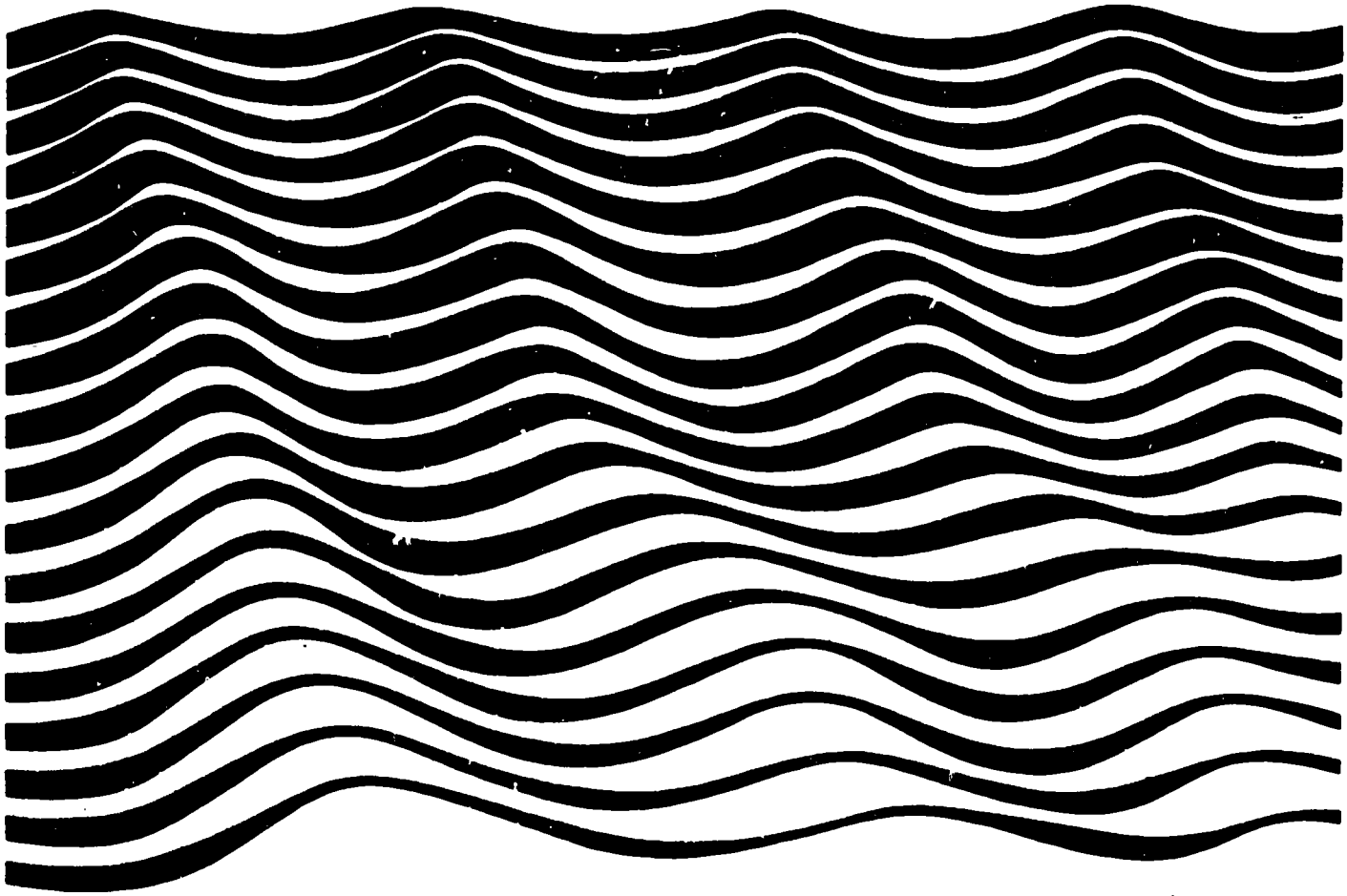
Unesco reports
in marine science 14

Marine science and technology in Africa: present state and future development

Synthesis of Unesco/ECA survey missions to African coastal states, 1980

Project RAF/78/024



Unesco, 1981

UNESCO REPORTS IN MARINE SCIENCE

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2	Marine ecosystem modelling in the Mediterranean *English only*	1977
3	Benthic ecology and sedimentation of the south Atlantic continental platform *Available in English and Spanish*	1979
4	Syllabus for training marine technicians *Available in Arabic, English, French, Russian and Spanish*	1979
5	Marine science syllabus for secondary schools *Available in Arabic, English, French, Russian and Spanish*	1979
6	Organization of marine biological reference collections in the Mediterranean Arab countries *Available in Arabic, English and French*	1979
7	Coastal ecosystems of the southern Mediterranean: lagoons, deltas and salt marshes *Available in Arabic, English and French*	1979
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PREFACE

Unesco Reports in Marine Science are issued by the Unesco Division of Marine Sciences. The series includes papers designed to serve specific programme needs and to report on project development. Collaborative activities of the Division and the Intergovernmental Oceanographic Commission, particularly in the field of training and education, are also represented in the series.

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NOTE

This document represents a synthesis of reports submitted by Unesco/ECA* missions to African coastal states to assess the situation regarding the development of marine science and technology in those countries. The synthesis has analysed the situation from a regional point of view and has treated the subject in a sequential series of chapters - Summary of Recommendations, Introduction, African Experience, Main Issues and Observations, and Recommendations.

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* United Nations Economic Commission for Africa

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FOREWORD

It is now realised and generally acknowledged by practically all the countries of the world, both developed and developing, that science and technology are necessary prerequisite tools for economic development. Indeed, it can be said that some of the major issues that have tended to divide the countries of the world into two camps such as "rich" and "poor", "developed" and "developing", "haves" and "have nots", "industrialized" and "non-industrialized", "north" and "south", etc. can, in the final analysis, be explained on the basis of the different levels of science and technology development and their applications in these countries. In other words, generally speaking, it is true to say that rich and developed countries are those with a high level of science and technology development, whereas poor and developing countries are those with a low level of science and technology development. It is obvious therefore that any action aimed at bringing about meaningful, rational and sustainable economic development in developing countries must, of necessity, take into consideration the development of science and technology as a support base. Without such a base, the products of the effort would at best be superficial and short-lived, and would not be effective in narrowing the gap between the poor and the rich countries of the world.

The application of science and technology which has become part of everyday life in developed countries has given these countries a lead in the exploitation and utilisation of the natural resources of the world and has consequently, enabled them to achieve a greater rate of economic development and a higher standard of living than is the case in developing countries. This lead is not limited to the exploitation and utilisation of land-based resources; indeed it has in recent years become especially conspicuous in the exploitation and utilisation of the resources of the sea and the sea-bed, and might even extend, before long, to the resources of the outer space.

The exploitation of the resources of the sea calls for a highly complex and sophisticated infrastructure and for advanced scientific knowledge and technology know-how. Thus a project aimed at increasing the capability of African coastal states in making fuller and more rational use of their marine resources, must regard the development of marine science and technology as of crucial and fundamental importance.

ACKNOWLEDGEMENTS

Much of the information contained in this paper was obtained by teams of UNESCO/ECA consultants who visited all the African coastal states included in this project during the middle and later half of 1980. Their missions would not have been successful without the invaluable cooperation of many people, including representatives of United Nations agencies, government authorities, heads of institutions, scientists and other individuals, in all the countries visited. It is a pleasure to express grateful thanks and appreciation to all of them. A full list of names is given in each country report.

I. SUMMARY OF RECOMMENDATIONS

1. Action at the National Level

1.1 African coastal states should establish sound economic development policies or review their existing national policies, concerning the development and exploitation of their marine resources, taking into consideration the full implications of the Third United Nations Conference on the Law of the Sea. These policies should reflect an appreciation of the potential importance of the resources of the sea in economic development.

1.2 African coastal states should establish or strengthen the necessary administrative machinery to ensure the efficient implementation of government policies relating to the development and rational exploitation of their marine resources.

1.3 African coastal states should strive to establish or strengthen the necessary infrastructural facilities for the development of marine science and technology as a basis for the full and rational exploitation of their marine resources. This should be reflected in the establishment or strengthening of training and research institutions in marine science and technology, and in the provision of the necessary services to ensure the efficient and rational use of their marine resources.

2. Action at the Regional Level

2.1 African coastal states should pool their resources and form regional or subregional cooperative groupings in order to bring about a quicker and more substantial development of marine science and technology as a basis for the full and rational exploitation of their marine resources, e.g. through cooperative training and research programmes.

2.2 African coastal states should cooperate on a regional or subregional scale in carrying out such undertakings as deep-sea oceanographic research, surveillance of their Exclusive Economic Zones, development of marine transport systems, e.g. shipping lines and provision of ship-building and repair facilities.

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3. Action at the International Level

3.1 Through international cooperation, individual African coastal states should be assisted to establish the necessary infrastructures for the development of marine science and technology through appropriate training and research programmes.

3.2 Through international cooperation, African coastal states should be assisted to form regional or subregional cooperative groupings in order to bring about a quicker and more substantial development of marine science and technology and thus enable these countries to be self-reliant in the development and rational exploitation of their marine resources and in making full use of the sea as a transport and communication medium.

II. INTRODUCTION

1. Project Rationale and Project Implementation

1.1 Project Rationale

The rationale and justification of this Project are based on the following general premises :

1. The state of the general economy of the world has in recent years forced nations (especially developed nations) to look more and more to the sea as an important source of food for the rapidly increasing human population, and of different kinds of raw materials and energy for the maintenance and development of industries. In developed countries, this awareness of the great potential of the oceans has been stimulated and encouraged by the great advances in science and technology in recent times. These advances in science and technology have not only made practically all the resources of the oceans accessible to man's exploitation but they have also increased the curiosity of scientists and technologists to learn more about the human environment, including the oceans and also the outer space. The appreciation of the importance of the sea as part of the human environment has also received great impetus in recent years through its increasing use as a medium of communication and transportation, both during peace time and at war, and through recent scientific discoveries showing that the influence of the oceans on terrestrial weather and climate is much greater than was originally thought.

2. The increasing use of the oceans, including the sea bed, for all sorts of human activities, such as navigation and sea transportation, exploration and drilling for minerals and oil, together with the development of coastal areas for such activities as harbour construction, tourism, etc.have created the problem of marine pollution

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which is a great threat to the living resources of the sea. Furthermore, it is now realized that such natural phenomena as sea waves and surges, and ocean currents, together with land erosion, can cause great damage to the coastal areas of continents and islands. Thus, in order to protect the marine and coastal environments and the resources therein against pollution and destruction, it is necessary to develop machanisms of controlling and regulating human activities and destructive natural forces in these environments. Such protective mechanisms would include the prevention and control of oil and other forms of pollution, the prevention and control of coastal area degradation and the regulation of such activities as fishing and the exploration and extraction of non-living resources.

3. The Third United Nations Conference on the Law of the Sea has considered the right of coastal states to establish a 200 mile wide "Exclusive Economic Zone" along their coasts. This action has brought vast living and non-living resources under the jurisdiction, management, control and ownership of coastal states. The management, control and rational exploitation of such resources calls for a highly complex and adequate legal, administrative, scientific and technological machinery. If African coastal states do not, as a matter of urgency, take steps to set up and develop such a machinery, these vast resources are likely to remain unavailable for economic development for a long time to come. The Third United Nations Conference on the Law of the Sea has also considered the concept that the resources of the sea-bed beyond the "Exclusive Economic Zone" are to be regarded as "the common heritage of mankind", to be used mainly to assist developing countries. This arrangement will only be meaningful to African countries if they can, within a reasonable time, develop the necessary scientific capability and technological know-how to be able to participate on an equal footing with developed countries in the exploration and exploitation of such resources.

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4. The rational exploitation of marine resources requires a proper understanding of the nature of the resources, the extent and distribution of their occurrence and the proper technological know-how. This is necessary in order to avoid environmental pollution and degradation, and resource wastage. The rational exploitation of living resources must be planned and carried out on a sustainable-yield basis, as a result of careful ecological and biological studies. In most African coastal states, the exploitation of marine resources is not at present based on this scientific and technological understanding and cannot therefore be regarded as rational, in the ecological and environmental sense.

5. Practically all African coastal states, covered by this Project, are at present making only minimal use of their marine resources owing to limitations in the necessary scientific knowledge and technological know-how and to the lack of efficient organizational and administrative machinery. In most of these states, even this minimal use of marine resources is limited to the inshore or near-shore living resources, mostly fisheries. The farming of the sea (mariculture) which is gaining momentum in many developed countries is still very much under-developed in African coastal states and there are at present very few of these states seriously engaged in the exploitation of their deep sea fishery resources. These resources are in many cases being exploited by foreign fishing fleets from developed countries.

6. In most African coastal states, the methods used in the exploitation of marine fishery resources are, for the most part, primitive and inefficient and are not based on sound scientific and technological experience. In some cases, destructive methods (e.g. fishing with dynamite, and indiscriminate fishing nets) are used and in very few of these states are there as yet any concrete and comprehensive programmes aimed at the protection, development, and conservation of the marine environment and the resources therein against pollution, over-exploitation, destruction and extermination.

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7. In most cases, there is still little or no understanding of the type and nature of the resources and their distribution, e.g. minerals and deep sea living resources, and the situation can only be remedied by a carefully planned and competently executed oceanographic exploration and resources survey of the whole "Exclusive Economic Zone" and its detailed mapping.

8. The shipping and navigation services, which are so vital for the management, control and exploitation of marine resources and for the development of international trade, are still very much in their infancy in most African coastal states. The development of such services (modern navigation, boat building industry, boat and ship repair facilities, land-sea communication, etc.) is therefore an important pre-requisite for the establishment and maintenance of a thriving marine resources exploitation (including fisheries) undertaking.

9. In many African countries, the teaching of marine science and marine technology in universities is a recent development and in many of the universities, there are as yet no comprehensive study programmes covering the whole spectrum of marine science and technology at the undergraduate or postgraduate level; the situation in regard to research in marine science and technology is equally unsatisfactory. Although there were some research activities in many African coastal states during the colonial period, most of such research programmes were narrow in outlook, short-term in objective and not sufficiently comprehensive. The knowledge that has emanated from such research activities, even when accessible, has for this reason not provided an adequate base for the development of a rational marine resource exploitation undertaking. Moreover, very few scientists were trained during the colonial period, with the consequence that at the time of independence these countries found themselves with little or no indigenous scientific manpower to carry on the research activities. Thus the development of sound

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training and research programmes and their effective linkages with the production system, are basic and most important steps towards enhancing the capability of African coastal states in making full use of their marine resources.

10. Marine technology is also very much underdeveloped in many African coastal states. In very few of these countries are there marine technology training centres with comprehensive programmes concerning all aspects of marine technology - marine engineering, fishing and fishing gear, boat building and repair, navigation, instrumentation repair and maintenance (including electronic equipment) fish processing and preservation, economics and marketing, etc. The training of marine technologists is just as important as the training of marine scientists; indeed, the thrust should be towards the urgent training of both the scientist and the technologist since their actions in the development and rational exploitation of marine resources are complementary, as in all aspects of science and technology for development.

11. The most immediate requirement, and one that is likely to make a favourable impression on African governments, would be concrete suggestions and steps aimed at the improvement of their efficiency in fishing. There is an urgent need in most of these countries for a great increase of cheap fish supplies. This would go a long way towards solving the very common protein malnutrition problem in the region.

12. The solution of some of these problems, e.g. efficient exploration, exploitation, surveillance and control of the resources of the deep sea within the 200 mile "Exclusive Economic Zone", would be beyond the capability of most African states working on their own. It is in such areas that regional and subregional cooperation would be most needed, useful and appropriate. This kind of cooperation would also be useful in such areas as high-level specialist training of marine

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scientists and technologists, deep sea research, shipping and navigation, data and information collection and exchange, creation of intra-regional markets and the exchange of research results and ideas through seminars, workshops, conferences, etc.

1.2 Project Implementation

1. This project is essentially a diagnostic exercise, the main purpose of which is to carry out a thorough study and analysis of the state of affairs obtaining in marine science and technology development in African coastal states, to find the main weaknesses and strong points that apply generally to the whole region and those that are only found in individual countries and, finally, to suggest remedial measures that are aimed at an overall improvement of the situation. As in the case of a doctor dealing with a human disease, the first and most important step is the carrying out of a proper and correct diagnosis of the disease. Without a proper and realistic diagnosis, no real cure can be obtained. Thus, the first and most important step in finding a correct and lasting solution to the problem of under-utilization of marine resources in African coastal states lies in the carrying out of a thorough, correct and realistic analysis of the situation as it is at present, in regard to marine science and technological development in all these countries and the factors that tend to impede an improvement.

2. The implementation of the Project was to be carried out according to the following schedule :

(i)	Appointment of Project Co-ordinator	- January 1980
(ii)	Working Group Meeting of Experts	- May 1980
(iii)	Consultant Field Missions to African Coastal States	- Scheduled May-August 1980 but lasted May-November 1980
(iv)	Workshop of Experts	- Originally scheduled January 1981 - Rescheduled June 1981
(v)	Inter-governmental Meeting	- Originally scheduled February 1981 - Rescheduled July 1981

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3. The Project Co-ordinator's preliminary activities included consultations with relevant Divisions of the ECA in Addis Ababa; with the Division of Marine Sciences and the Inter-governmental Oceanographic Commission (IOC), UNESCO, Paris; with the Department of Fisheries, FAO,Rome; and with UNEP, WMO and WHO, Geneva. During these consultations, detailed discussions were held on past, present and planned activities by these organizations and agencies, which are related to marine science and technology development in African coastal states. Opportunity was also taken to refer to relevant documents in these organizations in order to obtain detailed information on these activities.

4. These preliminary consultations by the Project Co-ordinator were aimed at obtaining as much information as possible from reports, surveys, conferences, seminars, workshops, etc., carried out under the auspices of the governments of the relevant countries, the United Nations agencies and other organizations, concerning the state of marine science and technology development in African coastal states; on steps that have been taken in the past, are being taken at present or are planned for the future, aimed at improving the situation. An attempt was made to put together as much information as possible on the history of marine science and technology development in individual coastal states of the region in a working paper for the Working Group Meeting of Experts - titled "The State of Marine Science and Technology Development in African Coastal States". This background information, after some improvement by contributions from participants in the Working Group Meeting, was a useful guide and source of reference to the field missions. The information was also useful to the Working Group Meeting in formulating the guidelines of the field missions.

5. The Working Group Meeting of Experts (5-9 May 1980, ECA, Addis Ababa, Ethiopia) which was attended by nine consultants appointed by UNESCO and ECA, discussed the working paper and adopted questionnaires that were designed to obtain as much information as possible on the state of marine science and technology development, in all aspects, in African coastal states. The meeting also discussed and agreed on the format to be followed in writing the mission reports.

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6. The field missions which were carried out by the UNESCO/ECA consultants, with the cooperation of the Project Co-ordinator, examined and studied the present situation in the different countries of the region in regard to marine science and technology development. They used the questionnaires adopted by the Working Group Meeting of Experts as a guide, and obtained, with the cooperation of government authorities, heads of training and research institutions, individual scientists etc., as much relevant information as possible. Most of the field missions received good cooperation in the countries they visited and obtained much useful information but a few encountered difficulties of various kinds and were unable to obtain all the information they needed.

7. The reports of the field missions were used by the Project Co-ordinator to prepare a comprehensive synthesis which is the subject of this working paper for the Workshop - "The Present State and Future Development of Marine Science and Technology in Africa." It is the belief of the Project Co-ordinator that this document gives a fairly true and accurate picture of the state of affairs obtaining, in regard to marine science and technology development, in the African coastal states covered by the Project. The purpose of the Workshop is to carry out a detailed discussion of the working paper and adopt the recommendations made, if necessary,after appropriate amendments. The Workshop is also expected to discuss and approve in principle,the draft outline of a project document for a second (full-scale) project on the subject.

8. An Inter-governmental Meeting to be held in Addis Ababa, Ethiopia in July, 1981 is expected to discuss the Workshop report and to approve both the recommendations and the draft project document, if necessary, after appropriate amendments.

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1.3 Organization of the Country Missions

The consultants were assigned to different African countries which they had to visit and submit reports of their findings to the Project Co-ordinator. The organization of the country missions was as follows :

Team	Names	Countries to be visited
Team A:	Prof. Y. Halim Mr. A. Samba	Ivory Coast, Senegal, Morocco
Team B:	Prof. E. Saaidi Mr. A. Samba	Mauritania, Guinea, Togo and Benin
Team C:	Dr. A. Ralison Prof. E. Saaidi *Prof. A.S. Msangi	Djibouti, Madagascar, Comoro Mauritius, Seychelles
Team D:	Prof. E. Saaidi Mr. S. Zabi	Cameroon, Gabon, Congo and Zaire
Team E:	Prof. C. Sankarankutty Mr. S. Zabi	Mozambique, Angola, Equatorial Guinea, Guinea Bissau, Cape Verde Sao Tomé and Principe.
Team F:	Prof. D.E. Chaytor **Mr. J. Adjettey Prof. A.S. Msangi	Gambia, Sierra Leone, Liberia, Ghana, Nigeria
Team G:	Dr. E. Gomez Mr. N. Odero Prof. A.S. Msangi	Sudan, Somalia, Kenya and Tanzania
Team H:	Prof. A.S. Msangi Prof. D.E. Chaytor	Ethiopia

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* The Project Co-ordinator, Prof. A.S. Msangi participated in part of these missions.

** Mr. J. Adjettey only participated in the mission to Ghana.

III. AFRICAN EXPERIENCE

1. Training and Research in Marine Science

It is important to remember that university education is a fairly recent development in most African countries and that when it was introduced, the main emphasis and priority were, of necessity, centred on the training of high level professional manpower badly needed to provide the backbone of the civil service in such vital areas as public administration, education, agriculture and public health including medicine. It is not surprising therefore that the curricula and teaching programmes of many African universities are still limited in scope and depth, placing most emphasis in the undergraduate teaching of the broad classical subjects in the natural sciences and the humanities. In the natural sciences the main aim in many of these universities, at present, is the production of first degree graduates (holders of the B.Sc. degree or its equivalent) in the common subjects - Biology, Chemistry, Physics, and Mathematics. Research which is the main lifeblood of scientific development, and specialist high level scientific training on which the production of research scientists depends, are either completely absent, as in some of the younger universities, or still in a fledgeling state, as in the majority of the universities. Thus only a few of the African universities do at present have teaching and research programmes in marine sciences, and even in these few, the main emphasis so far has been in marine biology and fishery science. It is therefore clear that in an endeavour to develop and improve the state of marine science in African countries, the greatest need is the establishment and strengthening of comprehensive and relevant training and research programmes, especially at the university level. The present situation in the different African coastal states is discussed below.

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1.1 Eastern Africa

COMOROS

Background information

The Federal Islamic Republic of Comoros comprises an archipelago of 4 islands - Grande Comoro, Anjuan, Maheli and Mayotte.

Area: 2160 km^2
Coastline: 560 km.
*Population: 0.37

Training in marine sciences

There are at present no training institutions in marine sciences and there is a great shortage of middle and high level manpower. Training of a few professionals of these cadres takes place abroad.

Research in marine sciences

At present there is practically no research activity going on in the field of marine science. The Department of Oceanography and Marine Fisheries (Département Oceanographie et Peches Maritimes) at Moroni is understaffed, has poor accommodation and no research equipment of any kind. There are however some routine meteorological observations carried out daily and it is intended to establish a marine meteorological station in the future.

DJIBOUTI

Background information

The Republic of Djibouti is a small country with a semi desert climate and poor terrestorial resources. It obtained its independence from France in 1977.

Area: 23,000 km^2
Coastline: 300 km.
Population: 0.11

*The population figures are given in millions and are based on the Midyear Estimated Population in the U.N. Demographic Year Book 1977. .../...

Training in marine sciences

There are no training institutions for middle and high level manpower in marine sciences and there is therefore a great shortage of such manpower. Furthermore, because of the poor standard of primary and secondary education, there are few suitable candidates for scientific training.

Research in marine sciences

The Government is making great efforts in developing a capability in marine science and technology, and has established three institutions to be responsible for marine science activities :

- Institut Superieur d'Etudes et de Recherches Scientifiques et Techniques (I.S.E.R.S.I.) - (Institute of Higher Technical Education and Scientific Research).

  This institute was established in 1979 to replace the former Le Centre d'Etudes Géologiques et de Développement (C.E.G.D.), (Centre for Geological and Development Studies)of the French colonial government. It is staffed by one research scientist and two assistants and at present, carries out some work on the farming of the brown alga (sea weed) Eucheuma spinosum. The Institute owns a boat and a barge.

- Service de L'Elevage et des Peches Maritimes (S.E.P.M.)
  (Farming and Sea Fisheries Department).

  This Department is responsible for all activities concerning fisheries development and livestock breeding. It is understaffed and does not carry out any research at present.

- Aquarium Tropical de Djibouti (A.T.D.)
  (Djibouti Tropical Aquarium)

  The aquarium which is intended for public entertainment and research is manned by a curator and an assistant and at present conducts no research.

ETHIOPIA

Background information

Ethiopia is a large country with a varied climate and rich terrestorial and freshwater resources. Its marine resources in the Red Sea are also said to be considerable.

Area : 1,221, 900 km^2

Coastline: 1,000 km.

Population: 28.93

Training in marine sciences

In the past there has been little activity in the training of marine scientists in the country but the University of Addis Ababa has recently reviewed the situation and is taking serious measures to introduce the teaching of marine sciences at both the undergraduate and postgraduate levels. The Department of Geology already offers a postgraduate (M.Sc.) course in marine geology.

Research in marine sciences

For the past several years the Government and the University of Addis Ababa have had an active interest in the development of marine science research. A project that was worked out with the assistance of UNESCO (Angot, 1976), aimed at the establishment of a marine research station on the Red Sea coast at Assab, under the University of Addis Ababa or, alternatively, at Massawa, under the University of Asmara, has not yet materialised. But both the Government and the University of Addis Ababa are still greatly determined that such a research station should be established soon. However there is no important research activity in marine science going on in the country at present.

KENYA

Background information

The Republic of Kenya has rich agricultural and freshwater resources. Its marine resources are also said to be considerable but are not yet being fully exploited.

Area: 582,646 km^2
Coastline: 500 km.
Population: 14.34

Training in marine sciences

Marine science activities are a recent development at the University of Nairobi and there are as yet no special training programmes in the subject at the undergraduate or postgraduate level. It has been reported however, that the University intends to introduce both undergraduate and postgraduate programmes in marine biology in the near future, and some departments in the Faculty of Science have recently introduced some marine-oriented topics in their undergraduate programmes.

Research in marine sciences

The principle institution engaged in marine science research at present is the Kenya Fisheries and Marine Research Institute which is very well located on the coast at Mombasa, with a modern marine research laboratory. The laboratory is however not fully equipped and most of the seven national marine scientists are still without postgraduate qualifications. The research programmes of the Institute at present include fishery biology, environmental studies, reef ecology and chemical oceanography. There are plans to train more scientific staff for the Institute and to acquire two research boats.

The Faculty of Science of the University of Nairobi has a research station on the coast of Diani near Mombasa, but it is not well equipped and the buildings are not in a good condition. A few members of the academic staff in the biological sciences carry out some marine science-oriented research, e.g. in coral reef ecology, marine algae and micro-biology. A closer cooperation between the University and the Institute would facilitate a more economic use of scientific manpower and facilities.

MADAGASCAR

Background information

Madagascar is the largest island in the Indian Ocean and is richly endowed with terrestrial and marine resources. In recent years there has been much emphasis on the development of university education in the country and the University of Madagascar has been greatly expanded to accommodate more students and to increase the range and depth of its teaching and research programmes. This has been achieved through the establishment of new university campuses in the six provinces of the country, each campus specialising in one type of professional training e.g. Agriculture, Engineering, Medicine, Dentistry, etc.

Area: 587,041 km^2

Coastline: 5000 km

Population: 8.52

Training in marine sciences

Since 1973 the University of Madagascar has been running a programme in marine biology as part of a general undergraduate course in Biology, based at its marine station at Tuléar (Station Marine de Tuléar), but the marine component of the course was rather weak. However the Station has been reactivated recently and will soon be conducting undergraduate and postgraduate courses in oceanography.

Research in marine sciences

The principle institution carrying out marine science research in the country is the Centre National de Recherches Oceanographique (C.N.R.O.)(National Centre for Oceanographic Research). This Centre which was established by the French colonial government in 1960 under the management of Office des Recherches Scientifiquesd'outre mer (O.R.S.T.O.M.) has been reactivated by the Malagasy Government and is being developed as an important oceanographic research centre. The Centre has already established a broad base for marine science research in fishery biology, biological oceanography, chemical and physical oceanography and marine geology. The present scientific staff of five includes four nationals and more are being trained abroad.

MAURITIUS

Background information

Mauritius is a small island state comprised of the main island (Mauritius) and a number of widely scattered small islands and islets - Rodrigues, Agalega and the Cargodos Carajos archipelago. This wide extension of its territory gives Mauritius one of the largest "exclusive economic zones" in Africa, estimated at 2,200,000 km^2. The economy depends heavily on one crop - sugar cane; but in recent years tourism has been making a significant contribution. The very dense population and serious unemployment would seem to dictate for the development and exploitation of marine resources as the most obvious opening for further economic development.

Area: 2,040 km^2
Coastline: 240 km.
Population : 0.91

Training in marine sciences

Although Mauritius has a national university, except for the sugar industry, most of its high and middle-level manpower is still trained abroad, mainly in India and Europe. This arrangement seems to be working satisfactorily since there is no serious manpower problem. The major effort of the University at present is directed towards the training of manpower for the sugar industry viz. agronomists, economists, sugar technicians, managers, etc. But the university also does sponsor postgraduate studies in biological sciences.

Research in marine sciences

The two institutions involved in marine science research activities in the country are :

1. The Ministry of Fisheries which has the overall responsibility for the administration, development and exploitation of marine as well as fresh-water fishery resources. There is a Research Division which is well staffed (20 scientists and technicans and more on training) and has

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a fairly well equipped research laboratory and two research boats. The main research effort is in aquaculture.

2. The Mauritius Institute which was formerly under the British Royal Society of Arts and Sciences, has a library and a museum, carries out some research on fishery biology and publishes an annual "Bulletin du Muséum". Among the future research programmes planned are :

   - Pollution in view of the reported serious pollution of the lagoons resulting from the extensive use of pesticides in the sugar plantations;

   - Algae Resources Potential to determine the economic feasibility of exploiting these resources.

MOZAMBIQUE

Background information

Mozambique is a fairly large country with rich agricultural, mineral and marine resources, all of which are not as yet being fully exploited. After winning its independence from Portuguese colonialism in 1975, and establishing a stable national government, the country has been making a great effort to reconstruct and develop its economy, by establishing progressive and relevant policies and laying the foundations for appropriate infrastructures. In its economic development policy great emphasis has been placed on the development of the country's marine resources.

Area: 785,000 km^2
Coastline: 2,500 km.
Population: 9.68

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Training in marine sciences

In common with most of the young African universities, much of the effort of the Eduardo Mondlane University in Maputo is directed towards the production of secondary school teachers and government administrators. However the Faculty of Biology of the University now offers a three-year B.Sc. course in general fishery biology and has a marine biological station at Inhaca Island which, among other things, is used for field courses of university students. There are as yet no postgraduate programmes and no specialised undergraduate courses in marine sciences at the university, and for its qualified scientists, the country depends on fellowships and scholarships to foreign universities and other institutions.

Research in marine sciences

The principal institution responsible for fishery and oceanographic research is the "Servico de Investigacoes Pestiquers" (SIP) - (Fishery Research Service) of the Ministry of Industry and Energy. The Institute is well equipped and has a scientific staff of nine including five Mozambicans with M.Sc. degrees. Most of the research programmes of the Institute are fishery-oriented and are in the areas of fishery biology, stock assessemnt, aquaculture and chemical oceanography.

The Marine Biological Station of the Faculty of Biology of the University at Inhaca Island is also used for research by University and visiting scientists and for the development of a marine museum and reference collection.

SEYCHELLES

Background information

The small island-state of Seychelles comprises 92 islands, 32 of which are granite and 60 mostly low-lying uninhabited coral atolls. The furthest of these atolls lies 600 miles from the main island of Mahe, thus giving the country a vast "exclusive economic zone". The small size of the country and its small population are factors militating against rapid economic and cultural development including the establishment of a university and other institutions for advanced training; this is due to coast/benefit considerations.

Area: 308 km^2
Coastline: difficult to estimate
Population: 0.06

Training in marine sciences

As there are no institutions of higher learning the few high level professionals required by the government, including those concerned with marine activities, are trained abroad.

Research in marine sciences

The Seychelles government established a Department of Fisheries under the Ministry of Agriculture in 1972 which created a Research Section in 1976. The research activities of the Department have been and are still mainly fishery-oriented, aimed at providing data for the development of the fishery industry. These activities are centred on fishery surveys, stock assessment and post-harvest handling (fish technology).

The Royal Society Research Station on Aldabra atoll: The government of Seychelles recently established a foundation to operate the island of Aldabra and the Research Station of the British Royal Society on the atoll after the termination of the Society's lease. It is intended to use the multi-disciplinary research facilities for externally-funded visiting research scientists.

SOMALIA

Background information

The Somali Democratic Republic is a hot and largely arid country with a population over 60% of which is made up of nomadic pastoralists. The country has few natural terrestrial resources and its economy is at present based mainly on livestock and bananas. However, its coastline is one of the longest in Africa and being within the Somali upwelling area the fishery resources of its "exclusive economic zone" are said to be some of the richest in the continent; these resources however remain far from being fully exploited. The present economic policy of the government places much emphasis on the development of the country's marine fisheries to facilitate a settled existence for the nomadic population.

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Area: 637,657 km^2
Coastline: 3,200 km.
Population: 3.35

Training in marine sciences

There is at present no important activity concerning the training of marine scientists in the country but the Somali National University has had a long-standing plan to establish a Faculty of Marine Sciences and Fisheries. It is still hoped that this project which was worked out with the assistance of UNESCO (G. Hempel, 1979) will be implemented in due course when the state of the economy of the country becomes more favourable or through bilateral or multilateral cooperation. It has been reported that a few marine scientists are undergoing training abroad.

Research in marine sciences

There are at present no important research activities going on in the country but the Ministry of Fisheries has worked out a project aimed at the establishment of a marine biology and fishery research institute. It was originally expected that this project, which remains unimplemented, would be executed through multilateral cooperation between the governments of Somalia and Japan and the Arab League Educational, Cultural and Scientific Organisation (ALECSO).

SUDAN

Background information

The Democratic Republic of the Sudan comprises a vast territory with a varied climate ranging from desert in the north to equatorial in the south. The economy of the country is mainly based on irrigation agriculture of which there are plans for enormous expansion, with assistance from Arab States. In recent years the government has shown much interest and enthusiasm in the development of marine sciences with a view to enabling

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the country to make full and rational use of its living and non-living resources in the Red Sea.

Area:	2,505, 825 km^2
Coastline:	700 km.
Population:	16.13 (1976)

Training in marine sciences

The training of marine scientists in the country is centred at the Institute of Oceanography at Port Sudan, which was established in 1977 under the National Council for Research and which received various forms of assistance from UNESCO (Morcos, 1974, Schroeder, 1977) during its formative years. In its training programmes the Institute works in close collaboration with the University of Khartoum. The Institute is at present headed by an expatriate Director and there are two qualified national scientists on the staff, with more undergoing training abroad.

Research in marine sciences

There are three institutions in the country responsible for marine science research activities :

The Institute of Oceanography, Port Sudan: Apart from training (see above) the Institute is empowered to carry out all relevant types of oceanographic research. However, owing to limitations of staff and facilities present research programmes are confined to the ecology and conservation of coral reefs, ecology and geology of coastal lagoons, hydrography of the Red Sea and coastal sedimentology. Future programmes would include general fishery biology, mariculture, heavy metal deposits, reef conservation, pollution and basic oceanography.

The Department of Zoology of the University of Khartoum has a Marine Biology Station at Suakin on the Red Sea coast, which was established in 1973, but due to lack of staff there has not been much research activity at the Station. It is expected, however that with a recent

improvement in the staffing situation the Station will start functioning soon.

The Fishery Research Centre which was established in 1975 under the Agricultural Research Corporation has a Red Sea Fisheries Research Section at Port Sudan with two field laboratories situated at Port Sudan and at Dongonab respectively. Present research activities are limited to the biology and culture of oysters and future programmes would include fishery surveys and mariculture. The present scientific staff consists of two nationals and five more are on training.

TANZANIA

Background information

The United Republic of Tanzania is a large country comprising the former territory of Tanganika and the Indian Ocean islands of Zanzibar and Pemba. The country has a varied climate and is endowed with rich terrestrial, freshwater and marine resources, all of which remain underexploited at present. In its economic development policy,the government has given much emphasis to the development of the country's marine resources,especially fisheries.

Area:	945,087 km^2
Coastline:	800 km. (excluding islands)
Population:	16.09

Training in marine sciences

The University of Dar es Salaam started to develop an interest in marine sciences in 1968 when it established a Marine Biological Station under the Department of Zoology : Through various forms of assistance from UNESCO,mainly for equipment and teaching experts, the Station has becme an important training and research centre.

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In 1978 the University took over the former East African Marine Fisheries Research Organisation (EAMFRO) at Zanzibar and established an Institute of Marine Sciences, in corporating the former Marine Biological Station at Kunduchi in Dar es Salaam, as a field Station. The Institute's mission includes the development of research and teaching programmes in all aspects of marine sciences.

The University now offers a B.Sc. course in Marine Biology and an M.Sc. course in Fisheries and Aquatic Science; and, with the assistance of UNESCO, will be offering the Open University Post-graduate Course in Oceanography with effect from the 1981/1982 academic year. There are also facilities for Ph.D. studies in marine sciences by research. The teaching of marine sciences at the University is a cooperative exercise between the Institute of Marine Sciences and several other sections of the University including the Departments of Zoology, Botany, Chemistry, Geology, Mathematics, Sociology and the Faculty of Law.

The Fisheries Research and Training Centre under the Ministry of Natural Resources and Tourism runs a three year Diploma course for fishery extension officers.

Research in marine sciences

The principal institution responsible for research in marine sciences in the country is the Institute of Marine Science of the University of Dar es Salaam, at Zanzibar. The scientific staff of the Institute and its Marine Biological Station includes seven Tanzanians and two expatriates; another four Tanzanians are doing their postgraduate training. The current research programmes of the Institute include fishery biology, fish taxonomy, benthic ecology, phytoplankton, population dynamics, fishery statistics, aquaculture and marine pollution. Among the important research and training facilities is a well equipped modern research vessel. It is intended to relocate the Institute at a new more spacious site where there will be enough room for future expansion.

The Fisheries Research and Training Centre, of the Ministry of Natural Resourcesand Tourism, also carries out research oriented towards the development of the Fishery Industry.

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1.2 West, Central and Southern Africa

ANGOLA

Background information

The Peoples Republic of Angola is a large country with rich natural resources including minerals and marine fisheries. The long guerilla war with the Portuguese colonialists and the sudden pull out of Portuguese professional personnel at the end of the war left the country in a very disorganised state. However, the national government is making great efforts to reconstruct the economy and these efforts are showing considerable success.

The mission to Angola by the UNESCO/ECA consultants was not able to make the necessary contacts with the relevant government authorities and institutions concerned with marine science and technology development in the country. Consequently little information concerning these activities was obtained.

Area: 1,246,700 km^2
Coastline: 1,600 km.
Population: 5.80 (1972)

Training in marine sciences

It has been reported that the Department of Biology of the Faculty of Science of the University of Angola offers a specialised programme in Aquatic Ecology which incorporates some courses in marine sciences.

Research in marine sciences

The Centro de Investigacoes Pesqueiras(CIP)(Fisheries Investigation Centre) which was funded by the Portuguese colonial government has been revived and carries out research in fisheries and oceanography. Under a SIDA assistance project the research vessel of the Centre - GOA (36m) is being recommissioned and short and long-term consultants are to be provided to assist in research execution and planning.

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BENIN

Background information

The Republic of Benin is a small densely populated country with rich agricultural resources. It was a former French colony (Dahomey) which gained its independence in 1960 and changed its name to Benin in 1975. Due to its very short coastline marine resources are not very important in the country's economy.

Area: 112,622 km^2

Coastline: 100 km.

Population: 3.29

Training and Research in marine sciences

There is a great shortage of scientific manpower and there are no activities on training and research in marine sciences at present. However, with adequate staffing and equipment there are several institutions potentially capable of performing this role, including:

The University of Benin;
The Ministry of Higher Education and Scientific Research;
The Ministry of Cattle Breeding, State Farms and Fisheries;
The Directorate of Fisheries.

CAMEROON

Background information

The United Republic of Cameroon is a country rich in agricultural, forestry, freshwater and marine resources, non of which are being fully exploited at present. There is a serious shortage of high level manpower in all sectors of the economy.

Area : 476,000 km^2
Coastline: 350 km
Population: 6.67

Training and Research in marine sciences

There are at present no activities concerned with high level training or research in marine sciences. However, the Faculty of Science of the University of Cameroon with the cooperation of the University of Bordeaux I and a few other French institutions, is planning to establish an institute of marine sciences.

CAPE VERDE

Background information

The Republic of Cape Verde is composed of an archipelago comprising ten islands - St. Antao, St. Vicente, St. Lucia, St. Nicolau, Sal, Boa Vista, Maio, St. Tiago, Fogo and Biava. Fisheries form the mainstay of the economy, accounting for 60-62% of its export earnings.

Area: 4033 km^2
Coastline: 2000 km
Population: 0.31

Training and Research in marine sciences

There is a great shortage of trained manpower and there are no training or research institutions in marine sciences. However, some oceanographic studies are being carried out by scientists from the German Democratic Republic.

CONGO

Background information

The People's Republic of the Congo is a medium sized country rich in agricultural,forestry, freshwater and mineral resources, including oil. It has a comparatively small population and these resources are not being fully exploited at present.

Area: 342,000 km^2
Coastline: 170 km
Population: 1.44

Training and Research in marine sciences

There are no training institutions for marine scientists in the country and the only institution which carries out marine science research is the "Centre ORSTOM de Pointe Noire" (ORSTOM Centre of Point-Noir). The Centre is run by French scientists with two Congolese on the scientific staff and the present research programmes include physical, chemical and biological oceanography, plankton ecology and population dynamics.

EQUATORIAL GUINEA

Background information

Equatorial Guinea is a small country with a small population, which has suffered a long stormy period of colonialism dating back to 1494. The territory is made up of the mainland province of Rio Muni with its three small offshore islands (Corisco, Elobey Grande and Elobey Chico) and Mscias Nguema Island (formerly Fernando Poo) on which the capital Malabo is situated. After gaining its independence from Spain in 1968 the country has been facing great problems in developing its predominantly agricultural economy.

Area: 28,051 km^2
Coastline: 400 km
Population: 0.32

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Training and Research in marine sciences

There is an acute shortage of trained manpower and there are at present no activities concerned with training or research in marine sciences.

GABON

Background information

Gabon is a wealthy country with a small population, whose economy is based mainly on minerals including oil and to a lesser extent on timber. The marine fishery resources of the country which are said to be considerable are being little exploited at present.

Area: 267,000 km^2
Coastline: 800 km
Population: 0.53

Training and Research in marine sciences

Although there are not as yet any concrete programmes concerning training and research in marine sciences, the country is concious of the importance of science and technology in economic development and has set up the necessary machinery to look after the development of scientific research and training in the way of :

- a national university - the Omar Bongo University,
- a National Anti-Pollution Centre, and
- a Directorate for Scientific Research and Environmental Protection.

Gabon's interest in pollution problems was demonstrated in 1979 when it hosted a UNEP Meeting of Experts to review the Draft Action Plan For the West African Region.

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GAMBIA

Background information

The Republic of Gambia is a small country with a relatively small population, whose economy depends mainly on tourism.

Area:	11,300 km^2
Coastline:	80 km.
Population:	0.55

Training and Research in marine sciences

There are no institutions of higher learning or professional training in marine sciences and the country depends for most of its middle and high level manpower training on overseas institutions or those of neighbouring countries. The very limited research activities in aquatic sciences are centred in the Department of Fisheries of the Ministry of Agriculture and Natural Resources and these are mainly oriented towards the development of freshwater and brackish water fisheries in the Gambia river.

GHANA

Background information

The Republic of Ghana is one of the most progressive countries in tropical Africa,and concerning the availability of basic infrastructural facilities and professional scientific and technological manpower the country is better placed than many other African coastal states. There are good training institutions in marine sciences in the country and many professional scientists especially in the field of aquatic biology. However, the state of the economy of the country, which has been steadily deteriorating in the past several years has been a great constraint and is tending to lead to stagnation in the development of marine science and technology. This has been caused by such factors as lack of

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foreign exchange for the importation of spare parts and new equipment, and the decline of interest and enthusiasm among national scientists, many of whom have left the country in search of better conditions of work elsewhere. This kind of brain drain is one of the most serious problems facing Ghana and many other African countries today, and it is a problem for which a quick solution is difficult to find.

Area:	235,500 km^2
Coastline:	600 km.
Population:	10.48

Training in marine sciences

The training of marine scientists in Ghana takes place at the Universities of Ghana and Cape Coast. Although the plans to establish an institute of marine science and oceanography at the University of Ghana have not materialized, the University has been offering postgraduate studies in Aquatic Biology since 1974, and scientists with this kind of background can easily orientate towards marine biological research. However, there are no university programmes as yet in the areas of physical oceanography, chemical oceanography or marine geology and consequently, there is a shortage of scientists with these specializations in the country. This would not seem to be a big problem, however, as appropriate postgraduate programmes in these subjects could easily be introduced in one or other of the country universities. The question is simply one of giving priority to these areas of marine science by the Government and University authorities.

Research in marine sciences

The principal institution engaged in marine science research in Ghana goday is the Research and Utilization Branch (RUB) of the Fishery Department, Ministry of Agriculture. The research is therefore

mostly fishery-oriented, although there have also been some observations in the past in physical and chemical oceanography and marine geology. RUB has good laboratory facilites at the port of Tema and owns a modern, well-equipped research vessel - R.V. Kakadiama (180 tons, 29.2m) and two smaller vessels. The research section of RUB has a staff of 32 including six scientists and four senior technical officers. Current research aprogrammes are in the areas of biological oceanography, hydrography, planktonology, stock assessment, fishery statistics and population dynamics.

The Institute of the Aquatic Biology under the Council for Scientific and Industrial Research is mainly concerned with research in limnology but also carries out some marine science-oriented research.

There has also been some studies, sponsored by UNEP on marine pollution and coastal erosion.

GUINEA

Background information

The Republic of Guinea is a country rich in agricultural and mineral resources. After severing its close relationship with France as an "overseas territory" in 1958, the country went through a difficult period of reconstruction and it was only during the past few years that the country began to take an active interest in the development of science and technology as a basis for the development of its marine resources, which are still little understood.

Area: 245,857 km^2
Coastline: 300 km
Population: 4.65

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Training in marine sciences

The most important institution concerned with high level training of marine science personnel for the country is the Institut Polytechnique Gamal Abdel Nasser (Gamal Abdel Nasser Polytechnic Institute) which has ten departments. The Biology Department of the Institute offers a 5-year programme leading to an M.Sc. degree in Ichthyology and graduates in mathematics and physics can opt for appropriate marine science courses (e.g. physical oceanography and fishery statistics) to specialize in marine sciences. It is also expected that when fully operational CROH (see below) will participate in the training of local marine scientists by introducing M.Sc. courses in oceanography for graduates from the University and the Polytechnic Institute.

In addition to these training facilities, a number of Guinean students are sent abroad annually (USSR, Poland, Cuba, Yugoslavia) to specialize in various marine science subjects.

There are as yet no strong research and training programmes in marine sciences at the University of Conakry, but the Biology and Fisheries Departments of the University have been carrying out some joint surveys and mapping of fishing grounds.

Research in marine sciences

There are two institutions specialized for marine science research in the country:

- Le Laboratoire de Biologie Marine de la Direction des Peches (The Marine Biology Laboratory of the Fisheries Service) of the Ministry of Rural Economy was established in 1974 to be responsible for all research in marine fisheries. Because of the lack of qualified scientists, no substantial research work is being carried out by the Laboratory at present. The Laboratory has a reference collection of fish and crustacean species found in Guinea waters.

- Centre de Recherches Oceanographiques et Heliophysique (CROH) (Centre for Oceanographic and Fisheries Research). This Centre which was built through a technical cooperation agreement with the USSR Government, was completed in 1980 and was to be formally dedicated in 1981. The agreement provides for technical and financial assistance from the USSR in running and managing the Institute for the first five years after its establishment (1981-1986) and for the training of Guinean counterpart scientists at CROH or in the Soviet Union. The research programmes of the Centre are to be agreed upon by the two parties, but have not as yet been worked out. It is envisaged, however, that they will include chemical oceanography, physical oceanography and phyto-plankton and zooplankton studies. Among the important equipment to be supplied to the Centre later are a research vessel and a computer.

- Le Institute National de Recherche et de Documentation (INRD) (National Institute for Research and Documentation) does not carry out research. Its functions are to oversee and co-ordinate research and to harmonise research and development by organising meetings of scientists and administrators at the national level. It also serves as a documentation centre.

GUINEA BISSAU

Background information

The Republic of Guinea Bissau is a small country with good agricultural, forestry, mineral and fishery resources. The nearly 100 years of Portuguese colonialism (1879-1974) in Guinea Bissau left the country one of the poorest and most backward in Africa. At the time of independence in 1974, after a protracted guerilla war, illiteracy was 97%, infantile mortality rate 45% and life expectancy 35 years. After achieving independence, however, the national government has been making great efforts in reorganizing the society and reconstructing the economy. These efforts have began to bear fruit in the form of a very marked improvement of the economy and of the standards of health and education.

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Area:	36,125 km^2
Coastline:	250 km
Population:	0.54

Training in marine sciences

There are as yet no institutions for advanced training or research in marine sciences and professional scientists and technologists are at present being trained abroad (Brazil, Portugal, USA, Cape Verde). The country is planning to establish some training and research institutions of its own.

Research in marine sciences

Some oceanographic observations and fishery surveys and stock assessment have been made by foreign research vessels and by the "Centre de Recherches Océanographiques de Dakar Tiaroye" in Senegal. These studies have revealed the existence of very rich fishery resources in the inshore and the extensive continental shelf, which are due to a combination of several favourable physical characteristics of the oceanic waters of the country, including upwelling and convergence of ocean currents with different physical properties.

IVORY COAST

Background information

The economy of the Republic of Ivory Coast is based on agriculture, timber and recently on offshore oil. There has not in the past been much emphasis on the development of the living marine resources of the country. Because of the close relationship existing between the Ivory Coast and France there is close collaboration between the two countries in matters concerning scientific research and training.

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Area: 322,463 km^2
Coastline: 550 km
Population: 5.15

Training in marine sciences

There are no specialized courses in marine sciences offered at the National University of the Ivory Coast and students wanting to specialize in marine science subjects are sent to foreign universities and other institutions, mostly in France. However, the Faculty of Science offers a course in Hydrobiology as part of the programme in Tropical Ecology whose main emphasis is Freshwater Biology.

Research in marine sciences

The Government of Ivory Coast attaches high priority to the development of science and technology as a basis for economic advancement and has set up an elaborate administrative machinery for the direction, execution and coordination of scientific research. There is a Ministry of Scientific Research with several research institutions under it:

The most important institution concerned with marine science research is the "Centre de Recherches Océanographiques (CRO)" which was founded in 1959. The Centre is administered and managed through a cooperative arrangement with the French organization - "Office de la Recherche Scientifique d'Outre Mer (ORSTOM) which specializes in the development of scientific and technological research in developing countries. The French Government contributes in the financing of the research activities of the Centre and most of the senior scientists at present are French nationals. However, there is a concerted effort to train Ivory Coast scientists and the present scientific staff includes seven qualified or training indigenous scientists. The present research programmes of the Centre are biased towards fisheries development, but there is also some work being carried out in physical

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and biological oceanography. Besides carrying out research, CRO also participates in the training of local marine scientists by taking on postgraduate students from the national or overseas universities for the field work part of their research projects.

The "Institut d'Ecologie Tropicale" (Institute of Tropical Ecology) in collaboration with the Faculty of Science of the University, carries out some limnological research.

There is also an Institute of Maritime Documentation, Research and Studies under the Ministry of Marine Affairs.

LIBERIA

Background information

The economy of the Republic of Liberia is at present dependent on minerals (mainly iron ore), rubber and timber. The marine resources of the country are not well developed and not being fully exploited.

Area: 113,370 km^2
Coastline: 550 km
Population: 1.80

Training and Research in marine sciences

There is practically no activity going on at present concerning research and training in marine sciences. The Biology Department of the Falkner College of Science and Technology, University of Liberia, carried out some observations in the past on marine plankton and fishery biology, but owing to staff problems, even this modest effort has stopped. It would appear that there is a great need for cooperation between the University and government ministries and of a coordinating mechanism to ensure that university activities were in harmony with and relevant to the country's economic problems and in particular to its manpower needs.

In a recent reorganization of the Division of Fisheries, Ministry of Agriculture, a Research Institute which will be responsible for all research related to fisheries development, was to be created.

MAURITANIA

Background information

Mauritania is a large country, most of which is desert. Consequently, the population is small consisting largely of nomads whose main occupation is live-stock raising. There is no tradition of life at sea or of eating fish and the artisanal fishery is very much underdeveloped. However, the recent Sahel draughts almost decimated the livestock industry and it seems highly probable that gradually Mauritanians will have to take up fishing as the most obvious alternative means of livelihood.

Area: 1,030,700 km^2
Coastline: 450 km.
Population: 1.32 (1975)

Training in marine sciences

The general standard of education is low and there are no institutions of higher education or professional training in the country; the small middle and high level professional cadre is largely trained abroad (France, USSR and neighbouring countries). There are plans to establish training programmes in fisheries and marine sciences to be run by the National Centre of Oceanographic Research and Fisheries (see below) and the proposed "Ecole de Formation Maritime à Noadhibou" (Maritime Training School at Noadhibou), but these programmes have not started and they are likely to be for middle grade personnel.

Research in marine sciences

The only institution engaged in marine science research in the country at present is the "Centre National de Recherche Oceanographique et des Peches" (CNROP)-(Centre of Oceanographic Research and Fisheries) which was established in 1979 with assistance from the USSR. This Centre which took over the research functions of the Fisheries Laboratory at Noadhibou is at present manned by a team of four Russian marine scientists headed by a Mauritanian Director. It was expected that they would be joined by a team of French marine scientists. The present research programmes of the Centre are in the areas of physical and chemical oceanography, survey and stock

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assessment of pelagic and demersal fisheries and marine pollution. It is hoped that future research programmes will include mariculture.

The Centre is facing several problems arising from the lack of a clear fishery policy, lack of equipment and shortage of suitably qualified local counterpart scientists.

MOROCCO

Background information

Morocco is bordered by the Mediterranean in the north and the Atlantic in the west. The country has rich fishery resources in its Atlantic Ocean waters, which are not being fully exploited at present. There has been an interest in marine science research for several decades and several research institutions were established and staffed by French scientists during the French colonial government. However, in recent years, with the departure of most of the French scientists, the country has been experiencing an acute shortage of trained scientific manpower which has resulted in a serious decline in scientific activities in all areas.

Area: 567,600 km^2
Coastline: 1,800 km
Population: 18.24

Training in marine sciences

At present training in marine sciences is limited and takes place at the Mohamed V (formerly Rabat) University. The Department of Earth Sciences of the University, in collaboration with the University of Bordeaux I in France, offers courses in sedimentology, geochemistry and physical oceanography. However, there are no courses being offered by the University in marine or fishery biology, which would seem to explain the great shortage of qualified scientists in these areas.

Research in marine sciences

Research in marine sciences is centred at the Mohamed V University and in a few government ministries :

The Department of Earth Sciences of the University and the Department of Geology of the Ministry of Energy and Mines carry out research on the geology and geochemistry of the continental shelf; an inventory of the results of this research including detailed bathymetric charts are being prepared. The Department of Earth Sciences of the University, in collaboration with the University of Bordeaux I, is also carrying out studies in the geochemistry and sedimentology of the coastal estuarine zone.

The Sherifien Scientific Institute of the University carries out some research in marine biology and ecology.

The "Institut de Peches Maritimes" (Institute of Marine Fisheries) of the Department of Merchant Marine, Ministry of Commerce and Industry, in Casablanca, has good facilities for marine research in biochemistry, pollution and fish processing.

There is also a well planned UNDP/FAO project on stock assessment and resource management which is provided with seven experts, a well equipped research vessel and a computer.

NIGERIA

Background information

Many African countries are in a dilemma, created by the vicious circle of poverty, leading to limited ability to develop and exploit their natural resources, leading to stagnation of their economies, leading to poverty. Nigeria is fortunate to have come out of this vicious circle, and, in recent years, the country has been making a great effort in the promotion of science and technology for its economic development. The new-found wealth in oil has provided both the stimulus and the material support for this effort. However, the energy and enthusiasm have come so suddenly,

and are being translated into action so forcefully, that one sometimes feels that in order to avoid unnecessary duplication and wastage, that might arise from lack of harmony and coordination, some caution would not be out of place. There is no doubt, however, that with the necessary caution, Nigeria with its vast oil wealth, its big population and its large territory, is well poised for rapid economic development.

Area:	923,773 Km^2
Coastline:	700 km
Population:	66.63

Training and Research in marine sciences

The main institutions which are at present carrying out training and research in marine sciences are :

- Nigerian Institute for Oceanography and Marine Research (NIOMR) - This is the most important institution in the country engaged in training and research in marine science and fisheries at present. The Institute is well planned and is housed in a complex of new and modern buildings providing ample office, laboratory and service accommodation. The laboratories are well equipped for research work in fishery biology, chemical oceanography and marine pollution. Some of the facilities e.g. the aquarium, had not been completed at the time of the mission. The Institute had a generous budget and the scientific staff establishment seemed adequate, but several vacancies were unfilled and many of those on post were on study leave abroad. The areas best provided for were biological oceanography, fisheries and chemical oceanography, but there was also a qualified and experienced marine geologist on the staff. There was not much oceanographic research work going on as the Institute's research vessel, which was being built in West Germany, had not arrived; it was expected in December 1980.

Apart from research, the Institute has under its wings two training institutions :

- The Federal School of Fisheries situated next door to the Institute, runs diploma courses in fisheries and fish technology and orientation courses for fishermen.

.../...

- The African Regional Centre for Aquaculture at Calabar has an intake capacity of 40, was opened in June 1980 and offers a one-year Diploma course in Aquaculture to marine scientists who would, after qualifying, go back to their countries and organize teaching and research projects in acquaculture. The Centre also carries out research and field work to support its training programmes.

Several universities in Nigeria have also, during the last few years, established research and teaching programmes in marine sciences:

- The University of Lagos offers a course in marine biology and fisheries as a component of the B.Sc. Biology programme.

The University (Department of Biological Sciences) has also established a Marine Research Unit, which is well equipped, but whose facilities are not being fully utilized due to a shortage of qualified staff. There are facilities for M.Sc. and Ph.D. studies by research.

- The University of Calabar offers a course in fishery biology as a component of the B.Sc. Zoology programme. It was also intended to introduce a full B.Sc. programme in Marine Biology and to create a Department of Marine Sciences in 1981. There is a plan to establish an Institue of Marine Sciences eventually.

- The University of Port Harcourt runs an M.Sc. programme in Hydrobiology and Fisheries.

It has also been reported that the universities of Ibadan and Ife offer M.Sc. programmes in marine biology. In addition, the University of Ife conducts and coordinates research on pollution problems in the country.

SENEGAL

Background information

The economy of the Republic of Senegal is based on agriculture (mainly groundnuts), industry and fisheries. The country derives much of its protein requirement and a considerable portion of its export earnings from its fishery

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resources and in its economic development policy, considerable emphasis has been given to the development and exploitation of the country's marine resources.

Area:	196,192 km^2
Coastline:	500 km
Population:	5.09 (1976)

Training in marine sciences

The University of Dakar does not at present offer full-scale degree studies in marine sciences, but a few marine-oriented courses are offered as parts of major programmes in some departments, e.g. courses in coastal geomorphology and hydrology are offered to geography students and in marine ecology and marine invertebrate and vertebrate systematics to zoology students. Graduate students wanting to specialize in marine sciences have to go abroad.

Research in marine sciences

The principal institution responsible for marine science research is the "Centre de Recherches Océanographiques de Dakar-Tiaroye" (CRODT). The Centre is under the Secretariat of Scientific and Technological Research and its research programmes are mostly oriented towards the development and exploitation of marine fisheries. The scientific staff of the Centre consists of 14 expatriate scientists (mostly French) and 11 qualified or training Senegalese scientists. The Centre has fairly well equipped laboratories and two small boats; there is also an FAO research vessel on loan to the Centre. Most of the staff scientists are marine biologists and the main research programmes at present are stock assessment and management and fishery biology. Future research programmes would include pollution studies of the coastal environment.

The Departments of Geography and Zoology of the University of Dakar also carry out research in coastal geomorphology and remote sensing, and pollution respectively. There does not seem to be much cooperation or coordination of activities between the University and CRODT.

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The Department of Marine Biology of the "Institute Fondamental d'Afrique Noire (IFAN)" has in the past conducted some marine biological research, but the shortage of qualified scientists has seriously affected its research activities.

SIERRA LEONE

Background information

The Republic of Sierra Leone is a country rich in agricultural, mineral and fishery resources. It has a larger tradition of marine science and technology development than most of the other West African coastal states. The British colonial government established the West African Fisheries Research Institute (WAFRI) in 1952 to serve the fishery interests of its former colonies of Sierra Leone, Gambia, the Gold Coast (Ghana) and Nigeria. Through a series of transformations WAFRI eventually gave rise to the Institute of Marine Biology and Oceanography (IMBO) of the Fourah Bay College, University of Sierra Leone in 1967. Since then, the country has maintained its lead among the West African coastal states in having well conceived training and research programmes in marine science and technology. With the recent development of the University of Sierra Leone, these programmes have been diversified in scope and strengthened in depth.

Area:	71,740 km^2
Coastline:	400 km
Population:	3.47

Training and Research in marine sciences

Practically all activities concerned with research and training in marine sciences in the country are centred at the University of Sierra Leone with IMBO as the focal point. Apart from research in marine sciences, IMBO also conducts freshwater (limnological) research, a diversification which deserves commendation as it is a good example of economical use of manpower. The main research programmes being carried out by the Institute at present are in fishery biology and ecology, fishery resources survey, algology and limnology. Future research programmes include biological and chemical

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oceanography, stock assessment and population dynamics of economic species, marine pollution, egg and larval ecology, aquaculture and biology and ecology of mangroves.

In its training activities, the Institute contributes the oceanography component of the B.Sc. programme in Zoology and Oceanography in the Faculty of Science of the University and offers a diploma course in Aquatic Biology and Fisheries. As a result of good working arrangements between IMBO and the Faculties of Science and Engineering of the University, many students in these faculties now graduate having taken appropriate courses in marine sciences which would make them more versatile, and sometimes more competent, in their future work, e.g. in matters concerning coastal area development and construction. Some members of the Faculty of Engineering and the Department of Geology also carry out some research projects in such marine science-related problems as coastal erosion, siltation and sediment transport.

The Institute (IMBO) at present has a staff of 11 including five scientists and six technical and administrative staff. The main constraints being experienced by the Institute are shortage of staff and of working space. The Institute could also do with a good research boat, but it has access to the boats of the Fishery Division of the Ministry of Natural Resources.

SAO TOME AND PRINCIPE

Background information

The Democratic Republic of Sao Tome and Principe comprises the two islands of Sao Tome and Principe. It is located about 300 km from the coast of Gabon and the two islands are separated by a distance of 150 km.

Area:	854 km^2
Coastline:	260 km
Population:	0.08

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Training and Research in marine sciences

There are at present no activities in marine science training or research in the country.

TOGO

Background information

The Republic of Togo is a small country with a relatively large population. Its economy is at present based on agriculture and mineral (mainly phosphates) resources.

Area:	56,000 km^2
Coastline:	50 km
Population:	2.35

Training and Research in marine sciences

There are at present no institutions concerned with research or training in marine sciences in the country, but an oceanographic laboratory is under construction at Agbodrafo.

ZAIRE

Background information

The Republic of Zaire is a large country with a great variety of resources including mineral, agricultural and forestry. The country has a very short coastline, and except for offshore oil, not much importance is attached to other marine resources.

Area:	2,345,000 km^2
Coastline:	50 km.
Population:	26.38

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Training and Research in marine sciences

At present there are no important research or training activities in marine sciences. There is a great shortage of trained manpower.

2. Marine Technology Development and Other Aspects Of Applied Marine Sciences

Theoretical scientific knowledge,although of prime and fundamental importance, is not by itself sufficient to bring about a real improvement in the quality of human life unless it is accompanied by the appropriate technology, i.e. by a capacity to apply it wisely to solve the many environmental problems that tend to frustrate man's desire and struggle for a better life. Thus the early philosophers, mathematicians, physicists, astronomers etc. laid the foundation for human progress by discovering the natural laws and forces that govern natural phenomena. But it was only centuries later, after the acquisition of the knowledge as to how to manipulate these natural laws and forces to advantage, that practical human progress became possible. An "arm chair farmer" who has all the theoretical knowledge,as to how to cultivate a good crop or how to raise a good stock of farm animals is not of much use in a community that is making a desperate struggle against famine, unless he can put his knowledge into practice by actually cultivating a good crop or actually raising a good stock of farm animals. Needless to say, however, that the scientific knowledge must always precede the technology,since you cannot design and make a tool, and use it effectively unless the design and making stages have taken into consideration and allowed for the natural laws and forces that will affect the use of such a tool; for example, in designing and laying a water supply to a house,unless you intend to use a pump,you cannot have the reservoir below the level of the house,because the natural flow of water is governed by the law of gravity; so a knowledge about the law of gravity is a prerequisite in such a case. Thus a project aimed at improving the capacity of African coastal states in making fuller and more rational use of their marine resources,must aim at developing both marine science and marine technology in these countries.

The state of marine technology in African coastal states is just as unsatisfactory as, and in some cases even more unsatisfactory, than in the case of marine sciences. Furthermore, the little technology that is available is in many cases of a low standard and sometimes obsolete. It cannot therefore be competitive in the modern age. The intricacies of modern marine technology, the speed at which it is advancing and the magnitude of its demands in manpower and material resources, calls for a great effort in evolving the right strategy to enable African countries to catch up. In examining this problem it is important to remember that there are aspects of marine technology, such as modern marine engineering,which are completely lacking in all African coastal states. Thus the following discussion will be concerned mostly with relatively simple but relevant technology and other aspects of applied marine science, such as are presently found in African coastal states, e.g. fishing technology, boat building and a repair, navigation and seamanship, coastal area management, development and protection, conservation of marine resources, pollution, harbour development etc.

2.1 Eastern Africa

COMOROS

Main activities of interest

Marine resources development and exploitation: The fishery industry is not well developed. The artisanal fishery uses dug-out canoes with sails or paddles; only 3% with outboard engines. The total landing is about 7,000 metric tons a year. Plans to establish a tuna industrial fishery have not materialised. There are no research or training programmes in fisheries. There are plans to establish a salt extraction plant at Moroni.

Marine environment protection: There is a Directory for the Environment responsible for the protection of territorial waters from oil pollution from tanker traffic but there are no facilities or personnel to run a marine pollution control service.

Tourism:

There is a plan to increase hotel accommodation.

Harbour facilities:

There are plans to improve and expand the two small harbours at Moroni and Mutsamuda.

Meteorology service:

Being within the tropical cyclone zone, there is a meteorological station at Moroni which collects data daily.

DJIBOUTI

Main activities of interest

Fisheries development: There is a Department of Farming and Sea Fisheries (Ministry of Agriculture). The artisanal fishery is being developed by motorising the simple fishing crafts. A $500,000 USAID funded project for the establishment of an industrial fishery is under consideration. It will involve construction of fibreglass boats, supply of fishing vessels and outboard motors, provision of maintenance service and canning, refrigeration and drying facilities, together with vehicles for fish distribution. There are no institutions for research or training in fisheries and there is a great shortage of manpower at all levels.

Harbour facilities

There is a harbour at Djibouti which also serves Ethiopia.

ETHIOPIA

Main activities of interest

Marine resources development and exploitation: There is a Ministry of State Farms which is responsible for industrial fishery development and a Department of Fisheries (Ministry of Agriculture) which is responsible for the development of the artisanal fishery. Both these fisheries are in a state of re-organisation. At present there are no fishery training schools and qualified personnel is in short supply. Other marine resources being exploited are sea salt, shells and corals.

Conservation: There are plans to establish a marine national park at the Dalakh Archipelago.

Pollution: Ethiopia participates in the ALECSO/UNEP Programme for Environmental Studies of the Red Sea and Gulf of Aden.

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Marine Transport and Harbour Development: There is a national Maritime Transport and Harbour Authority (Ministry of Transport and Communications) and a National Shipping Corporation responsible for regulating maritime transport and for running and managing the national merchant marine fleet respectively. It is intended to establish a marine training institute. There are plans to modernise and expand the two harbours of Assab and Massawa.

Boat Building and Servicing: There is a small shipyard at Massawa which is to be expanded.

KENYA

Main activities of interest

Fisheries development and exploitation: There was not much emphasis on marine fisheries in the past but steps are being taken to develop both the artisanal and industrial fisheries. An Institute of Wildlife and Fisheries Training is under construction. There is an FAO aquaculture project at Malindi.

Conservation and Tourism: There is a Department of Wildlife Conservation and Management under the Ministry of Environment and Natural Resources. Three marine national parks and three marine reserves have been established near Malindi. Tourism is well developed both inland and on the coast.

Boat building and repair services: There is a large shipyard at Mombasa with good dry dock facilities, capable of building large inboard engine boats and of repairing large ocean-going vessels. It is one of the best dry dock facilities in Eastern Africa.

Harbour development: Mombasa is one of the best natural harbours in Eastern Africa. There are plans to build another harbour at Lamu in the north and to expand the Mombasa harbour. It is also intended to establish several small harbours for fish landing.

Pollution: There is an Anti Marine Pollution Committee one of whose functions is to monitor pollution around the Mombasa harbour.

MADAGASCAR

Main activities of interest

Marine resources development and exploitation: The artisanal fishery is not well developed but the industrial fishery is moderately developed with several fishing companies. The only other marine resource being exploited at present is salt.

Maritime training: There is a maritime training school at Majunga for commercial and fishing deck officers and marine engineers.

Boat building and repair facilities: There is a large shipyard at Diego Suarez with good dry dock facilities. It has the capacity to build large inboard engine boats and to repair large ocean-going vessels. It is one of the largest dry dock shipyards in Eastern Africa.

Harbour development: The two important harbours in the country are Tamatave (the largest) and Majunga, both of which are experiencing severe congestion. There are plans to enlarge the harbour at Tamatave and to resite the one at Majunga due to serious siltation problems.

Cartography and hydrography: There is a National Institute of Geodesy and Cartography one of whose functions is to deal with the questions of cartography and hydrography of the inshore area of the country.

MAURITIUS

Main areas of interest

Marine resources development and exploitation: Both artisanal and industrial fisheries are moderately developed and there is a mariculture project. There are plans to exploit the marine algae resources of the country.

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Training of middle-level personnel: Training of middle-level personnel takes place on the job or abroad.

Marine Pollution: There is a serious pollution of the coastal waters and lagoons arising from pesticides used in the sugar plantations.

Conservation: There are plans to set up special marine reserves for ecological studies and conservation of some of the interesting lagoons.

Museum: Mauritius is one of the few countries in Africa which have established marine museums.

MOZAMBIQUE

Main activities of interest

Fisheries development and exploitation: Both artisanal and industrial fisheries are moderately developed. There are cold storage facilities and a canning factory is under construction in Maputo. These facilities are to be increased to cater for the shrimp industrial fishery.

Training of technical staff: There is a Fisheries Training Centre at Matola being run with FAO assistance for the training of master-fishermen and boat mechanics.

Harbour development: Maputo is the main harbour of the country but there are also harbour facilities at Beira and Quelimane. There are plans to construct other fishing harbours and to expand the Quelimane harbour.

Boat building and repair facilities: There is a boat yard at Matola at present building wooden boats, and with aid from external sources, there are projects for the consturction of fibre glass and ferrocement boats. The port of Maputo has dry dock facilities for servicing large ocean going vessels.

Pollution: It is intended to establish a marine pollution monitoring programme along the coast.

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SEYCHELLES

Main activities of interest

Fisheries development and exploitation: The artisanal fishery is not well developed, and the tuna industrial fishery is being reorganised.

Training of technicians: There is a Fishery Training School which is being reorganised to train fishermen, sailors and motor mechanics.

Harbour development and coastal area management: The main port of Victoria is being expanded by land reclamation and there are also plans to expand and improve the Mahe harbour.

Marine parks, conservation and tourism: There are five marine national parks around and including five islands, established for the purpose of tourism and conservation. The sea turtle is one of the animals being protected.

SOMALIA

Main activities of interest

Marine resources development and exploitation: The artisanal and industrial fisheries are not very well developed. There is some exploitation of sea salt.

Training of marine technicians: Training of marine technicians takes place abroad, mainly in the USSR.

Harbour development: The three main ports of the country are Mogdisho and Kismayu, on the Indian Ocean coast, and Berbera, on the Red Sea coast.

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Boat building: There is a fibre glass boat construction project being run with technical assistance from Sweden.

Conservation: The Dugong is protected by law.

SUDAN

Main activities of interest

Marine resources development and exploitation: The marine fishery resources are not well developed but there are projects aimed at an improvement. There is a joint project with Saudi Arabia on the exploitation of heavy mineral deposits at the bottom of the Red Sea.

Marine parks: There are plans to establish national marine parks.

Boat building: There is a small boat yard at Port Sudan for building small and medium-size boats.

Marine pollution: There is a multidepartmental marine pollution monitoring programme.

Harbour development: Port Sudan is the country's only sea port at present but a new port scheduled for completion in 1985 is being built at Suakin, south of Port Sudan.

TANZANIA

Main activities of interest

Marine resources development and exploitation: Both the artisanal and industrial fisheries are moderately developed. There is some small scale exploitation of sea salt and sea weeds (algae).

Training of technicians: The Division of Fisheries, Ministry of Natural Resources and Tourism, runs two training institutes, one for a general diploma in fisheries and the other for specialised technical training.

Harbour development: Dar es Salaam is the main harbour of the country but there are medium harbours at Mtwara, Tanga and Zanzibar and small harbours at Pangani, Bagamayo, Kilwa, Lindi, Mafya and Pemba. There are plans to enlarge the Dar es Salaam harbour and to improve the other harbours.

Boat building and repair facilities: The Mbegani Fisheries Development Centre has facilities for the construction of medium-sized wooden boats with inboard engines. There are also boat yards at Pangani, Lindi, Mtwara and Mwanza on Lake Victoria. There are plans to construct a large dry dock shipyard at Dar es Salaam.

Marine pollution and coastal area degradation: A law prohibiting marine pollution was enacted in 1970 and there are plans to establish an oil disaster centre to cope with oil spills outside the Dar es Salaam harbour. There is a serious coastal erosion problem along the coast of Dar es Salaam.

Conservation and tourism: Three marine conservation areas have been established to protect the coral reefs around the near-shore islands off Dar es Salaam, the sea turtles around Maziwi Island off Pangani and the dugong in the Rufiji Delta and Mafya Channel. Tourism is a well developed and important industry both on the coast and inland.

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2.2 West, Central and Southern Africa

*ANGOLA

Main activities of interest

Fisheries development and exploitation: The fishery industry is not well developed; the rich resources are at present being exploited by foreign fishing fleets.

Training of technicians: With the assistance of SIDA, a school of fisheries is to be established at Cacuaco near Luanda.

Boat building: The SIDA project includes the construction of ferrocement fishing boats.

Harbour development: The main harbours of the country are Cabinda, Lobito, Luanda and Mocamedes.

Pollution: There have been some marine pollution studies and Angola is covered by the UNEP Action Plan for the West Africa Region.

BENIN

Main activities of interest

Fisheries development and exploitation: The fishery industry is underdeveloped and there is an acute shortage of manpower.

Coastal area erosion: There is a National Commission for the Environment one of whose responsibilities is to look into the very serious problem of coastal erosion.

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* The information on Angola is incomplete because the mission consultants were unable to make the necessary contacts.

Harbour development: A Hydrographic Commission has been created to coordinate all activities concerned with the extension of the Cotonou port.

CAMEROON

There is a great shortage of manpower and the marine resources of the country are not well developed. The fishery resources are making an insignificant contribution to the economy of the country.

CAPE VERDE

Main activities of interest

Fisheries development and exploitation: Both artisanal and industrial fisheries are well developed and fishery resources contribute 60-62% of the country's export earnings. There are freezing facilities at Mindelo and an old canning factory at Paria. Further development of the fishery industry is hampered by the lack of qualified personnel.

Training of technicians: There is a Nautical School at Mindelo for training mechanics and electricians, which also caters for Guinea-Bissau.

Harbour facilities: Mindelo is a major fishing port.

CONGO

Main activities of interest

Marine resources development and exploitation: The exploitation of marine fisheries is carried out by foreign fishing companies under

licence; some of these companies are in partnership with the Government. Due to the short coastline, most of these companies fish in the waters of neighbouring countries (Angola and Gabon). The artisanal fishery which is not well organized is mainly based on freshwater fisheries of the Congo river. Most of the information about marine fisheries (including data) is kept at the Oceanographic Research Station,ORSTOM at Pointe Noire. There is off-shore exploration of oil.

Marine pollution: There is a Directorate of Environment under the Ministry of Public Works which is supposed to be responsible for all matters pertaining to environmental protection, including marine pollution, but there is at present no organized activity going on despite the danger (if only potential at this stage) of oil pollution. There is a serious shortage of trained manpower in the country.

EQUATORIAL GUINEA

Main activities of interest

Marine resources development and exploitation: The artisanal fishery is at present underdeveloped and not well organized, but steps are being taken to reorganise and improve its performance with the assistance of EEC and the French Government. There was a joint venture with the USSR for the management and running of the industrial fishery, but this arrangement came to an end in 1979, after the coming in of the new government, and it has not been reactivated. There is off-shore oil exploration being carried out by a joint Equatorial Guinea/Spanish company (GEPSA).

Harbour development: There are two small harbours at Malabo and Bata respectively and there are plans to enlarge them to double their present capacities.

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GABON

Main activities of interest

Marine resources development and exploitation: The artisanal fishery is mostly being run by outsiders with little participation of the local people. There is an industrial fishery with modern fishing vessels exploiting the rich fishery resources of the country but there is much room for improvement. There is off-shore exploitation of oil and marine pollution is a serious problem.

GAMBIA

Main activities of interest

Marine resources development and exploitation: The artisanal and industrial fisheries are fairly well developed and there is an elaborate administrative machinery for their running and their further development, but they are mostly run by foreigners. There seems to be a conflict between foreign and national interests in the exploitation of the resources. There is a shortage of qualified manpower compounded by the fact that fishing as an occupation is not popular among Gambians. There are plans to exploit several mineral resources from the continental shelf.

Training of technical personnel: This takes place overseas or in neighbouring countries e.g. at the Ghana Nautical College; occasionally, it is done on the job.

Boat building: There is a small dockyard under the Gambia Port Authority equipped to service small ocean-going vessels and to build small trawlers, river barges and ferries.

Harbour development: There are plans to build a second port at Banjul.

Coastal area management: The Public Works Department of the Ministry of Works and Communication is responsible for the control of coastal area erosion.

Tourism: Tourism is well developed along the Atlantic coast of the country and up the Gambia river in the way of good hotel facilities, water sports and river transport.

Marine Pollution: There is regular monitoring of oil pollution in the port area.

Meteorology, hydrography, topography and cartography: These activities are carried out by the Water Resources Department of the Ministry of Agriculture and Natural Resources.

GHANA

Main activities of interest

Marine resources development and exploitation: Both the artisanal and industrial fisheries are well developed. There is an all round infrastructure for the efficient exploitation of the marine fishery resources of the country in the way of efficient and experienced fishermen, good fishing boats including factory ships and gear, large and efficient local fishing companies, a good fishing port (Tema), off-shore facilities for fish-handling and processing; practically all these activities are run by Ghanaians themselves and almost all the infrastructures are owned and managed by Ghanaians.

Training of high level technical personnel: The Ghana Nautical College provides practically all the training required at this level.

Training of middle level technical personnel: There are no formal fishery or maritime schools for middle level personnel, but the Fisheries Department (Ministry of Agriculture) organizes vocational courses for all the personnel required in this cadre.

Boat building: There are several boat building companies with boat yards of all grades. There is a large well equipped dry dock at Tema, capable of handling large ocean-going vessels and claimed to be the best in West Africa.

Harbour development: The main harbour of Tema can handle and service large ocean-going vessels. A deep-sea fishing harbour is to be constructed at Elmina and a smaller fishing port for the artisanal fishery at Mumford.

Pollution and environmental protection: There is an Environmental Protection Council which is responsible for environmental protection including pollution and coastal area erosion control.

GUINEA

Main activities of interest

Marine resources development and exploitation: Both the artisanal and industrial fisheries are being reorganised to improve their efficiency and to co-ordinate their activities, and there are plans to build several fish-landing harbours along the coast. The Guinea Hydrocarbon Society is carrying out off-shore exploration of oil.

Harbour development: Conakry is the main harbour of the country and there are plans to expand it. Port Kamsar is a small harbour for the mining industry.

Boat building: There are small boat yards capable of repairing small boats and two floating docks in the Conakry harbour are at present carrying out dredging work.

Pollution: There is an Agency responsible for the monitoring and control of pollution arising mainly from sewage and the aluminimum industry.

Training of technical personnel: The Secondary Marine Polytechnic and the Centre for Oceanographic and Fisheries Research are responsible for the training of technical staff at this level.

GUINEA BISSAU

Main activities of interest

Marine resources development and exploitation: The rich marine resources of the country are not being fully exploited at present, but their development is one of Government's priorities in its economic reconstruction effort. For the industrial fisheries, there are three companies operating in fish processing and a modern freezing plant is under construction. There is a Secretariat of Fisheries under the Prime Minister's Office which is reorganizing the fishery industry with assistance from Brazil.

Training of technical personnel: The School of Navigation in Cape Verde offers training places to trainees from Guinea Bissau and there are annual fellowships from Portugal for middle level training. A mechanical engineering school is to be established in the country.

Harbour development: The harbour in Bissau is small and can handle only one ship at a time.

IVORY COAST

Main activities of interest

Marine resources development and exploitation: The fishery resources of the country are not fully exploited and both the artisanal and industrial fisheries are underdeveloped. However, the Government has now set up an elaborate administrative machinery for the development of both fisheries. There is a Directory of Marine and Lagoon Fisheries which is responsible for fishery statistics, fish handling, fishing technology, improvement of fishing boats and fishing gear, aquaculture and fishermen cooperatives. There are agreements for fishery exploitation with Senegal, Guinea, Spain, France, Korea and Japan. There is off-shore exploration and exploitation of oil.

Training of technical staff: There are at present no training institutions for higher level technicans and technologists, but there are proposals for the establishment of a Regional Academy of Marine Sciences and Technology in Abidjan to serve all the French-speaking West African countries.

Marine pollution: The Directorate of Hydrocarbons is responsible for the protection of the off-shore oil fields and of the environment generally. A National Commission for the Environment was formed recently to take over some of the functions of the Directory of Hydrocarbons, including oil pollution.

Harbour development and marine transport: The port of Abidjan is one of the busiest and most efficient in West Africa and there are plans for its further modernisation and expansion. The country has two modern and competent shipping companies - The state-owned

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"Societé Ivorienne de Transports Maritimes"(SITRAM) and the privately owned "Societé Ivorienne de Navigation Maritime" (SINM). These two companies handle about 40% of the country's shipping business, in accordance with the code of conduct stipulated by the United Nations Conference on Trade and Development (UCTAD),to the effect that 40% of shipping should be carried by the country of origin.

LIBERIA

Main activities of interest

Marine fisheries development and exploitation: The artisanal fishery is not well developed and the industrial fishery is only moderately developed. However, steps have been taken to improve the situation, including the establishment of a Division of Marine Fisheries of the Central Agricultural Research Institute (CARI). There are plans for joint fishing ventures with the USSR and for an acoustic fisheries survey of the EEZ area through assistance from the French Government.

Training of technical personnel: There is no organized training of this cadre at present, but the proposed "Manu River Union Marine Training Institute" to be established in 1981 as a cooperative venture between Liberia and Sierra Leone, is expected to fill this gap.

Harbour development: Monrovia is the main port of the country and there are plans to modernize and expand it. The other ports - Greenville, Harper and Buchanan are also to be improved.

Boatyard facilities: The Masurado Fishing Company owns a small boatyard for servicing small boats.

Maritime Transport: There is a Maritime Affairs Commission which is responsible for regulating all maritime affairs including maritime transport. Many shipping lines in the world use the Liberian"flag of convenience" by special agreement with the Liberian Government.

Pollution and coastal area degradation: There is some pollution arising from the iron ore industry and coastal erosion is a serious problem.

MAURITANIA

Main activities of interest

Marine resources development and exploitation: The fishery resources of the country are very much underdeveloped at present. An on-going FAO project aimed at improving the artisanal fishery has run into several difficulties and after six years of operation has not met with much success. A Japanese-assisted project has also not been very successful. There is off-shore exploration of oil.

Training of technical personnel: The Mamadou Toure Centre at Nouadhibou runs vocational training courses in several technical subjects including diesel mechanics, fishing, refrigeration, electrical work etc. But this is not enough, and there is a great shortage of manpower at all levels.

MOROCCO

Main activities of interest

Marine resources development and exploitation: The fishery resources of the country are only moderately developed, but the Government is making a great effort to improve the situation through manpower training and research. There is an Institute of Marine

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Fisheries which is responsible for stock assessment and management. There is a seaweed industry based on the collection and processing of seaweeds into agar-agar.

Training of technicians: This training is carried out by the Institute of Marine Fisheries and the Ministry of Agriculture.

Boat building: There are small boat yards at Casablanca, Agadir and Saefi.

Harbour development: There is an on-going project of constructing ports at every 200 km of coastline.

NIGERIA

Main activities of interest

Marine resources development and exploitation: The Government is making great efforts to develop and modernize the fishing industry. The artisanal fishery is to be greatly expanded through the training of higher and middle level technical personnel, the strengthening of fishery research, the development of fishery cooperatives and the provision of on-shore facilities for fish landing, fish handling and fish processing. Nigerian participation in industrial fisheries exploitation (at present largely in the hands of foreign companies) is to be increased through the encouragement of local private fishing companies and formation of state fishing enterprises. The establishment of aquaculture in the lagoon zone is also being given prominence. Oil exploration and exploitation already form a big thriving industry.

Training of technical personnel: The training programmes of the Federal Marine Training School, the existing state fishery schools and the Nigerian Nautical college are to be expanded and their trainee

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capacities greatly increased so as to satisfy the country's need for such manpower.

Harbour development: All the main ports of the country - Lagos, Calabar, Warri and Port Harcourt - are being greatly expanded and modernized and several new small harbours for fishing and other industries are being established. It is planned to establish a big ocean terminal complex capable of handling large container ships.

Boat building and repair facilities: There are plans to expand and improve the boatyard facilities of the country which will include the manufacture of fishing equipment. Three large dry docks, capable of handling large ocean-going vessels are to be established at Lagos, Buruti and Port Harcourt.

Pollution and environmental protection: There is a Directorate of Environmental, Planning and Protection which looks after all environmental matters. Environmental pollution (including marine pollution) has become a serious problem. Recently, there were several oil pipe bursts in the River and Cross River States causing serious and extensive pollution of some of the lagoon areas. In response to the situation, the Government has made it mandatory for all future development projects to include an environmental protection component in their investment plans.

*SAO TOME AND PRINCIPE

Both the artisanal and industrial fisheries are under-developed and their exploitation is said to be far below the

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* The information about Sao Tome and Principe is incomplete because the mission consultants were not able to make the necessary contacts.

potential. The artisanal fishery uses mostly primitive fishing methods and the industrial fishery consists of three boats, using hook and line. There was a plan for an FAO-assisted project in 1975, aimed at an overall improvement of the artisanal and industrial fisheries, including the establishment of a tuna fishing fleet and a tuna harbour.

SENEGAL

Main activities of interest

Marine resources development and exploitation: Both artisanal and industrial fisheries are well developed and the rich fishery resources are making a considerable contribution to the economy of the country. There is good fishing capability among the local fishermen and the artisanal fishery which is entirely in the hands of the Senegalese, is very efficient and productive. The industrial fishery is also largely operated by Senegalese whose fishing fleets go as far north as Mauritania and as far south as Angola.

Training of technical personnel: The Nautical Maritime School (E.N.F.M.) and the Technical School for Oceanography and Marine Fisheries (E.A.T.O.P.M.) train all the middle level technicians required for the fisheries and other maritime activities of the nation, but high level technologists have to be trained overseas or in neighbouring countries. It is hoped that the latter category of personnel will in future be trained at the proposed Regional Marine Science and Technology Academy to be established in Abidjan, Ivory Coast.

Harbour development: Dakar is the main harbour of the country. A fishing port is to be established at St. Louis on the mouth of the river Senegal, and two new ports are to be constructed at Saloum and Casamance, south of Dakar.

Boat building and repair facilities: A major super-tanker dockyard is being built in Dakar.

Conservation and tourism: Senegal has established three marine parks at "Lagune de Barbarie", "Ile de la Madeleine" and "Parc du Delta de Saloumi". These marine parks are an additional attraction for the long established tourist industry.

Pollution: There is a Department of the Environment whose functions are purely legislative.

SIERRA LEONE

Main activities of interest

Marine resources development and exploitation: The artisanal fishery is well developed, well organized and well staffed, with qualified national manpower. There are plans to further develop the artisanal fishery through the improved training of fishermen and other marine technical staff at all levels, the provision of more modern fish-landing harbours, development and provision of modern fishing boats and fishing gear and better organization of fishing cooperatives. The industrial fishery which is also well developed is to be further improved through the training of local manpower at all levels, and through the provision of on-shore facilities such as fishing harbours, cold storage and fish handling and processing facilities. Off-shore oil exploration is to start soon.

Training of technical personnel: Until recently, there were no specialized institutions for the training of such cadres, but there were ad hoc vocational courses given by the Division of Fisheries, Ministry of Natural Resources, the University of Sierra Leone and

the Sierra Leone Ports Authority and through on-the-job training by the fishing companies. Recently (September 1980), the Sierra Fishing Company, with technical assistance from the USSR, established the Siaka Stevens Marine Training School in Freetown for the training of low-middle level marine technicians. It is hoped that this school, together with the proposed Manu River Union Nautical School in Monrovia and the proposed regionalization of the Ghana Nautical College, will provide all the technical manpower required at all levels.

Harbours development: The main harbour in Freetown is capable of handling large ocean-going vessels including container ships, and there are plans to construct several modern fishing harbours.

Boat building and servicing facilities: Existing boat yards are to be improved so as to have the capability of building medium-sized boats and two dockyards are to be constructed with slipways capable of handling small ocean-going vessels. There are long-term plans for further improvement and modernization of harbours and other on-shore facilities.

Tourism: The tourist industry is well established with several first class modern hotels along the fine beaches in Freetown.

Coastal area degradation: Coastal area erosion is becoming a serious problem in many places along the coast and there are also problems caused by siltation and by sediment transport and deposition.

TOGO

Main activities of interest

Marine resources development and exploitation: The fishery industry is underdeveloped and there is a great shortage of manpower at all levels. There are no training institutions for technical personnel. There is a

Department of Planning and Fisheries Protection under the Ministry of Rural Planning, and a Division of Marine Fisheries under the Ministry of Rural Development, both of which are responsible for the development and administration of the country's fishery resources.

Environmental protection and marine pollution: Coastal area erosion is a serious problem and there is some pollution in the Lome harbour arising from domestic sewage, oil spills and the phosphate industry.

ZAIRE

Owing to its very short coastline and the abundance of its other resources - minerals and agricultural products, Zaire does not have much interest in marine resources, with the exception of off-shore oil exploration and exploitation. There is, however, a Belgian-owned fishing fleet whose operations are centered mainly on the rich fisheries of Angola.

3. SUMMARY

Generally speaking, it would be true to say that the present level of marine science and technology development in practically all African coastal states is low, and far from being adequate in providing a sound and sustainable base for the rational exploitation of the marine resources of these countries. This statement is particularly true when consideration is taken of the full implication of the Third UN Conference on the Law of the Sea, especially as it relates to the sizes of the "exclusive economic zones" of coastal states, and the rights and obligations of these states in the management and exploitation of their marine resources and in safe-guarding international interests in the sea areas under their national jurisdiction. The situation, however, differs from country to country, some of these states being in a better position than others, both in regard to the actual state of marine science and technology development and to the awareness of the governments of these countries as to the crucial importance of marine science and technology in economic development generally, and in the development of marine resources in particular. In attempting to make some comparison between the different African coastal states as regards their present levels of marine science and technology development, these countries could be divided into three broad categories:

3.1 Countries in which there are already good infrastructures for marine science and technology development, in the way of appropriate training and research institutions and other facilities, where the governments are well aware of the importance and crucial role of marine science and technology in the development of their marine resources and where there are reasonable numbers of qualified and/or training national personnel:

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Ghana, Kenya, Madagascar, Morocco, Nigeria,
Sierra Leone, Sudan, Tanzania.

3.2 Countries in which there are moderate infrastructures for marine science and technology development, in the way of appropriate training and research institutions and other facilities, where the governments are fully aware of the importance and crucial role of marine science and technology in the development of their marine resources; and where there are some qualified and/or training national personnel :

Angola, Ethiopia, Guinea, Ivory Coast, Mauritius,
Mozambique, Senegal, Seychelles, Somalia.

3.3 Countries which for various reasons are at a low stage of marine science and technology development, where there are not as yet any substantial infrastructures for marine science and technology development, in the way of training and research institutions and other facilities, and where there are great shortages of trained manpower:

Benin, Cameroon, Cape Verde, Comoro, Congo,
Djibouti, Equatorial Guinea, Gabon, Gambia,
Guinea-Bissau, Liberia, Sao Tome and Principe,
Togo, Zaire.

IV. MAIN ISSUES AND OBSERVATIONS

The main problems facing African countries in their development programmes, including the development of marine science and technology, can be classified into four categories :

- Problems of manpower
- Problems of financial resources
- Problems of priorities
- Problems of care and maintenance of equipment

1. Problems of manpower

1.1 Many African countries are confronted with serious manpower problems which are proving to be great impediments in the economic development of these countries. In many cases, the most important cause underlying these problems, is the lack of adequate training facilities for the type of manpower required. Although the majority of African countries now have national universities and other institutions of higher learning of their own, most of these institutions are young, and many are still facing teething problems concerning adequate staffing, adequate equipment, sound curriculum development, etc. In many of these countries, therefore, the universities are still grappling with the fundamental issue of producing adequate manpower for the vital organs of the civil service requiring high-level personnel, such as public administration, school education, public health, agriculture, etc. In a considerable number of cases, even these vital sectors of the civil sercice are still far from being adequately staffed by qualified and experienced nationals. It is understandable, therefore, for the universities in these countries to be persuing for the present, narrow crash training programmes, with the short-term objective of producing high-level manpower, badly needed in key areas of the civil service, as soon as

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possible. In such cases, other needs for manpower development, important as they might be, e.g. the training of marine scientists and technologists, usually receive low priority considerations, and have to wait for the future.

1.2 The lack of adequate training facilities, however, is not the only cause of manpower shortages. There are countries in Africa today where enough manpower for the country's main needs is produced from institutions within the country, but where the conditions of service are so unattractive that a considerable portion of the trained manpower leaves the country annually in search of better paid employment elsewhere. This situation is serious as it tends to perpetuate the manpower problem; it is like trying to fill a water tank with a hole at the bottom! The problem of "brain drain" is well known in practically all developing countries and, in Africa, it deserves serious examination.

1.3 It is not always that trained manpower is used wisely and profitably, i.e. to the best advantage of the country. There are many examples in African countries where highly specialized professionals such as doctors, professors, scientists, etc. have been removed from their specialist jobs and given purely administrative jobs which could be done by non-specialists. In a country with a serious shortage of doctors, professors and scientists, such a gross misuse of manpower, which is hard to come by, is inexcusable. Sometimes however, it is the specialized professionals themselves who leave their specialist jobs and take up administrative jobs. The main reason for this is the self-defeating policy in many African countries whereby administrative jobs are better paid than scientific and other professional jobs. The weakness of this policy is not only that it attracts badly needed professional staff from their jobs to those of administration, but it also works against the development of scientific and other professional manpower by making scientific and professional jobs unattractive to university and other students. The irony of it is that training in science-based professions usually demands a higher mental aptitude and takes longer than training in other professions.

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2. Problems of financial resources

2.1 Most African countries are poor, especially in foreign exchange reserves. This is largely a result of the acute inflation of the last ten years, which is still continuing with increasing momentum, but also arises from the great dependence of African countries on imports from industrialized countries for some of their vital needs. The importation of all types of machinery, scientific equipment, books, boats, boat engines and sometimes even fishing gear, needs large sums of foreign exchange which many African countries today can ill afford.

2.2 But even with this acute shortage of foreign exchange reserves, it is common to find that the available facilities and manpower are not used fully and to the best advantage. There are several countries in Africa today where unnecessary duplication of effort and facilities is quite common, e.g. where two or more institutions may be engaged in very similar work. There is no compelling reason, for example for a small country with very limited resources to have two schools of fisheries teaching to the same level, one in marine and the other in freshwater fisheries. The best arrangement would have been to have one well staffed and well equipped school running, if necessary, two programmes. A well established university with departments or faculties of chemistry, biology, physics, mathematics, geology and engineering, should be able to mount courses in chemical, biological and physical oceanography and marine geology and engineering with little additional staff and equipment. There is also no reason why university teaching staff should not take part in the teaching of courses for middle-level personnel, e.g. fishery officers. The problems caused by underdevelopment and poverty call for the most economical use of available manpower and facilities.

3. Problems of priorities

3.1 In many African countries the problems of manpower and of financial resources are compounded by the problems of priorities. Available

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manpower and financial resources are sometimes not used to the best advantage because the priorities have not been determined realistically, taking the overall development strategy of the country into consideration. Quite often economic planning in some African countries is based on short-term objectives aimed at providing temporary, rather than long-term, solutions to existing problems. For example the employment of expatriate scientists for the training and research programmes of an institution can never be a reasonable and realistic substitute for the training of national scientists. It can only make sense therefore if it is regarded as an expedient means to an end, and not an end in itself.

3.2 In the early days of University education in many African countries training and research programmes were often determined on the basis of which programmes could be mounted with the minimum of capital input and with the manpower that was readily available. This approach has lead to the development in some universities of training and research programmes which have little relevance to the economic development problems of the countries concerned.

3.3 The realisation of the potential importance of marine resources in the economic development of coastal states, and consequently, of the importance of marine science and technology development as a basis for the rational exploitation of such resources, is a recent development, especially in developing countries. It is therefore understandable that only during the last few years have some African countries began to give emphasis to training and research in marine science and technology, and even today, this emphasis is still wanting in some African coastal states.

3.4 But even in institutions where there are well established training and research programmes, there is still, sometimes, need for a more realistic determination of priorities as reflected in the actual details and objectives of the programmes. For example a research project on the ecology and breeding behaviour of a locally-occurring species of lobster would in many cases, be more relevant to the

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development of the lobster fishery, including its possible mari-culture, than a research project on the endocrinology of such a species of lobster, even though the latter research might sound more sophisticated and more exciting to the research student than the former. This is not to say that pure or fundamental research should be divorced from African universities and research institutions. Indeed such research may sometimes lead to some important discoveries of universal application. The point being made is that the demands for rapid economic development in Africa today, dictate that, for the time being at any rate, the main effort should be directed towards applied, rather than towards pure, research.

4. Problems of care and maintenance of equipment

4.1 Although this may sound to be a relatively simple matter, it is one that in the African context today, cannot be over emphasised. The problem is that in many African training and research institutions the care and maintenance of scientific equipment is not regarded with the seriousness that it deserves, and consequently leaves much to be desired. Much too often very expensive scientific equipment falls into disuse due to the lack of minimal care and maintenance. Sometimes also expensive equipment is purchased without the necessary stock of spare parts as stipulated by the suppliers or manufacturers, with the consequence that minor break downs may result into long holdups of work and heavy expenditure in flying in the spare parts from overseas. The installation of an expensive piece of equipment, e.g. a research boat, a computer or an electron microscope should always be accompanied by the provision of competent technical service for its running, maintenance and repair and a stock of the necessary spare parts. Several African countries have in recent years run into serious problems with their expensively-acquired oceanographic research vessels, because of having overlooked these necessary precautions. It should be remembered that with certain types of equipment, e.g. a computer, it is sometimes cheaper and more convenient to hire than to buy.

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V. RECOMMENDATIONS

1. Action at the National Level

1.1 All African coastal states should establish or strengthen their national policies and their economic development plans in the light of the Third United Nations Conference on the Law of the Sea, and ensure that they accord high priority to the development of marine science and technology as a basis for the full and rational exploitation of their marine resources.

1.2 All African coastal states should establish or strengthen, as a matter of urgency, the necessary administrative and legal machinery to ensure the smooth and efficient execution of government policies and plans, concerning the development of marine science and technology as a basis for the full and rational exploitation of their marine resources.

1.3 All African coastal states should establish or strengthen the necessary infrastructures for the development of marine science and technology as a basis for the full and rational exploitation of their marine resources. Such infrastructures should consist of adequately equipped and appropriately staffed training and research institutions for the development of the skilled manpower and the scientific and technological knowledge needed in the development of their marine resources and in their effective and rational use of the sea as a reservoir of living and non-living resources and energy, and as a medium of communication. In most African coastal states the establishment or strengthening of university training and research programmes in marine sciences would be the most important strategy. Depending on circumstances the establishment or strengthening of such infrastructures could be achieved through a concerted national effort, a cooperative arrangement with neighbouring countries, bilateral, multilateral or international cooperation or through a combination of these alternatives.

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1.4 All African coastal states should establish or strengthen the necessary machinery and services for :

- The full and rational exploitation of their marine fishery resources;
- The exploration and exploitation of their marine mineral and energy resources;
- The development of maritime transport and communication systems;
- The protection and conservation of the marine and coastal environment and ecosystems;
- The development of coastal areas and the promotion of tourism.

2. Action at the Regional Level

The fact that most of the coastal states of Africa are poor and at a low level of scientific and technological development means that they cannot, acting individually, provide all the scientific and technological basis and infrastructural facilities necessary for the exploration and rational exploitation of their marine resources in the foreseeable future. If, however, they are to drive maximum benefit from these resources, it is necessary that they should acquire the capability to exploit them as soon as possible. This capability is also necessary if these countries are to be able to participate fully in the exploitation and sharing of the resources of the sea bed beyond the areas under national jurisdiction, i.e. the so-called "common heritage of mankind". There would also be the need to maintain good control and constant surveillance of the resources within the "exclusive economic zone", an undertaking too costly for any individual country. Under these circumstances, it would seem that the quickest and most practicable way of acquiring the necessary capability is through regional and subregional cooperation, an arrangement which has in recent years become a very important strategy in economic development planning, even in developed countries. This strategy holds a great hope for

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the future of Africa and deserves very thorough and serious consideration. It is therefore recommended that in order to enhance the development of marine science and technology in African coastal states, the following arrangements for regional cooperation should be made :

2.1 Training

1. Since the requirement for high level manpower in certain areas of marine sciences, e.g. physical oceanography, chemical oceanography, marine geology, aquaculture, etc. is not so great in terms of numbers needed by any one country at any one time, existing institutions (e.g. universities) in the region suited for teaching and research in these areas (e.g. because of their previous experience or the availability of qualified staff) should specialize as regional or sub-regional training centres by enlarging their facilities to enable the enrolment of students from other member states, wanting to study the subjects of their specializations. This arrangement would need to be worked out carefully so as to have as far as possible, an equitable distribution of such specialized training and research centres between the countries of the region. There should also be an equitable distribution of training places in the centres for students from different member countries.

2. The same arrangement as above should be made for the training of specialized technologists and technicans, as in ship and boat building, marine engineering, navigation, general seamanship, etc.

3. The on-board training of marine scientists and technologists should be carried out on a regional basis using collectively- operated research vessels (see below).

2.2 Research

1. Oceanographic research within the EEZ of member countries should be carried out on a regional or subregional cooperative basis using collectively-operated research vessels which are well equipped and well

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staffed for all types of oceanographic research and for the on-board training of marine scientists and technical staff. To start with one or two such vessels should be adequate for each of the subregions, i.e. Eastern and Western Africa. These research vessels should have well planned research programmes and work schedules and should conduct research systematically to cover the whole area of EEZ of the subregion. It might be necessary at the beginning to employ expatriates to the senior research and crew positions on the research vessels, but the aim should be to localise most of these positions as soon as possible without lowering standards. In order to foster efficiency, interest and satisfaction among the workers of the research vessels (both scientific and technical), it would be most important to offer them good and attractive terms of service, commensurate with the hard conditions of life at sea and comparable to those obtaining on other interational research vessels involved in international research programmes.

2. The coordination of research on a regional scale, the exchange and dissemination of research information and the storage of research data are important support activities in the development of science and technology. It is therefore recommended that at an early stage, a regional coordinating mechanism to facilitate the establishment of these activities should be set up.

2.3 Exploration and exploitation of the resources of the EEZ

1. The exploration and exploitation of the resources of the EEZs of African coastal states, would call for very considerable investment in the way of highly sophisticated equipment and highly specialized

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manpower. This is another area where the individual effort of a single country would in most cases be inadequate and ineffective, and where therefore regional cooperation would be the most obvious and appropriate strategy. As in the case of oceanographic research within the EEZ, member countries should form regional or subregional cooperative groupings and use collectively-operated vessels and equipment for the exploration and exploitation of their marine resources according to an agreed arrangement. Where possible and feasible, the collectively-operated research vessels (see above) should be used in the exploratory work.

2. In order to guard their resources against poaching by other countries, it would be necessary to maintain constant surveillance of their EEZs, and owing to the great size of the total area of the EEZs of member countries, an effective surveillance would require the use of aircraft . This is another area where regional cooperation would be most appropriate.

2.4 Others areas of possible regional cooperation

Several of the countries visited mentioned the need for regional cooperation in such undertakings as the establishment and running of large and modern ship building and dry dock service yards and the formation of joint shipping lines for commercial maritime transport. It was argued that such an approach would make it more economical to manage such services and would cut down exploitation from countries outside the region which at present provide most of these services to African countries. Such a move would also enhance the development of marine technology in Africa.

3. Action at the International Level

The most meaningful and lasting contribution that international cooperation can make to the economic development of developing countries generally is to assist in making these countries "stand on their own feet". Any form of assistance that does not have this objectives as the ultimate aim is superficial and cannot have a lasting effect; in some cases, it could even be damaging, causing more harm than good. A villager who helps his neighbour by giving him some seed to grow his own food would have given the neighbour more meaningful and lasting help than if he had offered to feed him and his family for a whole month. The latter sort of help would never make the neighbour independent in feeding himself and his family and could even turn him into a lifetime beggar. In many developing countries the experience gained from external, including international, assistance so far, has not always been encouraging. In some cases such assistance has tended to make the recipient country more dependent rather than more independent economically. To avoid this kind of negative effect it would seem necessary for the parties concerned to examine each form of international aid thoroughly to ensure that it has a good chance of producting the desired results. Thus, the sort of international cooperation that would be meaningful and appropriate in the development of marine science and technology in Africa would be one that would assist:

3.1 Individual African coastal states to establish sound infrastructures (including manpower) which would provide a strong base for the continued development of marine science and technology. The assistance given should depend on the particular circumstances of the country concerned and need not necessarily be of a material nature. In some cases, it might simply be in the form of informed advice as to how the country could organize its affairs to the best advantage and arrange its priorities realistically. In other cases, it might require some capital injection as "seed money" to enable the country to establish the necessary infrastructures such as training institutions or specialized training and research programmes in universities or to install special equipment for research and training.

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Such assistance should always have a time limit, based on a reasonable expectation that after a certain period, and under normal circumstances, the country in question should be able to continue on its own.

3.2 African countries collectively, on a regional or subregional basis, to establish regional or subregional infrastructures to facilitate a rapid development of marine science and technology in these countries. Such infrastructures would take the form of:

- regional or subregional training programmes for specialised marine science or technology, based in one or more of the existing institutions, but serving the needs of all member countries in the region or subregion, as the case may be;

- regional or subregional training and research facilities such as teaching and research equipment, research vessels etc. based in one or more of the existing institutions, but serving the needs of all member countries in the region or subregion, as the case may be.

3.3 African countries collectively, on a regional basis, to strengthen regional co-ordinating mechanisms to be responsible for such activities as the co-ordination of marine science research at the regional level, the dissemination and exchange of research information, the storage of research data and the fostering of cooperation between universities and research institutions of member States.

4. Immediate measures to be taken

African governments should support the establishment of a project on a network of training and research programmes in marine science and technology as a follow-up of the ECA/Unesco preparatory phase project; and to this end, they should request financial assistance from the United Nations Development Programme (UNDP).

ANNEX I*

3. GENERAL ACTIVITIES RELATED TO MARINE SCIENCE AND TECHNOLOGY DEVELOPMENT CARRIED OUT UNDER THE AUSPICES OF UNITED NATIONS ORGANIZATIONS AND OTHER AGENCIES

In the past, there have been several activities related to marine science and technology in most African coastal states and today there is hardly any such state without some form of that kind of activity going on. These activities have been and are being carried out under the auspices of the governments of the countries concerned and/or that of UN or other agencies. All these activities have contributed in one way or another to the development of marine science and technology in these countries and the achievements and experience gained are useful and must be taken into consideration in the working-out of this project, in order to obtain a realistic base and a proper perspective of the situation. Perhaps the most important short-coming of these activities is that most of them were conceived, planned and executed as separate projects with narrow and sometimes short-term objectives and with little or no co-ordination. Hardly any of them was conceived as an all-embracing comprehensive programme looking at the problem in its totality both as regards regional coverage and the inclusion of all aspects of marine sciences and technology. This was most probably due to the fact that most of these activities were planned and executed by single UN or other agencies acting on their own or at best in collaboration with a few bodies with similar interest in a comparatively narrow field.

This project has been planned with a view to overcoming these earlier shortcomings. Firstly, it is being executed by two UN agencies, both with very wide interdisciplinary interests, which have enlisted and invited the co-operation of other interested organizations; and, secondly, the project covers the whole of the African region (except the Mediterranean African countries) and is to consider all aspects of marine science and technology and their applications including fisheries, biological oceanography, chemical and physical oceanography, marine geology, food processing and preservation, economics and marketing, marine engineering, pollution, mariculture, coastal area development, training and research in marine science and technology, etc.

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* This annex is a reproduction of Chapter 3 of a working document discussed at a Working Group Meeting, convened by ECA and Unesco, in Addis Ababa, from 5 to 9 May, 1980.

Another point which might be of advantage is that most of the key personnel involved in the execution of this project are people of experience who are indigenous to the region and therefore with a good understanding of the region and its needs.

In the following pages, the main past and present activities related to marine science and technology in African coastal states are summarized first on a regional basis and then in individual countries. This information was collected from reports of various UN organizations and agencies such as ECA, FAO, IMCO, IOC, UNDP, UNEP, Unesco, WMO and other organizations and from relevant correspondence in Unesco and ECA files. No claim is being made about the completeness of this information. In a quick search of this kind, some omissions and oversights are almost inevitable, but as this report is only aimed to serve as a general introduction and guide, this discrepancy is not a serious one. Moreover, some of the information will undoubtedly be found to be out-of-date, especially in relation to ongoing activities. It is hoped and expected that this information will be greatly improved upon and updated by the field missions.

3.1 United Nations Educational, Scientific and Cultural Organization (Unesco)

Unesco's marine science activities can be divided into two main categories: those of the Division of Marine Sciences (OCE) and those of the Intergovernmental Oceanographic Commission (IOC). During the sixties, Unesco's marine science programme continued to increase in scope, until it was decided in 1972 to divide the functions of the Office of Oceanography into the 'Secretariat of the IOC' and the 'Division of Marine Sciences'. The roles of the two units are complementary. The separation has been salutary in that each Secretariat has concentrated on its own mission, giving enhanced effectiveness to its programme actions. Simplistically, the separation of function is that the Division of Marine Sciences helps Member States to attain high quality marine science programmes and infrastructure so that they can participate in IOC-organized and co-ordinated scientific programmes, while meeting their other marine science needs as well. The Division of Marine Sciences

is an integral part of Unesco, and the Intergovernmental Oceanographic Commission (IOC) is an autonomous body 'established within Unesco', the membership of which (more than 100 Member States) differs somewhat from Unesco. The scientific programme of IOC is determined by its members through the IOC Assembly.

The programme of Unesco's Division of Marine Sciences is designed to respond to marine science needs of all Unesco Member States and especially to those of the developing countries. Unesco develops co-operation between scientists (and their governments) at three levels - globally, regionally and nationally - with the object of strengthening marine science at all three levels, which is done closely with the Intergovernmental Oceanographic Commission and other components of the UN system. Many of the activities are executed directly in association with IOC or in response to specific IOC recommendations. Similarly, Unesco works closely with the Scientific Committee on Oceanic Research (SCOR) of the International Council of Scientific Unions (ICSU). Finally, the Division works with certain other United Nations bodies (such as ECA, FAO, IAEA, IMCO, UN, UNEP and WMO).

The programme of the Division of Marine Sciences includes the following major components:

(i) Dissemination of knowledge in the marine sciences, including publications and information services;

(ii) Development of the scientific basis for the understanding and management of the marine environment and resources, especially coastal;

(iii) Development of national and regional infrastructures in the marine sciences;

(iv) Training and education of specialists in the marine sciences.

Those are the activities of immediate concern to the development of marine science in African member states through Unesco's regular programme or through large development projects carried out by extrabudgetary funds.

During the last decade, and particularly during the last few years, the marine sciences in Unesco have undergone a major evolutionary step in their development, which can be seen in two aspects of Unesco activities: (i) the extrabudgetary marine science development programme has grown rapidly to significant size, and (ii) research guidelines concerning a suite of relevant marine ecosystems have been developed to provide substance to national infrastructure development.

Unesco is working with Member States and SCOR to develop scientific programmes that are sound scientifically and are also relevant to a nation's development needs. Such programmes will allow a scientist both to contribute responsibly to his country's development and also to contribute to the advancement of science at the same time. An example is the mangrove programme being developed in Asia in order to provide a scientific basis for the more applied aspects, such as fisheries investigations and management of the mangrove environment. This mangrove programme already serves as the nucleus for regional co-operation and related projects are being established by nations on other continents. The national efforts are buttressed by international workshops, working groups and research projects, partly within the context of Unesco's Man and Biosphere Programme.

The increasing interest of the Member States in the coastal zones led to an evolution in the policies and programmes of the Division of Marine Sciences of Unesco, where emphasis on coastal research is gradually building up to the establishment of a major regional project on integrated management research of coastal marine ecosystems (COMAR). The inter-regional interdisciplinary research and training programme for the management of the coastal ecosystem will consist of a network of activities and pilot projects in different regions, including all sub-tropical sub-regions concerned in Africa, Asia and Oceania, the Mediterranean, Red Sea and adjacent Gulfs of the Indian Ocean and in Latin America and the Caribbean. Most of the work done in Unesco within the framework of this project was on coastal lagoons, mangroves and coral reef study. Among the activities carried out in Africa were two meetings, one on coastal lagoons on the north coast of Africa, 'Coastal ecosystems of the southern Mediterranean: lagoons, deltas and salt marshes', which took place in Tunis, 25-27 September 1978, and the other on 'Coastal ecosystems, with special reference to the coastal lagoons and estuaries on the West coast of Africa', which was convened in Dakar, 11-15 June 1979.

As a step towards the preparation of the Dakar Workshop, two Unesco consultants visited the coastal states of West Africa in 1978 in order to assess the needs of the region in coastal research. The findings of the Workshop were taken into consideration when formulating the UNEP Action Plan for West Africa (Libreville, Gabon, 5-9 November 1979). A project on coastal lagoons of West Africa is under preparation by Unesco and UNEP.

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3.2 Intergovernmental Oceanographic Commission (IOC)

According to its Statutes (revised 1970), the Intergovernmental Oceanographic Commission is "to promote scientific investigations with a view to learning more about the nature and resources of the oceans through concerted actions of its members". Of the presently 103 State Members of the Commission, 11 are from the West African region (Cameroon, Congo, Gabon, Ghana, Ivory Coast, Mauritania, Morocco, Nigeria, Senegal, Sierra Leone and Togo) and 6 from the East African region (Kenya, Madagascar, Mauritius, Seychelles, Somalia and Tanzania).

At the eleventh session of its Assembly (Paris, October/November 1979), the IOC established a Programme Group for Scientific Investigations in the North and Central Western Indian Ocean (IOC resolution XI-9). At the same session, the IOC Assembly decided in resolution XI-18 to arrange, in collaboration with the Division of Marine Sciences of Unesco, a Workshop on Marine Science Co-operation in order to provide the basis for a Marine Science Association for countries of the Atlantic coast of Africa. The proposed Workshop is scheduled for 1981.

The Commission's operational activities may be said to fall into the following categories: (i) Ocean Science, i.e., marine scientific research, (ii) Ocean Services, including transfer of knowledge and technology, and (iii) Training Education and Mutual Assistance in the marine sciences (TEMA).

Of particular interest for African countries are the Commission's activities in the field of ocean services, which include the promotion of exchange and archiving of oceanographic data from both national oceanographic efforts and from all marine programmes sponsored or supported by UN Specialized Agencies, and also the co-operation, with other UN bodies, in the development of information service related to marine science, including promotion and provision of guidelines for the development of regional co-operative networks for exchange of information.

3.3 Food and Agriculture Organization (FAO) of the United Nations

The Food and Agriculture Organization (FAO) of the United Nations has carried out and is carrying out several activities in many African coastal states. These activities have been mainly aimed at increasing and improving the capability of these countries in making fuller and more rational use of their fishery resources. These activities can be said in general terms to have been concerned with the development and improvement of various aspects of fishery technology - training of fishermen and fishery extension officers, fishing gear technology, fishing methods, fish surveys, boat building and repairs, navigation, marine engineering, fish processing and preservation, fish marketing, aquaculture (including mariculture), etc. FAO has also carried out, in co-operation with other UN organizations or agencies, activities related to the improvement of fisheries in African coastal states, e.g. the monitoring and control of marine pollution.

Actual on-going activities are too many to elaborate on here and it is hoped that the details of these activities in the regions and in individual countries will be obtained during the visits of the country missions through the co-operation of FAO country representatives and the relevant government authorities.

Some specific FAO activities in African coastal states

The United Nations Food and Agricultural Organization (FAO) has carried out and is carrying out several activities in many African coastal states whose main aim is the overall development and improvement of the fishery industry. These activities have taken various forms :

1. Training : The training of fishery personnel at all levels and in all aspects of the fishery industry has been and is one of the most important activities of FAO in African coastal states. The areas covered in these activities include : fishery biology and ecology, fishery statistics and stock assessment, exploratory fishing surveys, fishery management, navigation, marine engineering, pollution assessment and monitoring etc. Some of this training is carried out on a regular basis in established institutions, e.g. universities, and some takes the form of seminars, workshops or ad-hoc training courses.

2. Boat building : FAO has assisted several African coastal states to establish or improve their boat building technology in relation to the development of their fishery industry using the most appropriate and most easily available boat building materials, including timber, fibre glass, ferrocement, aluminium and steel. There is a great need for the establishment of technical schools for modern boat building in many African countries.

3. Fish technology : The development of appropriate fishing technology, including the right fishing gear and fishing vessels is still very much underdeveloped in many African countries. This shortcoming is realised and many of these countries have included the development of fishing technology as a priority among their regular FAO-assisted programmes.

4. Fish processing and marketing : One of the problems in the development of the fishery industry in African coastal states is the lack of efficient fish processing and marketing systems. FAO is assisting several of these countries in finding an appropriate solution to this problem through research, seminars and cooperative programmes. FAO is also, in collaboration with WHO, working out more efficient, hygienically-sound and safe methods of processing and preserving fish.

Some of the FAO-assisted activities related to fishery resources development in African coastal states are summarized in the following table :

Country	FAO-assisted activity
Madagascar	On the job training of fishermen, survey for sardines, reactivation of the CNRO at Nosy Be, training of marine biologists and oceanographers.
Mozambique	Training of fishermen in navigation, stock assessment, age reading and survey techniques, provision of consultants.
United Republic of Tanzania (mainland)	Advisory service to the Tanzania Fishing Corporation (TAFICO).
United Republic of Tanzania (Zanzibar)	Training of fishermen, fish processing.
Somalia	Training of fishermen, fish processing.
Kenya	Training of fishermen, fishing surveys, mariculture.
Sudan	Exploratory fishing, training of fishermen, boat building.

Country	FAO-assisted activity
Seychelles	Advice on management of fishery stocks and fishery development.
Sierra Leone	Marine engineering, fish technology.
Ghana	Fish technology.
Nigeria	Shallow water fisheries development.
Senegal	Improvement of artisanal fishery, fish marketing and processing.
Togo	Fish technology.
Morocco	Improved method of handling small pelagic fish.

5. Legal Advisory Service : FAO provides legal advisory service to African coastal states on :

(a) revision of national legislation in relation to the 200 mile limit "exclusive economic zone",

(b) control of foreign fishing within the 200 mile "exclusive economic zone",

(c) legislation on fishery resources management and exploitation,

(d) assessment and enforcement of control measures,

(e) joint measures and licensing agreements,

(f) bilateral agreements,

(g) new forms of institutional structures, e.g., fishing corporations,

(h) technical assistance, etc.

3.4 World Meteorological Organization (WMO)

Important activities of the WMO which are related to marine science and technology development in African coastal states include:

1. Global weather experiments

These are experiments using floating buoys placed in different parts of the world oceans to collect scientific data (e.g., temperature and currents) and transmit it to satellites from which it is in turn

transmitted to land-based data collecting stations. This has been one of WMO's most successful activities. Although the main experiment is now over, about 133 buoys at different parts of the world oceans are still transmitting information.

2. Marine meteorology experiments over the sea

Experiments are being designed to observe the upper mixed layers of the atmosphere over the oceans.

3. Long-term world climate programmes

Experiments designed to enable long-term forecasting of the climate of the world.

3.5 World Health Organization (WHO)

The WHO is interested in problems of marine pollution as they relate to: sea food, tourism, fishing and environmental health.

The Organization has been participating in activities in several African coastal states related to:

- sanitary engineering works
- disposal of waste (e.g., sewage) into the sea
- provision of clean and safe water supply
- assessment and prevention of pollution
- water pollution monitoring
- food pollution monitoring
- health criteria, etc.

ANNEX II *

4. REGIONAL ACTIVITIES RELATED TO MARINE SCIENCE AND TECHNOLOGY IN AFRICA

4.1 The East African Region

In the context of this Project, the East African region coastal states are: Sudan, Djibouti, Ethiopia, Somalia, Kenya, Tanzania, Mozambique, and the Indian Ocean islands - Madagascar, the Seychelles, the Comoro Islands, Mauritius and La Réunion (France).

Important activities related to marine science and technology which were organized on a regional basis include:

4.1.1 International Indian Ocean Expedition (IIOE), 1959-65

When the IOC was established, the IIOE was already under preparation by the International Council of Scientific Unions (ICSU) and the Scientific Committee on Oceanic Research (SCOR). It was conceived as an exploratory programme to allow individual scientists to carry out their own specialized research programme of interest. When the IOC was formed in 1960, it assumed the role of co-ordinating agency, but SCOR continued to play the scientific advisory role. Under the co-ordination of IOC, the following organizational measures were instituted in the programme:

(i) Establishment of an International Co-ordination Group for the IIOE composed of national co-ordinators for the programme and dealing with data exchange, preparation of atlases and processing analysis and publication of results.

(ii) Arrangement of special customs facilities and courtesies for ship and personnel of the expedition.

(iii) Publication of an IIOE Information Paper Series.

(iv) Establishment of International Centres, e.g., the Indian Ocean Biological Centre (responsible for sorting zooplankton samples) at Ernakulam, South India, supported by Unesco and India; and the International Meteorological Centre at Bombay, supported by UNDP and WMO.

(v) Designation of a Fisheries Subject Leader for co-ordination and evaluation of the fisheries aspect of the programme.

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* This annex is a reproduction of Chapter 4 of a working document discussed at a Working Group Meeting, convened by ECA and Unesco, in Addis Ababa, from 5 to 9 May, 1980.

(vi) Arrangement for international standardization and inter-calibration tests.

(vii) Agreement upon reference stations at 15 locations throughout the Indian Ocean for intercomparison of methods and for information on seasonal changes.

The IIOE programme provided a stimulus in marine science education to developing countries as a substantial number of such countries participated in the expedition, became interested in marine science, obtained technical assistance and developed national organizations to deal with international oceanographic co-operation.

The two World Data Centres for Oceanography in Washington, D.C. and Moscow were charged with the responsibility of collecting the data obtained during this international co-operative programme and Unesco accepted the responsibility for the publication of the Collected Reprints of the IIOE, which were issued in eight volumes, together with an index.

The observational results of this co-operative investigation have been summarized and published in the form of five comprehensive atlases:

- IIOE Meteorological Atlas, Vol. 1, Surface Climate of 1963 and 1964, edited by C.S. Ramage, F.R. Miller and Chairman Jeffries, Washington D.C. (1972).

- Vol. 2, Upper Air, edited by C.S. Ramage and C.V.R. Raman, Washington D.C. (1972).

- IIOE Oceanographic Atlas edited by C. Wyrtki, Washington D.C. (1971).

- IIOE Phytoplankton Production Atlas, edited by J. Krey and B. Babenerd, Kiel (1976).

- IIOE Geological-Geophysical Atlas, edited by G.B. Udintsev, Moscow (1975).

The more important findings of this expedition include:

(a) The surface current regime in the Northern Indian Ocean is influenced by the seasonally changing monsoon winds, which blow strongly from the south-west in summer and gently from the north-east in winter.

The ocean does not react on the summer monsoon from the south-west by establishing a simple current gyre covering the main part of the northern Indian Ocean, but by establishing a gyre which appears to contain many

relatively strong cyclonic and anticyclonic eddies, with dimensions ranging from 100-1000 km, capable of changing dramatically within two months or less. Numerical models were a great help in the understanding of these current features which certainly affect chemical and biological processes in the ocean.

(b) The biological results indicated that not even 0.1% of the primary production of the Indian Ocean was harvested by man's fishing at that time and that up to a tenfold increase in the fishing yield might be reached with present conventional means, which could be further augmented by new technology. IIOE provided the oceanographic basis for planning a rational exploitation of living resources. From oceanographic considerations the most promising areas for development appeared to be Somalia, South Arabia, Malabar, Madagascar and Java.

(c) In the geological-geophysical field the atlas mentioned above gives ample information including relief maps of the ocean floor; charts showing the depth of the sedimentary layer and of bedrock outcrops, the deep structure of the earth's crust and the upper mantle, as revealed by seismic investigation; magnetic and gravitational anomalies and many other relevant observations which are of paramount significance for current knowledge and further development of the concepts of plate tectonics and sea-floor spreading, all of which add to our understanding of the history of the oceans. Among the discoveries was that of a 'hot spot' of anomalously hot, highly saline water trapped in a deep basin in the Red Sea. It was suggested that it would be worth exploiting the locally rich metaliferous sediments found with this hot brine spring. The Saudi-Sudanese Red Sea Joint Commission for the development of the Red Sea non-living resources was created in 1975. The Commission carried out the first systematic research work for the evaluation and exploitation of the Red Sea deposits in 1976-77.

4.1.2 Co-operative Investigations in the North Central Western Indian Ocean (CINCWIO)

These activities consisted of a Workshop (Nairobi, Kenya, March-April 1976), a Joint Mission by IOC/FAO/SIDA/SAREC to Somalia, Kenya and

The Institute was established by the University of Dar-es-Salaam in 1974 as an integral part of the University and is located on the island of Zanzibar. Its mission includes training and research in all aspects of marine sciences. Recently, the Institute was allocated enough land on a suitable site on the island for any future expansion and development.

4.2 The West African Region

In the context of this Project, the countries considered to belong to the West African Regional Coastal States are: Angola, Benin, Cape Verde, Cameroon, Congo, Equatorial Guinea, Gabon, the Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mauritania, Morocco, Namibia, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, Togo and Zaire.

Among the most important activities related to marine science and technology organized on a regional basis in West Africa are:

4.2.1 International Co-operative Investigations of the Tropical Atlantic (ICITA), 1963-64

This was a development and an internationalization of an earlier locally conceived programme - the Guinean Year - which was drawn up on the request of the Commission for Technical Co-operation in Africa (CCTA) and the Scientific Council for Africa (CSA) and approved by them in 1961. The project had the following priorities:

(a) A trawling survey of the demersal resources from Mauritania to Angola;
(b) A campaign to study the meteorology and physical, chemical and biological oceanography of the Gulf of Guinea;
(c) An experimental fishing campaign for sardine-like fishes, and
(d) An experimental fishing campaign for tunas.

Later, the demersal fishery survey was financed by the US Agency for International Development and the US itself undertook the tuna survey and the oceanographic investigation survey of the Gulf of Guinea. In 1962, the IOC adopted the latter project as an official IOC programme and established an International Co-ordination Group for ICITA. The programme them comprised a multi-ship survey of the tropical Atlantic Ocean between latitudes 18°N and 18°S from the West Coast of Africa to South America. The field phase was subdivided into three periods during 1963/64, called Equalant I, II and III, in which up to fourteen research vessels from Argentina, Brazil, Rep. of Congo, German Dem. Rep., Rep. of Ivory Coast, Nigeria, Spain, USA and the USSR participated. The scientific

Tanzania (3-24 September 1977) and an ad hoc Intergovernmental Meeting of the Countries of the CINCWIO Region [*] (Nairobi, Kenya, 5-9 March 1979).

All these activities were aimed at finding out the state of marine science development (including research and training, fishery development, human and material resources, infrastructure facilities, etc.) in the Eastern African countries, the need for assistance in improving the situation and the scope for regional and international co-operation. These activities culminated in the Intergovernmental Meeting, which approved the recommendations that were made in all these areas.

References

Report of the Scientific Workshop to initiate planning for a Co-operative Investigation in the North and Central Western Indian Ocean (CINCWIO), Nairobi, Kenya, 25 March - 2 April 1976. IOC Workshop Report No. 7, Unesco, Paris.

Meeting of the Countries of the CINCWIO Region, Unesco Regional Office for Science and Technology for Africa, Nairobi, 5-9 March 1979. Ref. IOC/CINCWIO ad hoc 3.

4.1.3 International Conference on Marine Resources Development in Eastern Africa (University of Dar-es-Salaam, Tanzania, April 1974)

This Conference was organized by the University of Dar-es-Salaam in collaboration with the University of Rhode Island. The main objective of the conference was to explore ways and means whereby the Eastern African countries could develop their marine science research capability through the training of local scientists in all aspects of marine science with a view to enabling these countries to exploit their marine resources more effectively and more rationally. The most important recommendation that was made was that an Institute of Marine Sciences should be established at the University of Dar-es-Salaam which would have a regional and an international outlook in research and training.

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[*] The boundaries of the 'CINCWIO Region' were originally defined by the CINCWIO Steering Committee (meeting in Zanzibar, October 1975) as the area encompassed by the East African coastline out to 60°E, and from latitude 13°N to latitude 15°S.
The ad hoc Intergovernmental Meeting of the countries of the CINCWIO region (Nairobi, March 1979), at the suggestion of the delegate from the Democratic Republic of Madagascar, decided to recommend an extension of the boundary southward to the latitude of the southern border of Mozambique and thus to include Madagascar, Mozambique, Mauritius and La Réunion.

results were presented at a symposium on the oceanography and fisheries resources of the tropical Atlantic, organized at Abidjan, Ivory Coast, October 1966, through the joint efforts of Unesco, FAO and OAU. The oceanographic data was published in a two-volume atlas. Later, during the International Decade of Ocean Exploration (1971-80), an exploration of the eastern Atlantic continental margin was carried out and revealed the presence of large basins with a sediment thickness of more than 4 km in a belt associated with the Congo and the Niger rivers. These sediments contain many structural features suitable for gas and oil.

References

K.O. Emery: Review of the results from the Eastern Atlantic Continental Margin Programme of the International Decade of Ocean Exploration. In: IOC Technical Series No. 11 (Unesco, Paris, 1975), pp. 52-62.

ICITA Oceanographic Atlas: Vol. I Physical Oceanography, (Unesco, Paris, 1973), 289 pp; Vol. II Chemical and Biological Oceanography (Unesco, Paris, 1976), 358 pp.

Proceedings of the symposium on the oceanography and fisheries resources of the tropical Atlantic. Results of ICITA and of the GTS. Held at Abidjan, Ivory Coast, 20-28 October 1966. (Unesco, Paris, 1969), 430 pp.

H.U. Roll: International Co-operative Investigations of the Tropical Atlantic (ICITA), 1963-64. In: IOC Technical Series No. 20 (Unesco, Paris, 1979), pp. 18-19.

F. Williams: Fishery Resources of the Tropical Eastern-Central Atlantic Ocean: Exploration, Utilization and Management since 1960. In: IOC Technical Series No. 11 (Unesco, Paris, 1975), pp. 33-49.

4.2.2 Co-operative Investigations of the Northern Part of the Eastern Central Atlantic (CINECA), 1968-74 - ICES/FAO/IOC

In the 1960s, the International Council for the Exploration of the Sea (ICES) has been approached for affiliation of West African countries and the Council was interested in strengthening its activities in the southern part of its area through co-operative studies. The rich living resources of the up-welling region brought about an old tradition of Moroccan, Senegalese, Spanish, Portuguese and French fisheries in the Canary Current region, which in the past decades had been fished by many nations from outside the region. It was FAO which pointed out the need for detailed exploration of the living resources of the region in order to strengthen local fisheries.

The proposal for a Co-operative Investigation of the Northern Part of the Eastern Central Atlantic (CINECA) envisaged a multi-ship survey of the whole area between 10°N and the Straits of Gibraltar, extending up to 25°W into the Atlantic. If possible, aircraft and satellite observations should complement the data base of traditional oceanographic section studies in order to achieve a thorough description of the hydrography and of the biological productivity of the area during two different seasons.

However, the transfer of physical oceanographic results and primary production data into prediction of fish catches proved more difficult than expected.

A terminal symposium on CINECA results was held at Las Palmas, Canary Islands, Spain (April 1978), the report of which recommended future scientific activities to improve the understanding of the complicated mechanisms of inter-actions in oceanic upwelling ecosystems.

References

ICES 1978: Report of the CINECA Symposium on the Canary Current: Upwelling and Living Resources, Las Palmas, Gran Canaria, 11-14 April 1978 (Copenhagen, ICES, 1978), 12 pages, 4 Annexes.

4.2.3 West African Action Plan (WAAP) and related activities

Although UNEP's activities are concerned with problems connected with the human environment generally, its Governing Council has designated the 'Oceans' as a priority area in which UNEP will focus efforts to fulfil its catalytic role. For the convenience of carrying out its major functions in a systematic and integrated way, it has adopted a regional approach - UNEP Regional Seas Programme - in dealing with the main problem areas of the world oceans. By adopting this approach, UNEP feels that it will be able to focus effort on specific problems of high priority to the States of a given region thereby more readily responding to the needs of the governments and helping to mobilize more fully their own national resources. It is hoped that undertaking activities of common interest to coastal states on a regional basis would, in due course, provide the basis for dealing effectively with the environmental problems of the ocean as a whole.

A UNEP regional programme in this concept consists of a carefully worked out 'Action Plan' which is formally adopted by the governments before the programme is carried out.

At present, there are eight regional sea areas in which action plans are operating or are under development. Among these are: the Mediterranean (adopted in 1975), the Red Sea (adopted in 1976), and the West African region (under development, adoption expected in 1981), which are of interest to African countries.

UNEP has, in the past few years, sponsored or co-sponsored several activities aimed at studying existing or potential marine pollution [1] problems in the West African coast, especially the Gulf of Guinea, and at finding or suggesting solutions to such problems.

Because of these studies, there is much more information and much more awareness and concern about the problems of marine pollution in the West African region than in Eastern Africa, where hardly any comprehensive studies on the situation have so far been carried out. Among the activities carried out in the region are:

(i) UNEP Exploratory Mission on Marine Pollution Problems of the West African Coastal Countries of the Gulf of Guinea (25 April - 2 July 1976); [2]

(ii) IMCO/UNEP Workshop on Prevention, Abatement and Combating of Pollution from Ships in the Gulf of Guinea and Adjacent Coastal Areas (Douala, 12-17 December 1977);

(iii) IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas (Abidjan, 2-9 May 1978);

(iv) Unesco Workshop on Coastal Ecosystems with Special Reference to Coastal Lagoons and Estuaries on the West Coast of Africa (Dakar, Senegal, June 1979);

(v) UNEP Meeting of Experts to Review the Draft Action Plan for the West African Region (Libreville, Gabon, November 1979).

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[1] Marine pollution is defined as:
"Introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries), resulting in such deleterious effects as harm to living resources, hazard to human health, hindrance to marine activities, including fishing, impairing the quality for use of sea water and reduction of amenities".
(Joint Group of Experts on the Scientific Aspects of Marine Pollution /GESAMP/, 1972).

[2] M.P. Angot and D. Kaniaru. Report of Exploratory Mission on Marine Pollution Problems of the West African Coastal Countries of the Gulf of Guinea, 25 April - 2 July 1976. (UNEP, 1976).

The West African Regional Plan was discussed and approved by experts from member countries of the West African Region and from UNDP, FAO, Unesco, IOC, WHO and IMCO at a meeting organized by UNEP and hosted by the Gabonese Republic, held in Libreville, Gabon, 5-9 November 1979. It is hoped that the 'Action Plan' will be adopted by an intergovernmental meeting in January 1981.

For the purposes of the Action Plan, the region is defined as including the marine environment and coastal area of the following States: Angola, Benin, Cameroon, Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Namibia, Sao Tome and Principe, Senegal, Sierra Leone, Togo, Zaire.

It is important to note that there is, at present, no action plan contemplated for the Eastern African region.

References

Report of the Meeting of Experts to review the draft Action Plan for the West African Region, Libreville, 5-9 November 1979. (UNEP/WG.27/4), 6 pages and 5 annexes.

4.2.4 Other regional activities

(i) GARP Atlantic Tropical Experiment (GATE), 1974

Sponsored by WMO and ICSU, GATE aimed at studying the convection in cloud clusters and its interaction with large-scale atmospheric circulation over the tropical Atlantic. The oceanographic part of the programme was aimed at investigating the response of the tropical Atlantic to atmospheric forcing on various scales and at determining heat, water and momentum fluxes through the air-sea interface. About forty research vessels participated; in addition, a great number of buoys and aircraft were deployed in summer and autumn 1974.

But the oceanographic part of the programme does not seem to have allowed for active participation by the West African countries. Several workshops and a terminal symposium (Kiel, FRG, 1978) were held, and an oceanographic atlas entitled 'Physical Oceanography of the Tropical Atlantic during GATE' will be published later in 1980.

References

Final Report of the SCOR Working Group 43 on Oceanography related to the GARP Atlantic Tropical Experiment (GATE). (WMO/ICSU GARP Activities Office, Geneva, 1979). 49 pp.

(ii) Global Weather Experiment (FGGE)

FGGE, culminating during the two Special Observing Periods, January/February and May/June 1979, included two sub-programmes which were of special significance to Africa and Asia: the West African Monsoon Experiment (WAMEX), and the Asian Summer Monsoon Experiment (MONEX). They aimed at observing, describing, understanding and predicting the two monsoons' circulations in the respective areas.

Nearly all West African countries participated actively in WAMEX, but only Kenya and Somalia, and probably the Seychelles, participated in the oceanographic programme of MONEX (INDEX).

(iii) Proposed Joint Study of an Oceanographic Area designated 'The Atlantic-Iberian-African (AIA) Region'

The proposal (submitted by the delegation of Portugal) has been considered by the IOC Assembly, but the programme has yet to be developed. Countries of the region likely to participate include: Portugal, Spain, Senegal, Mauritania, Cape Verde Islands, and Morocco.

(iv) Proposed Pilot Ocean Monitoring Study (POMS) in the North Atlantic during the 1980s.

New observing techniques and new theoretical approaches renewed interest in the large-scale circulation of the ocean, as opposed to the nearly exclusive concentration on process studies which marked oceanography in recent years.

Co-sponsored by the Intergovernmental Oceanographic Commission, the Joint Organizing Committee for GARP and the ICSU Scientific Committee on Oceanographic Research organized a Pilot Ocean Monitoring Study Planning Meeting (Miami, U.S.A., 1-5 October 1979) to discuss the oceanographic aspects of the World Climate Research Programme in general and the prospectus for ocean monitoring in particular.

A number of oceanographic institutes in Canada, France, Federal Republic of Germany, United Kingdom, USA and the USSR are planning major experimental programmes relevant to POMS in the North Atlantic Ocean between 20° and 50°N during the early 1980s. This project is sponsored by ICES, IOC, WMO and ICSU, in conjunction with the development of the World Climate Research Programme (WCRP).

The research programmes are quite varied but most relate to the North Atlantic gyre and its associated currents to the North and South. Some of the programmes are to address the problem of studying the meridional heat transport associated with the North Atlantic circulation and related air-sea interaction processes.

References

Report of the Pilot Ocean Monitoring Study Planning Meeting, Miami, USA, 1-5 October 1979 (WMO/ICSU GARP Activities Office, Geneva, 1979), 43 pp., 8 Appendices.

ANNEX III

INSTITUTIONS VISITED BY THE COUNTRY MISSIONS

Eastern Africa

COMOROS

Ministère de la Production (Ministry of Production);

Département du Développement Industriel et de l'Artisanat
(Department of Industrial Development and Arts and Crafts);

Département du Transport et du Tourisme
(Department of Transport and Tourism);

Département du Service de la Peche Maritime
(Department of Maritime services and fisheries);

Département du Service Météorologique
(Department of Meterological Services);

Ministère de l'Equipement et de l'Environnement
(Ministry of Planning and the Environment);

Département de l'Environnement, de l'Architecture et de l'Urbanisme
(Department of Environment, Architecture and Town-Planning);

Bureau du PNUD (UNDP Office).

DJIBOUTI

Présidence de la République
(Office of the President of the Republic);

Institut Supérieur d'Etudes et de Recherches
Scientifiques et Techniques (I.S.E.R.S.T.)
(Higher Institute of Scientific and Technical Education
and Research) ;

Port de Commerce de Djibouti
(Commercial Port of Djibouti);

Ministère des Affaires Etangères
(Ministry of Foreign Affairs).

ETHIOPIA

National Research Council,
Ethiopian Science and Technology Commission;

Faculty of Science,
Addis Ababa University;

Ministry of Mines, Energy and
Water Resources;

Marine Transport and Harbours Authority;

Ethiopian Geological Survey;

Analytical Laboratory,
Ethiopian Geological Survey;

Animal and Fisheries Development Corporation,
Ministry of State Farms;

Ethiopian Shipping Corporation;

Fisheries Resources Development Department,
Ministry of Agriculture;

Wildlife Conservation and Development Organization,
Forestry and Wildlife Authority,
Ministry of Agriculture;

Hotels and Tourism Commission.

KENYA

UNESCO Office;

FAO/UNDP Office;

Kenya Marine and Fisheries Research Institute;

University of Nairobi;

Kenya Ports Authority;

National Council for Science and Technology;

Department of Wildlife Conservation and Management;

Department of Fisheries;

National Museum;

Fisheries Department Mombasa;

Kenya Fishing Industries Ltd.;

Malindi Fisheries Station;

Coastal Aquaculture Development Project (FAO).

MADAGASCAR

Centre National de Recherches Océanographiques (CNRO) - Nosy-Be
(National Oceanographic Research Centre Nosy-Be);

Société de Pecheries de Nosy-Be (PNB)
(Fisheries Society of Nosy-Be);

Société d'Etudes de Constructions de Réparations et d'Entretiens Navals
(SECREN) Diégo-Suarez
(Society for the Design and Construction of Naval Vessels,Diego-Suarez);

Compagnie Salinière de Madagascar - Diégo-Suarez
(Madagascar Salt Company);

Project d'Elevage de "Milkfish" (Chanos chanos) - Diégo-Surez
(The "Milkfish" Mariculture Project);

Port Autonome de Tamatave
(Port Authority, Tamatave);

Centre Universitaire Régional de Tuléar et Station Marine
(Regional University Centre and Marine Station, Tuléar);

Ecole Nationale d'Enseignement Maritime (ENEM) - Majunga
(National Maritime Training School - Majunga);

Fanjonoana Malagasy Koweitianina (FAMAKO) - Majunga
(Malagasy/Koweitianina Fishing Co.);

Port de Majunga
(Port of Majunga);

Ministère du Développement Rural et de la Réforme Agraire
(Ministry of Rural Development and Agrarian Reform);

Ministère des Transports, du Ravitaillement et du Tourisme
(Ministry of Transport, and Promotion of Tourism);

Institut National de Géodésie et de Cartographie
(National Institute of Géodésie and Cartography);

Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
(Ministry of Higher Training and Scientific Research);

Bureau du PNUD (UNDP Office).

MAURITIUS

Ministère des Peches
(Ministry of Fisheries);

Université de Maurice
(University of Mauritius);

Musée d'Histoire Naturelle - Institut de Maurice
(Natural History Museum, Institute of Mauritius)

Ministère de l'Economie, du Plan et du Développement
(Ministry of Economic Affairs, Planning and Development);

Ministère de l'Agriculture
(Ministry of Agriculture);

Ministère de l'Education
(Ministry of Education);

Commission Nationale pour l'UNESCO
(National Commission for UNESCO);

MOZAMBIQUE

National Directorate of Fisheries Development;

Servico de Investigacoes Pesqueiras(SIP)
(Fishery Research Service);

Faculty of Biology, Eduardo Mondlane University;

Fisheries Training Centre, Matola;

Experimental Fish Processing Plant, Maputo;

Marine Biological Station, Inhaca Island;

Canning Factory, Maputo;

National Directorate of Maritime Transport;

SEYCHELLES

Ministry of Planning and Development;

Ministry of Transport and Tourism;

Port Authority;

Ministry of Education and Information;

Ministry of Agriculture and Land Use;

Department of Fisheries;

St. Anne Marine National Park.

SOMALIA

UNDP Office;
Ministry of Fisheries;
National Committee for the Marine Environment;
Ministry of Transport and Ports;
Ministry of National Planning;
Ministry of Higher Education and Culture;
National Commission for UNESCO;
FAO Fisheries Project;
UNESCO Technical Education and Vocational Training Project;

SUDAN

UNDP Office;
National Council for Research;
Institute of Oceanography;
Fisheries Department;
Fisheries Research Section;
Fisheries Research Centre, Khartoum;
Fisheries Research Centre, Red Sea Section;
University of Khartoum;

SUDAN (Cont'd)

Port Sudan Regional Administration;
British-Assisted Fisheries Project, Port Sudan;
FAO - Red Sea Fisheries Project;
Red Sea Regional Geological Department.

TANZANIA

UNDP Office ;
National Commission for UNESCO;
Fisheries Department, Ministry of Natural Resources;
University of Dar es Salaam;
Kunduchi Fishery Research and Training Centre;
Kunduchi Marine Biological Laboratory, University of Dar es Salaam;
The Mbegani Fisheries Development Centre;
National Scientific Research Council;
Harbours Authority;
University of Dar es Salaam, Institute of Marine Sciences, Zanzibar;
Zanzibar Fishing Corporation;
Zanzibar Fisheries Department;

West, Central and Southern Africa

ANGOLA

Department of International Organization;
Department of Hydrology, Meteorological Service;
University of Angola;
UNDP Office;
SIDA Office;

BENIN

Ministère du Plan de la Statistique et de l'Analyse Economique (MPSAE)
(Ministry of Planning, Statistics and Economic Analysis);

Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
(Ministry of Higher Education and Scientific Research)

Ministère de l'Intérieur
(Ministry of Interior);

Université Nationale du Benin
(National University of Benin);

Ministère des Transports et des Communications
(Ministry of Transport and Communication);

Administration Maritime, Direction de la Marine Marchande.
(Directorate of Merchant Marine);

Ministère des Affaires Etrangères et de la Coopération
(Ministry of Foreign Affairs and Cooperation);

Ministère des Finances
(Ministry of Finance);

Ministère des Fermes d'Etat de l'Elevage et de la Peche (MFEEP)
Ministry of Agriculture and Fisheries);

Collège Polytechnique Universitaire et Faculté des Sciences
(Polytechnical College, University of Benin, Faculty of Sciences);

Port Autonome
(Port Authority);

Bureau du PNUD
(UNDP Office);

CAMEROON

Adjoint de la Marine Marchande du Cameroun, Douala
(Cameroon Merchant Navy, Douala);

Office National des Ports du Cameroun (ONPC) Douala
National Ports Office.

Peche Artisanale Maritime, Yacunde
(Artisanal Marine Fisheries);

Université de Yaoundé
(University of Yaounde);

CAMEROON (Cont'd.)

Comité National MAB
Man and the Biosphere (MAB) National Committee);

Bureau du UNESCO, Yaoundé
(UNESCO Office, Yaounde);

CAPE VERDE

Office of the Prime Minister;

Department of Customs;

Department of Fisheries;

Ministry of Transport and Communication;

CONGO

Direction de l'environnement du Ministère des Travaux Publics et de la Construction, Chargé de l'Environnement
(Directorate of the Environment, Ministry of Civil Engineering and Public Works Construction);

Centre ORSTOM de Recherches Océanographiques Pointe Noire. (ORSTOM Oceanographic Research Centre, Point Noir);

Bureau du PUND
(UNDP Office);

Services de la Marine Marchande
(Department of the Merchant Navy);

Service des Peches Maritimes Direction de la Marine Marchande
(Department of Marine Fisheries Merchant navy);

EQUATORIAL GUINEA

Ministry of Education;

Ministry of Public Works;

Ministry of Foreign Affairs;

Department of Technical Co-operation, Ministry of Foreign Affairs;

Department of Merchant Marine, Ministry of Public Works;

UNDP Office;

European Economic Community (EEC) Office.

GABON

Etudes au Ministère de l'Enseignement Superieur,
de la Recherche Scientifique, de l'Environnement et de la protection
(Ministry of Higher Education, Scientific Research, and Environmental Protection);

Service Technique du Centre National Anti-Pollution
(Technical Services at the National Anti-Pollution Centre);

Faculté des Sciences de l'Université OMAR BONGO
(University of Omar Bongo, Science Faculty);

Bureau PNUD
(UNDP Office);

Port Gentil
(Port Gentil);

GAMBIA

Ministry of Works and Communications;

Gambia Ports Authority;

UNDP Office, Banjul;

Department of Fisheries, Ministry of Agriculture & Natural Resources;

Ministry of Agriculture and Natural Resources;

FAO, Banjul;

Department of Water Resources, MANR.

Integrated Fisheries Development Project, Fish Marketing
Corporation-(FAO);

Ministry of Local Government and Lands.

GUINEA

Institut National de Recherche et de
documentation (INRD);
(National Institute for Research and Documentation (INRD));

Centre de Recherches Océanographiques et Héliophysiques(CROH);
(Centre for Oceanographic and Fisheries Research (CROH));

Laboratoire de Biologie Marine de la direction des Peches
(Marine Biology Laboratory of the Fisheries Office)

GUINEA (Cont'd.)

Direction de la Marine Marchande
(Directorate of Merchant Marine);

Port Autonome
(Port Authority);

GUINEA BISSAU

Fisheries Secretariate;

Ministry of Transport

UNDP Office.

IVORY COAST

Ministère de la Recherche scientifique
(Ministry of Scientific Research);

Centre de recherches océanographiques (CRO)
(Centre of Oceanographic Research); (CRO)

Institut d'Ecologie Tropicale (I.E.T.)
(Institute of Tropical Ecology)

Ministère de l'Education Nationale, Université Nationale de Cote d'Ivoire
(Ministry of National Education, the National University of Ivory Coast);

Faculté des Sciences Biologie et
Physiologie et Physiologie Animale
(Faculty of Biological Sciences and Physiology and
Animal Physiology).

Laboratoire d'Hydrobiologie
(Hydrobiological Laboratory);

Ministère de la Production Animale
(Ministry of Animal Production);

Direction des peches maritimes et lagunaires
(Directorate of Marine and Freshwater Fisheries);

Laboratoire d'analyses et de controle
(Analytical and Control Laboratory);

IVORY COAST (Cont'd.)

Ministère de la Marine
(Ministry of Marine Affairs);

Institut de Documentation, de Recherches
et d'Etudes Maritimes
(Institute of Maritime Documentation, Research and Studies);

Ministère des Mines
(Ministry of Mines);

Direction des Hydrocarbures
(Directorate of Hydrocarbons).

LIBERIA

Ministry of Agriculture;

National Fisheries Division, Ministry of Agriculture;

Central Agricultural Research Institute (CARI);

University of Liberia, Faulkner College of Science
and Technology;

Department of Zoology, University of Liberia;

Maritime Affairs Commission, Ministry of Finance;

Liberia Port Authority;

Masurado Fish Company;

Mano River Union, Monrovia.

MAURITANIA

Bureau PNUD
(UNDP Office);

Direction de la Marine Marchande
(Department of the Merchant Marine);

Direction des Peches
(Department of Fisheries);

Direction des Mines et de la Géologie
(Department of Mines and Geology);

Institut Mauritanien de Recherche Scientifique
(Mauritanian Institute of Scientific Research);

Lycée de Nouakchott
(School of Nouakchott);

MAURITANIA (Cont'd)

Centre National de recherches océanographiques et
de Peches (CNROP) de Nouadhibou
(National Centre of Oceanographic Research and
Fisheries, Nouadhibou.

Administration régionale de Nouadhibou
(Regional Administration, Nouadhibou);

Centre de Formation professionnelle "MAMADOU TOURE"
("MAMADOU TOURE" Vocational Training Centre);

Parc National du Banc d'Arguir
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MOROCCO

Institut Scientifique des Peches Maritimes, Casablanca
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Ministère du Commerce de l'Industrie, de la Marine Marchande
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(Ministry of Commerce, Industry, Merchant Navy and Marine Fisheries); Casablanca

Projet FAO - Institut Scientifique des Peches Maritimes- Casablanca
(FAO Project - Institute of Marine Fisheries); Casablanca

Bureau du PNUD - Rabat
(UNDP Office Rabat);

Université Mohamed V - Departement des Sciences de la Terre, Rabat
(Mohamed V University - Earth Sciences Department, Rabat);

Ministère de l'Energie et des Mines, Rabat
(Ministry of Energy and Mines, Rabat);

Bureau de Recherches et de Participations Minières, Rabat
(Bureau of Research and Mining Activities, Rabat);

Direction des Hydrocarbons, Rabat
(Hydrocarbon Division, Rabat);

Ministère du Commerce, de l'Industrie, de la
Marine Marchande et des Peches Maritimes, Rabat
(Ministry of Commerce, Industry, Merchant Navy, and
Marine Fisheries, Rabat);

Direction des Ports, Rabat
(Port Division, Rabat);

Ministère de l'Agriculture et de la Reforme Agraire, Rabat
(Ministry of Agriculture and Agrarian Reform, Rabat);

NIGERIA

UNDP Office

Nigerian Institute for Oceanography and Marine Research (NIOMAR);

Planning Department, Federal Ministry of Transport;

Department of Environmental Planning and Protection,
Ministry of Housing and Environment;

Faculty of Science, University of Lagos;

UNESCO Office;

Federal Department of Fisheries;

Federal Ministry of Science and Technology
Planning and Evaluation;

Regional Aquaculture Centre - Port Harcourt;

Niger Delta Basin Development Authority - Port Harcourt;

State Department of Fisheries - Port Harcourt;

University of Calabar;

Cross River Basin Development Authority,Calabar ;

International Maritime Consultative Organization (IMCO).

SAO TOME AND PRINCIPE

Ministry of Foreign Affairs and Co-operation;

UNDP Office.

SENEGAL

Ministère du Développement Rural
(Ministry of Rural Development);

Ministère de Peches Maritimes
(Ministry of Marine Fisheries);

Direction de l'Océanographie et des Peches Maritimes (D.O.P.M.)
(Directorate of Oceanography and Marine Fisheries);

Direction de la Recherche Scientifique et Technique
(Directorate of Scientific and Technological Research

Centre de Recherches Océanographiques de Dakar-Tiaroye (CRODT)
Oceanographic Research Centre - Dakar-Tiaroye

Faculté des Lettres et Sciences Humaines
(Faculty of Arts and Humanities);

Université de Dakar
(University of Dakar);

Departement de Géographie , University of Dakar.
(Department of Geography);

Faculté des Sciences, University of Dakar.
(Faculty of Science);

Département de Biologie et Physiologie Animale , University of Dakar
(Biology and Animal Physiology Department);

Institut Fondamental d'Afrique Noire
(Fundamental Institute of Black Africa); University of Dakar.

Département de Biologie Marine
(Marine Biology Department); University of Dakar.

Ministère de l'Equipment
(Infrastructure Ministry);

Direction de la Marine Marchande
(Department of Merchant Navy);

Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM)
(Overseas Scientific and Technological Research Office);

Project FAO/COPACE - Comité de Peches de l'Atlantique Centre Est
(Project - FAO/CECAF -Committee of the East Central Atlantic Fisheries.

Direction de l'Environnement, Ministere de l'Urbanisme, de l'Habitat et de l'Environnement
(Department of Environment, Ministry of Urban Development, Housing and Environment).

SIERRA LEONE

Institute of Marine Biology and Oceanography,
University of Sierra Leone;

Department of Zoology, Fourah Bay College;

Geology Department, Fourah Bay College;

Department of Botany, Fourah Bay College;

Faculty of Pure and Applied Science, University of Sierra Leone;

Sierra Leone Ports Authority;

Ministry of Natural Resources
Fisheries Division;

Sierra Fishing Company;

Ministry of Natural Resources;

Meteorology Department;

UNDP Office;

Social Affairs Division,
Mano River Union;

Department of Mechanical Engineering,
Fourah Bay College;

Faculty of Engineering,
Sierra Leone University;

Department of Civil Engineering,
Fourah Bay College.
Siaka Stevens Marine Training School, Freetown.

ZAIRE

Bureau du UNESCO;
(UNESCO Office);

Bureau du PNUD
(UNDP Office);

Bureau des Organismes régionaux et coopérations
Bilaterales, Departement de l'Environnement,
(Office of Regional Organizations and Bilateral
Co-operation, Department of the Environment);

Bureau du Programme Hydraulique International,
Departement Environnement.
(Office of International Hydraulic Programme,
Department of Environment);

L'encadrement du personnel scientifique à
l'Institut de Recherche Scientifique (IRS),
(Training of scientific personnel Section
Institute of Scientific Research (IRS));

Centre de Recherche Scientifique
(Centre of Scientific Research);

Service des Relations Internationales,
Departement de l'Environnement, Conservation de la Nature et Tourisme.
(Office of International Relations, Department of the Environment,
Nature Conservation and Tourism.).

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Syllabus for "Patron de Peche"
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