating to marine food production and regular regional reviews are carried out by the regional fishery bodies;

(b) A workshop on manatee research, conservation and management was held in Guyana in 1974;

(c) With the participation of UNESCO, FAO and UNEP, a Conference on East African Marine Resources was held in the United Republic of Tanzania in 1974.

(d) An FAO/SCOR Symposium on "Controlled Aquatic Ecosystems" is scheduled for 1976 and, with UNESCO, SCOR plans a symposium on tropical zooplankton in Goa also in 1976;

(e) A seminar on fisheries was co-sponsored by the Sierra Club at the Caracas session of the third United Nations Conference on the Law of the Sea, and other seminars are planned for the Caribbean and West African regions.

240. Publications and reports:

(a) The compilation and regular publication of statistics is a high priority task for virtually all of the regional fishery bodies;

(b) FAO publishes a yearbook on fishery statistics and various reports on fishery resources by species and region or sub-region;

(c) The Aquatic Sciences and Fisheries Information System (ASFIS) is preparing, during 1975/76, registers of experts in aquatic sciences and fisheries, of aquatic science research institutions, and of aquatic science research equipment.

(d) A World Bibliography on seals has been completed by the University of Guelph with support from UNEP, FAO and ICES. ICES regularly issues publications dealing with marine resources, such as the "Bulletin Statistique", "Fiches Internationales du Zooplankton", "Journal du Conseil", "Annales Biologiques", and "ICES Oceanographic Data Lists and Inventories".



(e) The International Society for the Protection of Animals (ISPA) is preparing a comprehensive manual dealing with the conservation of animals affected by oil pollution.

(ii) Training

241. Training activities take two forms: the funding of trainees to visit particular institutes and the conduct of training courses in particular regions. UNESCO supports training in wider aspects of marine science whilst FAO concentrates on training in the methodology of resource evaluation and management. An FAO/NORAD training course in Acoustic Methods for Fish Detection and Abundance Estimation was organized in 1975. FAO and UNDP are supporting a Training Centre and Working Group on Stock Assessment in Brazil. A training course on Methodology of Fisheries Science was convened in 1974 by FAO and the Danish International Development Agency for the Mediterranean and West African regions.

242. Under its participation programme, UNESCO organizes training courses on coastal ecology, mariculture and aquatic living resources. A training course in Japan included the study of phytoplankton zooplankton relationship.

(iii) Research

243. Intergovernmental research activities are conducted under UNESCO's MAB programme and International Decade of Ocean Exploration particularly on the biology of the benthos in South America, on plankton in Asia and on tropical planktonology in the Indian Ocean. Support is given by UNESCO to regional networks of marine laboratories and to SCOR's research programmes. Within the framework of the Long-term and Expanded Programme of Oceanic Exploration and Research, IOC is carrying out a survey of living aquatic resources jointly with FAO.

244. SCOR and ICES are studying the level of contaminants in fish and shellfish in the Baltic. ICES is also engaged in research programmes on salmon with ICNAF.

245. The FAO/ACMRR Marine Mammals Project is bringing together the results of research carried out by Governments.

246. Research by the International Whaling Commission includes analysis of the sex, length and size of the foetus of pregnant female whales, and the Smithsonian Institution is carrying out population research on minke whales. A number of research programmes are carried out by IUCN for conservation of marine habitats (marine turtles, manatees, dugongs, crocodilians, migratory species, etc.).

247. Among other non-governmental organizations ISPA is conducting field studies, including behavioural characteristics, into the over-exploitation of the northern fur seal, the Greenland and hooded seals. The European Ocean Association is studying the possibilities of extracting food from the oceans using new techniques and assuring the overall conservation of marine living resources.

(iv) Application of existing knowledge

248. In connexion with the Law of the Sea Conference a task force of specialists is preparing, with IUCN support, proposals for international intervention where conservation aspects are involved.

249. FAO, through its many Fisheries Departments and management field projects, funded mainly by UNDP, contributes to the protection of fish stocks by promoting management measures designed to ensure a sustained yield. UNDP has assisted FAO in the co-ordination of fishery conservation in the South Pacific, and in an inter-regional co-ordinating programme initiated in 1975 to strengthen the field activities in aquaculture.

250. UNESCO is supporting several marine biological institutes, particularly one in Mexico.

251. The United States National Wildlife Federation is particularly active as a pressure group in conservation measures regarding, inter alia, the Atlantic blue fin tuna, three species of marine turtles, porpoises.

252. Comprehensive conservation programmes are being prepared and/or implemented by IUCN to protect the Mediterranean monk seal, dugong, marine turtles and crocodylians as well as marine habitats, biomes and ecosystems.

Table 13

LIVING MARINE RESOURCES: ALLOCATION OF RESOURCES BY ORGANIZATION (DOLLARS)

Agency	A. Dissemination of information		B. Training		C. Research		D. Application of existing knowledge					
	1974	1975	1976	1974	1975	1976	1974	1975	1976			
UNESCO	42,000	2,000	6,000	19,000	34,000	27,000	35,000	32,000	27,000	168,000	272,000	260,000
FAO	234,000	343,000	214,000	90,000	70,000	-	2,303,000	2,323,000	1,858,000	5,000	112,000	81,000
WHO	20,000	15,000	-	-	-	-	5,000	4,000	-	15,000	-	-
Total	296,000	360,000	220,000	109,000	104,000	27,000	2,343,000	2,359,000	1,885,000	188,000	384,000	341,000

Table 14

LIVING MARINE RESOURCES: APPLICATION OF EXISTING KNOWLEDGE BY REGION (DOLLARS)

Agency	1. Africa			2. North Africa and the Near East			3. Asia and the Far East			4. Central and South America			5. Europe		
	1974	1975	1976	1974	1975	1976	1974	1975	1976	1974	1975	1976	1974	1975	1976
UNESCO RB	-	-	-	-	-	-	25,000	32,000	-	51,000	44,000	-	-	-	-
UNDP / UNESCO	-	-	-	18,000	9,000	109,000 (1)	24,000	141,000	140,000	51,000	46,000	11,000	-	-	-
FAO	-	-	-	-	-	-	5,000	5,000	-	-	-	-	-	107,000	74,000
Total	-	-	-	18,000	9,000	109,000	54,000	178,000	140,000	102,000	90,000	11,000	-	107,000	74,000

(1) In negotiation.

Table 15

LIVING MARINE RESOURCES: TOTAL ALLOCATION OF RESOURCES  
BY ORGANIZATION (DOLLARS)

<u>Agency</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>TOTAL</u>
UNESCO	264,000	340,000	320,000	924,000
FAO	2,632,000	2,849,000	2,153,000	7,634,000
WHO	40,000	19,000	no figures available	59,000
<b>Total</b>	<b>2,936,000</b>	<b>3,208,000</b>	<b>2,473,000</b>	<b>8,617,000</b>

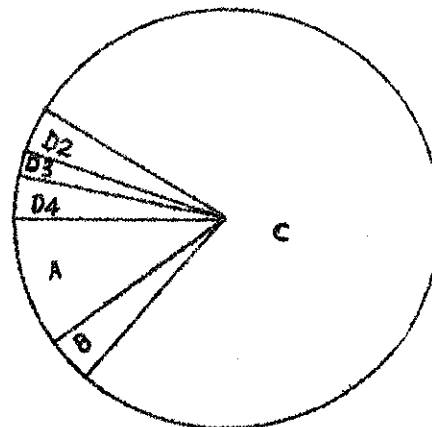
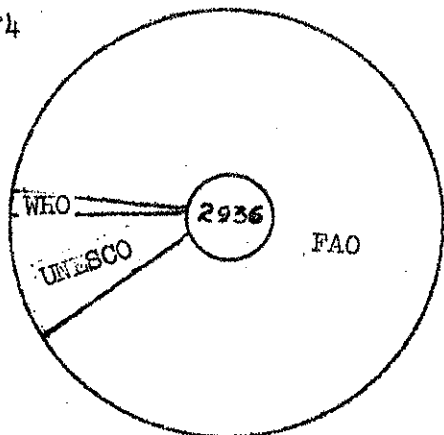
BREAKDOWN OF EXPENDITURES OF THE UN SYSTEM DEVOTED TO LIVING MARINE RESOURCES

BY ORGANIZATION

BY FUNCTION AND REGION

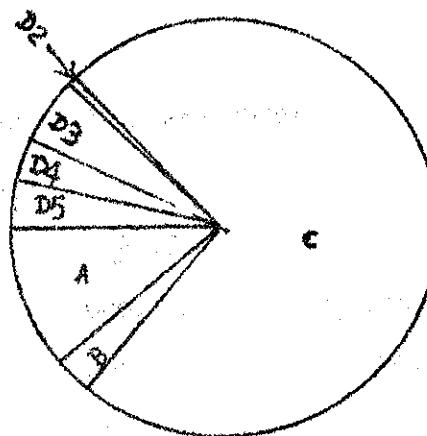
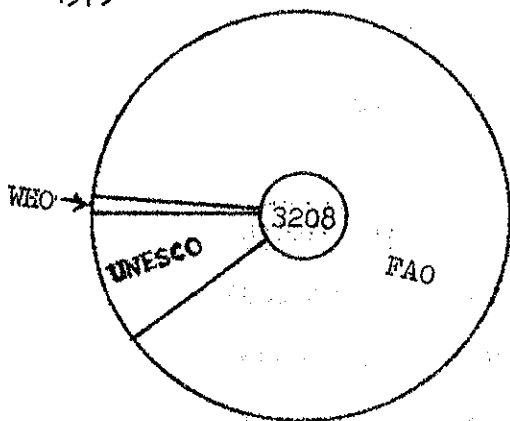
1974

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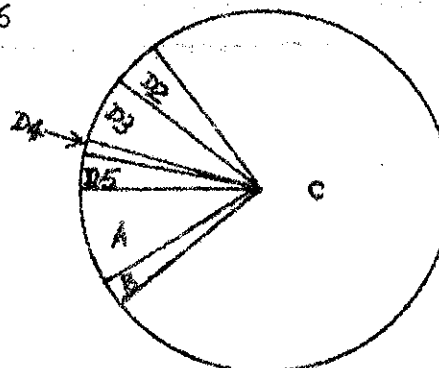
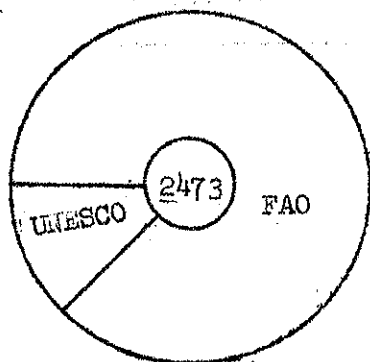
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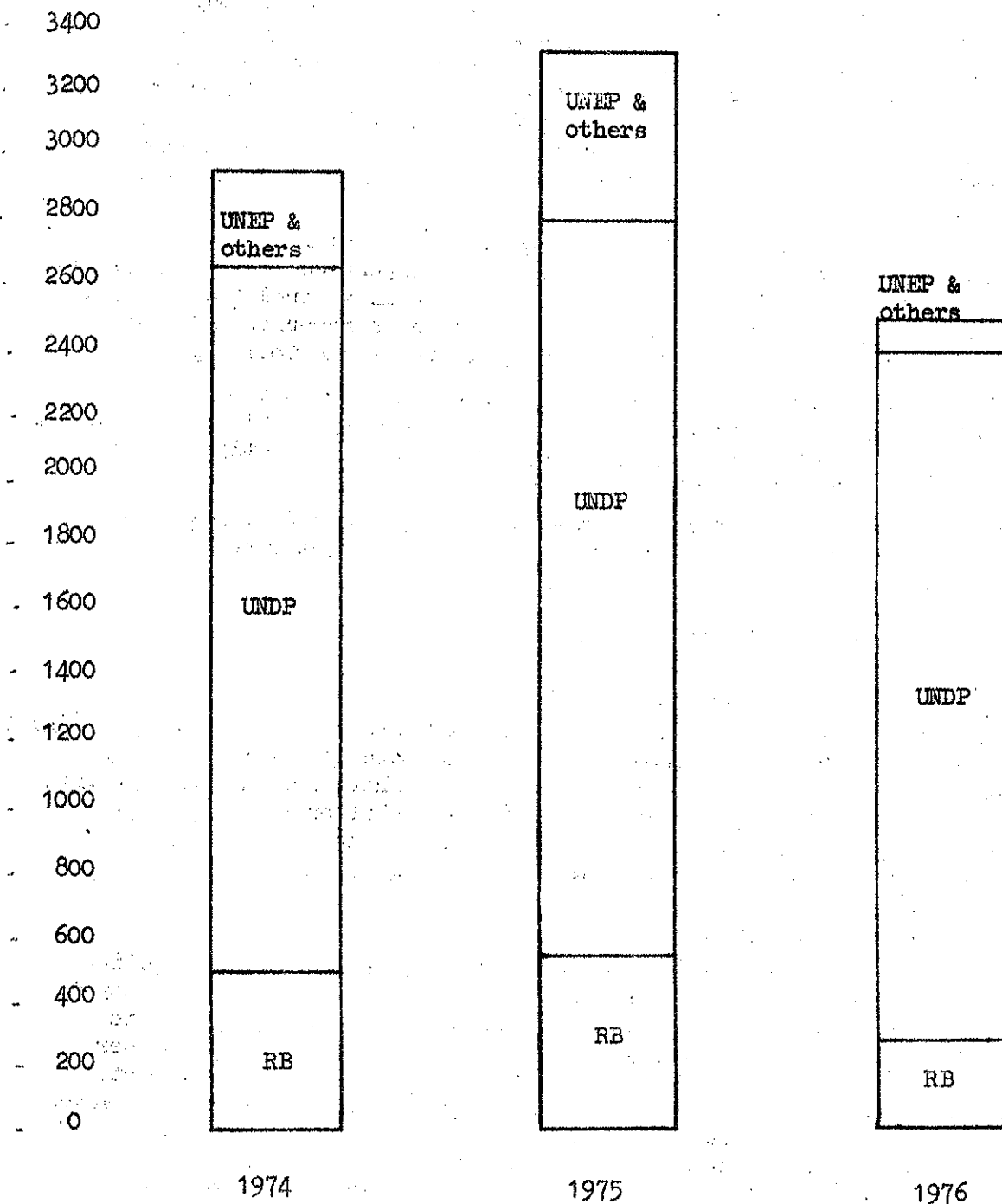


- A - Dissemination of information
- B - Training
- C - Research
- D - Application of existing knowledge
- 1 - Africa
- 2 - North Africa and Near East
- 3 - Asia and the Far East
- 4 - Central and Southern America
- 5 - Europe

Figures in small central circles represent expenditure in thousands of dollars

Expenditure in thousands of US dollars

RB = Regular budget



### 3. Proposed plan of action

#### (a) Objectives

253. It has long been known that the potential harvest of marine resources is limited by the biological basis of the system, and it has also long been recognized that the resources should be managed to ensure their rational utilization. The mechanisms for achieving this exist internationally and in the majority of individual countries. The main requirement now is to upgrade all aspects of this management capability, particularly in areas where fisheries have recently been developed.

254. In addition, there is a widespread need to create in the responsible authorities an awareness of the importance of preserving the productivity of habitats and ecosystems, both as a foundation for the resources they wish to exploit for food and as a resource in their own right for other purposes, e.g. amenity value and tourism.

255. The conservation, management and wise utilization of whale resources require a policy of long-term restoration until the populations have reached their potential density, whereafter a strictly regulated harvesting based on research data can be resumed.

256. A similar world plan of action for the conservation, management and wise utilization of marine turtles is also urgently required, before this valuable resource has disappeared.

#### (b) Outline of plan of action

##### (i) Exchange of information

257. The existing network of national, intergovernmental and international systems of exchange of fundamental resource data, research findings and management experience must be extended. There are also significant gaps in the recording of global activity in relation to exploitation, partly through lack of awareness and partly through the logistic difficulties of collecting the necessary information.

##### (ii) Research

258. There is a need for a much better understanding of the functions, inter-relationships and interactions of individual resources, ecosystems or habitats. It is essential to distinguish between the intrinsic natural variability of the system and the influence of man, whether through exploitation or through induced changes in the environment. The interrelationships between specified resources and other components of an ecosystem are equally vital to the understanding of its stability as a system, and to permit comparison of the merits of managing an ecosystem as a whole with those of managing individual resources in isolation and determination of the implications of simultaneous exploitation of adjacent resources which may be interdependent.



259. These are complex areas of research which are particularly demanding of research resources. There is an increasing need for co-ordination of these activities, beyond the level achieved by regional bodies and scientific councils, in order to integrate programmes and ensure the most effective utilization of facilities available.

260. There are significant gaps in knowledge of the fauna of the deep oceans and, in knowledge of all benthic fauna not exploited by man.

261. In recent years the world has seen a tremendous decline of two of its biggest fisheries: the Californian sardine in the Pacific and the herring in the North Sea. The role of human activity in these events is not clear. Both these species have previously shown considerable natural fluctuations, but there are this time good reasons to investigate whether human factors are behind this economically catastrophic decline.

(iii) Application of existing knowledge

262. Marine science and its application have developed most rapidly in areas with a long history of exploitation. The rapid expansion of exploitation and the risks of adverse effects through other uses of marine resources have in recent years outstripped the growth in knowledge necessary to provide a foundation for management. The fundamental methodology is available, and the need is to intensify its application on a global scale, particularly in view of the need to implement a management policy from the very outset of resources development.

(iv) Training and education

263. Decision-makers, technologists, and resource users at all levels need to be made aware of the importance and potential benefits of resource management. Much has already been achieved at the technical level through the activities of the various agencies, but this must be intensified to meet the requirements for application of existing knowledge by providing appropriate facilities for training in established methodologies.

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