

**Intergovernmental Oceanographic Commission**

Workshop Report No. 34



**IOC Workshop on Regional  
Co-operation in Marine Science  
in the Central Eastern Atlantic  
(Western Africa)**

Tenerife, Spain, 12-17 December 1983

**Unesco**

# IOC Workshop Reports

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No.	Title	Publishing Body	Languages	No.	Title	Publishing Body	Languages
1	CCOP-IOC, 1974, Metallogenesis, Hydrocarbons and Tectonic Patterns in Eastern Asia (Report of the IDOE Workshop on); Bangkok, Thailand 24-29 September 1973 UNDP (CCOP), 138 pp.	Office of the Project Manager UNDP/CCOP c/o ESCAP Sala Sanitham Bangkok 2, Thailand	English	17	Papers submitted to the Joint Suppl. IOC/WMO Seminar on Oceanographic Products and the IGOSS Data Processing and Services System, Moscow, 2-6 April 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
2	CICAR Ichthyoplankton Workshop, Mexico City, 16-27 July 1974 (Unesco Technical Paper in Marine Sciences, No. 20).	Division of Marine Sciences, Unesco Place de Fontenoy 75700 Paris, France	English (out of stock) Spanish (out of stock)	18	IOC/Unesco Workshop on Syllabus for Training Marine Technicians, Miami, 22-26 May 1978 (Unesco reports in marine sciences, No. 4)	Division of Marine Sciences, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
3	Report of the IOC/GFCM/ICSEM International Workshop on Marine Pollution in the Mediterranean, Monte Carlo, 9-14 September 1974.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish (out of stock)	19	IOC Workshop on Marine Science Syllabus for Secondary Schools, Llantwit Major, Wales, U.K., 5-9 June 1978 (Unesco reports in marine sciences, No. 5).	Division of Marine Sciences, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian Arabic
4	Report of the Workshop on the Phenomenon known as "El Niño", Guayaquil, Ecuador, 4-12 December 1974.	FAO Via delle Terme di Caracalla 00100 Rome, Italy	English (out of stock) Spanish (out of stock)	20	Second CCOP-IOC Workshop on IDOE Studies of East Asia Tectonics and Resources, Bandung, Indonesia, 17-21 October 1978.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
5	IDOE International Workshop on Marine Geology and Geophysics of the Caribbean Region and its Resources, Kingston, Jamaica, 17-22 February 1975.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English (out of stock) Spanish	21	Second IDOE Symposium on Turbulence in the Ocean, Liège, Belgium, 7-18 May 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
6	Report of the CCOP/SOPAC-IOC IDOE International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific, Suva, Fiji, 1-6 September 1975.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English	22	Third IOC/WMO Workshop on Marine Pollution Monitoring, New Delhi, 11-15 February 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
7	Report of the Scientific Workshop to Initiate Planning for a Co-operative Investigation in the North and Central Western Indian Ocean, organized within the IDOE under the sponsorship of IOC/FAO (IOFC)/Unesco/EAC, Nairobi, Kenya, 25 March-2 April 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian	23	WESTPAC Workshop on the Marine Geology and Geophysics of the North-West Pacific, Tokyo, 27-31 March 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Russian
8	Joint IOC/FAO (IPFC)/UNEP International Workshop on Marine Pollution in East Asian Waters, Penang, 7-13 April 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English (out of stock)	24	WESTPAC Workshop on Coastal Transport of Pollutants, Tokyo, 27-31 March 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English (out of stock)
9	IOC/CMG/SCOR Second International Workshop on Marine Geoscience, Mauritius, 9-13 August 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian	25	Workshop on the Inter-calibration of Sampling Procedures of the IOC/WMO UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open-Ocean Waters, Bermuda, 11-26 January 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English (superseded by IOC Technical Series No. 22)
10	IOC/WMO Second Workshop on Marine Pollution (Petroleum) Monitoring, Monaco, 14-18 June 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish (out of stock) Russian	26	IOC Workshop on Coastal Area Management in the Caribbean Region, Mexico City, 24 September-5 October 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
11	Report of the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions, Port of Spain Trinidad, 13-17 December 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish (out of stock)	27	CCOP/SOPAC-IOC Second International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific, Nouméa, New Caledonia, 9-15 October 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
11	Collected contributions of invited Suppl. lecturers and authors to the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions, Port of Spain, Trinidad, 13-17 December 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish	28	FAO/IOC Workshop on the effects of environmental variation on the survival of larval pelagic fishes Lima, 20 April-5 May 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
12	Report of the IOC/ARIBE Interdisciplinary Workshop on Scientific Programmes in Support of Fisheries Projects, Fort-de-France, Martinique 28 November-2 December 1977.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish	29	WESTPAC Workshop on Marine biological methodology Tokyo, 9-14 February 1981.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
13	Report of the IOC/ARIBE Workshop on Environmental Geology of the Caribbean Coastal Area, Port of Spain, Trinidad, 16-18 January 1978.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish	30	International Workshop on Marine Pollution in the South-West Atlantic Montevideo, 10-14 November 1980.	IOC, Unesco Place de Fontenoy, 75700 Paris, France	English (out of stock) Spanish
14	IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas, Abidjan, Ivory Coast, 2-9 May 1978.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French	31	Third International Workshop on Marine Geoscience Heidelberg, 19-24 July 1982	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish
15	CPPS/FAO/IOC/UNEP International Workshop on Marine Pollution in the South-East Pacific, Santiago de Chile, 6-10 November 1978.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English (out of stock)	32	UNU/IOC/Unesco Workshop on International Co-operation in the Development of Marine Science and the Transfer of Technology in the context of the New Ocean Regime Paris, 27 September - 1 October 1982	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish
16	Workshop on the Western Pacific, Tokyo, 19-20 February 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Russian	33	Workshop on the IREP Component of the IOC Programme on Ocean Science in Relation to Living Resources (OSLR) Halifax, 26-30 September 1983	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
17	Joint IOC/WMO Workshop on Oceanographic Products and the IGOSS Data Processing and Services System (IDPSS), Moscow, 9-11 April 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English	34	IOC Workshop on Regional Co-operation in Marine Science in the Central Eastern Atlantic (Western Africa) Tenerife, 12-17 December 1983	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish

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1. OPENING OF THE WORKSHOP

1 The meeting was called to order by the first Vice-Chairman of the IOC, Mlle Marie-Annic Martin-Sanĉ. She expressed the thanks of the IOC to the Spanish Government for having offered to host this important meeting, and, in particular, to the Instituto Espaol de Oceanografa for kindly providing the facilities of the Centro Costero de Canarias. She recalled the active participation of Spain in IOC activities, especially noting the offer made by the Spanish representative on the IOC Executive Council, Dr. Miguel Oliver Massuti, Secretary of State for Fisheries, of training for scientists from Member States in western Africa at Spanish institutions and aboard Spanish research vessels. The First Vice-Chairman spoke of the considerable preparation required in organizing this Workshop, and the impulse given to international co-operation as a result of the signing of the UN Convention on the Law of the Sea. This Convention brings not only new rights but also new responsibilities to Member States. Marine scientific research and the evaluation of its results will, she believed, provide the basis for the rational management of the marine zones of the Member States. The ocean, by its very nature, requires international co-operation in which the experience of each participating country can be shared and thus promote their development. The First Vice-Chairman extended to the participants the best wishes of the Chairman of the IOC, Prof. Inocencio Ronquillo.

2 Mr. Juan G3mez Gallego, on behalf of the Secretary of State for Fisheries and the Director of the Instituto Espaol de Oceanografa, welcomed the participants. He outlined the history of the Institute, particularly the Centro Costero de Canarias, noting the historical importance of the oceans to Spain and the primordial role of the Canary Islands, which led to Spain being a pioneer in oceanography as well. In closing, he offered the unstinting support of the Institute in the conduct of the Workshop and the follow-up thereto.

3 The Vicerector of the University of La Laguna, Mr. Julio Delgado Martn and the Commander of the Navy in the Canary Islands, Mr. Diego Carlier Pacheco, were also present during the opening ceremony.

4 The Assistant-Secretary of IOC, Mr. Ray C. Griffiths, expressed the regrets of the Secretary, Dr. Mario Ruivo, who was unable to be present, as he wished, because of unavoidable obligations. He, nevertheless, sent his best wishes for the success of the Workshop.

2. ADMINISTRATIVE ARRANGEMENTS

2.1 DESIGNATION OF A CHAIRMAN, VICE-CHAIRMAN AND RAPPORTEUR

5 The First Vice-Chairman of the IOC proposed Prof. Benjamin Akpati of Nigeria as Chairman for the Workshop, and suggested that there be two Vice-Chairmen, one from a Spanish-speaking country of the region and, likewise, one from a French-speaking country. She proposed Mr. Juan G3mez Gallego of Spain and Mr. Aka Kouame of the Ivory Coast. These proposals were welcomed unanimously by the participants.

6           The First Vice-Chairman of the IOC also proposed Mr. Henri Rotschi as Rapporteur, and this proposal was also accepted unanimously. The List of Participants is given in Annex III.

## 2.2           ADOPTION OF THE AGENDA

7           The Agenda was accepted without amendment and is given in Annex I.

## 2.3           CONDUCT OF THE WORKSHOP, TIME-TABLE AND DOCUMENTATION

8           The Assistant Secretary of IOC, Mr. George Kitaka, acted as Technical Secretary for the Workshop. He outlined the documentation before the Workshop and proposed a time-table of work. He suggested that the Workshop work as much as possible in Plenary, although ad hoc drafting groups could be formed to prepare special proposals for the consideration of the participants in Plenary. A list of the Acronyms used in this Report is given in Annex V.

9           The recommendations of the Workshop, although in the body of this Report, are summarized in Annex II.

## 3.           REVIEW OF THE MARINE SCIENCE ACTIVITIES IN THE REGION AND FUTURE RESEARCH

### 3.1           STATE OF ACTIVITIES IN MEMBER STATES

10          Participants from the western African region gave brief descriptions of the research activities in the field of marine sciences in their respective countries. The statements clearly showed that the major part of national marine research in the region has been carried out, and continues to be carried out, in the framework of programmes related to fisheries. Quite recently, some universities have decided to restructure themselves so as to include in their training and research activities an oceanic component, but these efforts are generally held back by a lack of material and human resources.

11          Another feature of the marine research in the region is that, with few exceptions, it is all oriented towards the study of the nearshore zone, with a view to improving the exploitation of marine resources, living and non-living, and to guaranteeing their conservation as well as the protection of the marine environment.

12          The description of these activities, which are summarized in Annex IV, underlined the present shortcomings with respect to knowledge of the physical environment and the circulation of coastal waters, of the production mechanisms of the marine ecosystem outside the main upwelling areas, especially regarding species of no particular economic importance, and of the topography and geology of the continental shelf.

### 3.2           COASTAL OCEAN DYNAMICS AND CLIMATE

13          Two talks, one on coastal surface oceanographic observations, the other on a study of variations in the heat content of the ocean by studying variations in sea level along the coast, showed the fundamental usefulness of easily made measurements in determining the fundamental mechanisms likely to have a significant impact on the living resources.

- 14           Regarding the first<sup>\*</sup>, it was shown that numerous and long time-series measurements of sea-surface temperature allow low-frequency spectra to be determined, and the most significant of these reveal forcing factors on various time and space scales.
- 15           Temporal coherence windows between the surface temperature and latitudinal and longitudinal components of the wind are revealed and lead to the possibility of predicting the development of surface temperature conditions on the basis of meteorological data. If the observations are multidisciplinary, the impact of this research on problems of recruitment (larvae and juveniles in coastal waters) and of the exploitation of living resources is obvious. For example, a comparison of gradients along the coast has shown an effect of the variability of these gradients on the heterogeneity of the biomass, which confirms that, in certain conditions, there is a logical connexion between the coastal circulation and the distribution of the biomass.
- 16           Because of the uneven distribution of coastal stations along the coast of Africa, significant geographical gaps in coverage occur. It was thought essential to strengthen the regional network of coastal stations, and the ideal would be at least two such stations in each country, and located so that open-sea conditions could, as far as possible, be observed; the measurement of nearshore currents from these stations was also recommended.
- 17           The second<sup>\*\*</sup> of these two talks dealt with the study of the heat content of the surface layers of the tropical Atlantic and of variations in sea-surface temperature; both types of data are fundamental to study of short-term climate variations. When applied to the tropical Atlantic, such studies should lead to a better understanding of the mechanisms responsible for drought in the Sahel, and lead eventually to climate forecasting over large areas. However, before this can be achieved, it is necessary to increase our knowledge of the role of the oceans in the overall heat budget of the two geophysical fluids that bathe the planet (sea and atmosphere), so there is a need to know the variability of the surface and subsurface temperatures of the tropical ocean. Continuous observations of temperature and currents over a large area are not at present feasible; it is necessary to exploit the high correlation, in the eastern tropical Atlantic, between the heat content of the upper layer of the ocean, the dynamic height and the mean sea level.
- 18           This coastal upwelling is related to a drop in the dynamic height at the surface relative to the 500-db surface, and to a drop in surface temperature, and has been detected by a drop in the mean sea level. In the coastal upwelling zones of the Gulf of Guinea, the mean sea level changes one month prior to the drop in sea-surface temperature, and a reduction in the heat content of the 0-100m layer. The value of a network of sea-level measuring stations in the tropical Atlantic is therefore clear, in the context of monitoring the heat content and the topography of the tropical Atlantic Ocean; this value will be enhanced by the introduction of satellite altimetry, because the most effective possible tool for monitoring the overall heat content of the ocean will be available. Satellite infra-red thermometry, by providing a continuous monitoring of surface temperature, will usefully complement these measures.
- 19           The Workshop participants recognized the use that could be made of coastal data in the study of coastal upwelling, the mechanisms that provoke it

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\* Given by Dr. Y. Gallardo, Centre Océanologique de Bretagne, B.P. 337, 29273 Brest, France

\*\* Given by Dr. J.M. Verstraete, ORSTOM, Paris, France.

(local winds, mesoscale and distant winds, propagation of trapped waves), and the influence of topography, which underlines the importance of theoretical studies of coastal water movements; the Workshop participants also recognized the interest to the region of strengthening the present coastal studies.

### 3.3 MARINE ECOSYSTEMS AND LIVING RESOURCES

20 Regarding living resources and production systems of the tropical Atlantic, two talks on various upwelling systems along the western African coast and their implication for the production of pelagic and demersal biomasses were given. There are two types of upwelling; one is found off Cape Blanc to the north of the equator and the other, in the Benguela Current to the south, but both are characterized by a high level of primary productivity and of total production. The fish stocks, demersal and pelagic, in each area differ appreciably, however. Other more localized zones of upwelling exist, especially in the Gulf of Guinea, but these have been less well studied.

21 As a result of the high productivity, the production to the north of 18°N and to the south of 17°S is, in certain zones, particularly high. The pelagic populations change according to the place: Sardina pilchardus to the north; Sardinops ocellata to the south, for example, although the genus Engraulis occurs in the north and in the south. Sardinella aurita, on the other hand, appears to prefer the intertropical waters, whereas the genus Trachurus is present throughout the whole region. The demersal stocks comprise a greater variety of species of which the most important are the Sparidae, present to the north and to the south, and the genus Otholitus in the equatorial zone. These species are distributed in shoals of low density and are not heavily fished. The demersal fish and shellfish belong to the Gadidae, the Cephalopoda and Crustacea; the crustaceans occupy a very large area. Hake are very abundant and have a characteristic geographical distribution, with five species covering the region; their bio-ecological characteristics pose certain problems that have implications for the fishery. Finally, the mesopelagic species such as euphausiids and myctophids have a significant biomass and play a fundamental role in the structure of the food chains; they merit particular attention.

22 Other studies, such as those made off the coast of Morocco within CINECA, have shown that the southward displacement of the upwelling off the coast of north-west Africa follows the seasonal variations of the north-east trade winds. These seasonal variations in upwelling are reflected not only in the surface temperature, the distribution of nutrient salts and the biological production, but also in the fishery, notably that for Scomber colias. The study of the dynamics of coastal upwelling shows the existence, over the continental shelf, of low-frequency waves that modify the upwelling along the west coast of Africa, as does the strong link between the coastal dynamics and those of the equatorial current system. Variations in the "Southern Oscillation" in the atmosphere should be studied from the standpoint of their influence on upwelling in West Africa. The study of the Southern Oscillation is part of the World Climate Research Programme (WCRP). Research has also been carried out on the correlation between the oceanographic conditions and the distribution of fish in the upwelling zone of Mauritania.

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\* One given by Prof. D. Nehring, Institute of Marine Research of the Academy of Science of the GDR, Rostock-Warnemünde, German Democratic Republic; and one given by Prof. C. Bas, Centro Nacional de Investigaciones Pesqueras, Barcelona, Spain.

23

The Workshop participants recognized the value of these different studies, but also that they imply the use of facilities that few countries in the region possess. These studies have, for the most part, been carried out by developed countries and the participation of the developing countries of the region has unfortunately been slight. The pursuit of such efforts should take more account of the development needs of the countries concerned and their capacity to participate as equal partners. The objectives, the programmes and the means should be chosen accordingly.

#### 3.4 CONTINENTAL MARGINS AND NON-LIVING RESOURCES\*

24

The demands of exploration and exploitation of the oceans are such that hydrographic charts prepared for navigators and fishermen are clearly inadequate and should be supplemented by charts giving the best possible representation of the sea bed; this is particularly important for the continental margin and the exclusive economic zones of the developing countries. Such charts are particularly necessary in the study of relations between the relief of the sea bed and the composition and characteristics of the rocks and sediments that make up the sea bed. The preparation of a precise bathymetric chart is an essential prior operation in all forms of utilization of the sea bed, as, for example, the laying of pipelines, the installation of drilling platforms, and the exploitation of mineral deposits. A high-quality bathymetric chart can fill various functions, such as: aid the definition and study of the continental shelves of coastal countries; aid the correlation of certain oceanographic phenomena with the relief of the sea bed, in certain cases of upwelling, for example; and facilitate study of the behaviour of sediment movements at the heads of marine canyons in the vicinity of the coast.

25

The published bibliography on the continental shelf of West Africa shows that knowledge thereof is relatively limited. Existing publications show that the continental shelf is, for the most part, well sounded, as a result of measurements made by naval vessels and coastal oceanographic institutes. But there are very few bathymetric charts on an appropriate scale able to meet the needs defined above. On the other hand, as far as the continental margin is concerned, work is less advanced, and there are only available, at present, small-scale charts (as GEBCO, for example) or detailed surveys of restricted areas. Knowledge of sedimentology is at the same level as that of the bathymetry: certain areas of the continental shelf are well known, and others are much less well known.

26

The International Decade of Ocean Exploration provided the opportunity for a detailed study of the continental margin of the eastern Atlantic. The results showed the importance of fracture zones which, in the Gulf of Guinea, take the form of abrupt escarpments oriented towards the coastline. The geological structure covers the eastern flank of the mid-Atlantic Ridge. Sedimentary trenches have developed during the expansion of the central Atlantic. The basins contain sediments to a depth often in excess of 10 km, the nature of the sedimentary deposit varying with depth.

27

The discussion of the results presented revealed that many bathymetric data exist but remain unused in the production of detailed ocean-floor charts of the coastal zone. These data are banked with the hydrographic and oceanographic services of many countries, particularly France, Federal Republic of Germany, Portugal, Spain, UK, USA and USSR.

\* Three talks were given on this subject, by: Prof. B.N. Akpati, Nigerian Institute for Oceanography and Marine Research, Victoria Island, Lagos, Nigeria; Mr. Aka Kouamé, Département de Géologie, Université d'Abidjan, Ivory Coast; and Prof. J.R. Vanney, Département de Géologie Dynamique, Université Pierre et Marie Curie (Paris VI), Paris, France.

In principle, all these data could be utilized. The need to assemble all available bathymetric data was stressed. This should allow the preparation of charts that would reveal zones insufficiently covered by sounder surveys. This would facilitate the definition of further sounding work to be carried out. The need to adopt the same scale for all bathymetric charts used for navigation purposes was underlined, as well as the regular updating of charts of unstable sea-bed zones, such as the Niger Delta where shipwrecks on the changing shoals are common. A detailed bathymetric chart of the continental margin of western Africa appears to be a unifying tool of co-operative research and a catalyst in the development of co-operative research programmes particularly those relating to non-living resources.

28           The Workshop was informed that, if requested by the countries of the region, France would consider constructively the possibility of assisting in the preparation of a bathymetric chart of the region.

### 3.5           MARINE POLLUTION RESEARCH AND MONITORING

29           It was recalled that at the IOC-FAO-WHO-UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas (Abidjan, 2-9 May 1978) four major sources of marine pollution were identified and listed in the following order of priority: Petroleum hydrocarbons (mainly from maritime transport), industrial waste, sewage (domestic waste), agricultural waste (pesticides, fertilizers). A review of recent literature reveals not only the absence of any improvement in the situation, but also a further deterioration.

30           The Representative of FAO, speaking also on behalf of the UNEP Regional Seas Programme, briefed the Workshop on progress made in the implementation of the UNEP Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the West and Central African Region, to which FAO and IOC are contributing.

31           He referred specifically to project WACAF-2 (Monitoring of Pollution in the Marine Environment) jointly organized by FAO, WHO, IOC and IAEA. A co-operative marine pollution analysis network, initially based on eight national laboratories, was established by FAO to allow the assessment of the level of pollutants in marine organisms. IAEA, in co-operation with FAO, will organize intercalibration/intercomparison of sampling and analytical techniques, and will assist in the maintenance of equipment. For petroleum hydrocarbons, IOC plans visual observations of oil slicks and regular surveys of tar on beaches and floating tar balls in the coastal areas. Sea water and shellfish will be sampled and analysed for their microbial contamination, by national laboratories which are being identified by WHO.

32           The Workshop participants agreed that oil pollution still remained the main regional marine pollution problem, but, in general, concern for other forms of environmental degradation, such as coastal erosion, was greater. It recognized that there was still not a critical mass of chemical analytical laboratories in the region to undertake sophisticated regional work requiring intercalibration exercises, although regional studies of beach tar deposits could be carried out following standard procedures recommended by IOC in its Marine Pollution Monitoring system (MARPOLMON) and applied in the UNEP Action Plans.

4. REQUIREMENTS FOR, AND DEVELOPMENT OF, OCEAN SERVICES

4.1 INTEGRATED GLOBAL OCEAN SERVICES SYSTEM (IGOSS)

33 The IOC Assistant Secretary introduced this item. The Integrated Global Ocean Services System (IGOSS) was jointly formed by IOC and the World Meteorological Organization (WMO) as an operational oceanic service system, inspired by the principles that have governed the development of the WMO World Weather Watch (WWW). The term "operational" here should be understood as implying that the products provided by the system (data sets, isopleth charts for specific parameters, analyses or various forecasts) should be made available to the user within a delay time determined by the nature of the product and the users' needs. These delays can range from a few hours (when the user is a weather-forecasting service, for example) to several weeks (for certain climate research programmes, for example).

34 The parameters that are currently exchanged within the System are essentially sea temperature and salinity at the surface and at depth. Formats are also envisaged for the exchange of current data, but they are not yet in current use. Other data on parameters such as mean sea level should soon be exchanged through IGOSS.

35 The originality of IGOSS (apart from its operational character already mentioned) lies in the fact that the data it uses are not necessarily, and are even rarely, collected for its own use. All measurements of a parameter can be handled by the System if transmitted in good time to any one of the centres that have volunteered to handle such data; the same data can be used for quite other purposes at other times and in other ways. This aspect of the System should be kept in mind when the cost/effectiveness ratio has to be taken into account in any possible decision to participate in the System.

36 As far as the central eastern Atlantic is concerned, a "Proposal for the establishment of IGOSS in the West African region" (Document IOC-XII/8 Annex 7) was presented to the IOC Assembly at its Twelfth Session (November 1982), to the Third Session of the IOC-WMO Working Committee for IGOSS (February-March 1983) and now at the present Workshop. Based on the interest in the System expressed by the countries concerned, and on their possibilities to participate in it, entirely or partially, it can be summarized in two themes:

(i) Regular monitoring of certain physical and dynamic marine parameters in a narrow band along the coast of western Africa; the following parameters could be chosen: sea-surface temperature and salinity; if possible, the temperature and salinity at other depths; and the sea level, which, as we have seen earlier, can be a useful climate indicator.

(ii) Regular monitoring of sea-surface temperature and, if possible, the salinity and sea-surface evaporation in a broad region bounded by the Tropic of Capricorn, the 20°W longitude and the west coast of Africa. For this purpose the data could come from METEOSAT (which will eventually be replaced by the European EUMETSAT), complemented, for calibration purposes, by some ground-truth data collected by ships-of-opportunity traversing the same zone. The object of this second plan arose from a project (the state of which is not known) for which Senegal will shortly be equipped (for itself and for the Gambia, Guinea-Bissau, Mali and Mauritania) with a METEOSAT receiving station,

and with a mini-computer for the processing of satellite data.

37 The Workshop participants considered these proposals as being sound. They underlined, in particular, the tendency, discernible in IGOSS as well as in research activities mentioned above, to increasing efforts in coastal oceanography, based on the use of judiciously sited coastal stations, with sea-going means of low capacity and proven measuring equipment. It was recognized that the proposed measures, associated with those concerning the primary production and the development of the marine food chain, and marine pollution research and environmental protection, formed a coherent whole that could constitute a realistic objective for the countries of the region.

38 The question of training and assistance in the framework of IGOSS was raised. The Workshop participants regretted that, as the survey conducted in 1982 had shown, the demand exceeds the supply. It noted, however, that efforts were being made to acquire more information on both, so as to try to meet better the requests received. It also recognized that this question would be best dealt with in the context of training, education and mutual assistance (TEMA) in the marine sciences, under Agenda Item 5.

#### 4.2 DOCUMENTATION AND INFORMATION EXCHANGE

39 The IOC Assistant Secretary introduced this item. Several Unesco-ECA missions to the coastal states of the regions show that, in the majority of these countries, there is a shortage of documentation on marine science. The few libraries in the region that are the best off in this regard do not, in many cases, have up-to-date holdings. Also, the majority of the results of scientific studies are published only in one language, which makes them relatively less accessible to workers in the region not familiar with that language. It would appear essential, then, to establish regional or subregional mechanisms for the exchange of documents, information and bibliographies in the marine sciences.

40 The Workshop participants confirmed the language difficulties; some English-speaking countries, notably Nigeria, offer courses in technical French, to enable researchers to take advantage of French-language publications, which are, by a considerable margin, the most abundant in the region. Ideally, research workers from English-speaking countries should learn French, and vice-versa, these being the two predominant scientific languages in the region. The problem remains, however, for Portuguese and Spanish-speaking scientists.

41 Besides the language problem, the Workshop participants underlined the financial difficulties experienced regularly by libraries in the region, even in the renewal of subscriptions to journals. Assistance from Unesco appeared to be essential, particularly in the form of Unesco coupons which represent a kind of widely accepted currency and have proved essential in certain cases. Certain institutions in developed countries could also contribute to the enrichment of library holdings in the region, at the request of interested libraries, and could open up possibilities for the consultation of data reports to interested researchers. The Instituto Español de Oceanografía was ready to make its publications available to interested libraries, and this offer was welcomed.

42 Several participants raised the question of publications of institutions and laboratories in the region. Too often, work done in the region was published outside the region. The value of publishing in well known international journals was recognized but it was thought highly desirable that the results of research work done in the region should first be published in the worker's own institutional periodical; the relatively restricted distribution of these publications should not prevent acceptance of articles by an international journal.

43 A related concern was that the local authorities should have access to the results of research carried out in the marine zones under their jurisdiction. Petroleum research is a particular example, amongst others. The possibility of establishing regulations on this was evoked, although it was agreed that this was an internal question in each country. Nevertheless, it was noted that the desired result (the communication of the data) could be better achieved if each country could make competent personnel available to participate in the research itself.

44 The Workshop participants agreed that one way to build up library holdings in the region was through publication exchange on a reciprocal basis, although special consideration should be given to newly formed centres not yet able to offer a comparable documentation in exchange.

45 It was pointed out that the distribution of publications represented a heavy financial burden for the institutions concerned, even if they were able to do the printing and binding themselves, not least because of the postal charges. The Workshop participants suggested that, to relieve the institutions concerned, international organizations, such as Unesco, IOC, FAO and WMO, each in its own field, should undertake the translation, printing and distribution of the publications in question.

46 The Workshop participants also agreed that many specialized marine science libraries needed restructuring or even reorganizing, and that international assistance was needed for this purpose.

47 The role that is played by the FAO-IOC-UN(OETB) Aquatic Sciences and Fisheries Information System (ASFIS) and the related Abstracts (ASFAS) was explained. An ad hoc Informal Planning Meeting on Future ASFIS Development and Support (Paris, 31 May - 3 June 1983) paid particular attention to the special problems of West Africa. A regional seminar on marine science information infrastructures was proposed, to determine needs and identify training and technical assistance requirements. This idea was taken up at a Training Course on Information and Data Management, organized under IOC TEMA, and which was held in Brest, France, under the aegis of the Centre National pour l'Exploitation des Océans (CNEXO). The Workshop participants accepted the proposal to organize a regional seminar and recommended that the IOC convene such a seminar.

48 The possibility of obtaining information on data through the Marine Environment Data Information Referral System (MEDI) operated by IOC with the collaboration of various other organizations active in marine affairs was described and welcomed by the Workshop participants as a contribution to the solution of the general problem.

49 Finally, the Workshop participants discussed the possibility of  
obtaining data of interest to the region through the International Oceanographic Data Exchange System (IODE) and, in particular, through the World Data Centres (Oceanography) A and B in Washington D.C. and Moscow, respectively.

50 Dr. Juan Gómez Gallego informed the participants that the Data Centre of the Centro Costero de Canarias would be willing to provide data-handling services in support of co-operative programmes developed by the IOC in the western African region.

51 The Workshop participants expressed their thanks for this offer.

5. TRAINING, EDUCATION AND MUTUAL ASSISTANCE (TEMA) IN THE MARINE SCIENCES

5.1 IMPLEMENTATION, IN THE REGION, OF THE COMPREHENSIVE PLAN FOR A MAJOR ASSISTANCE PROGRAMME TO ENHANCE THE MARINE SCIENCE CAPABILITIES OF DEVELOPING COUNTRIES

52 The IOC Assistant Secretary outlined the background to, and the content of, the Unesco/IOC Comprehensive Plan, and indicated the principal modalities proposed for its implementation. He indicated the need to determine first the situation in the Member States and defined the purpose of Marine Science Country Profiles. Following this assessment of the current state of affairs, it was necessary to present one or more regional or subregional projects designed to build up national infrastructure, capacity and capability in the marine science and the related technology.

53 He finally stressed the importance of having a national mechanism, if not already existing, to concentrate and co-ordinate national actions to satisfy national needs in marine affairs.

54 Some doubt was expressed as to the validity of elaborating regional or sub-regional projects unless funding was available. It was pointed out that multilateral and bilateral funding agencies will only respond positively if a clearly laid out proposal is presented, if it is likely to contribute substantially and fairly quickly to economic development, and is given a high priority by a large number of interested governments.

55 Stress was laid on the need to base such infrastructure building on real problems in the region. Pollution of the coastal zone and shoreline erosion were cited as two leading candidate problems.

56 Other participants suggested that some universal problems could be chosen as a basis for regional co-operation and, therefore, for a regional project. Comparison and analysis of all available regional data on a particularly important problem, such as those mentioned above, is desirable. Every opportunity should be taken to intercalibrate the physical, chemical and biological methods and instruments used, so as to guarantee the comparability of data. A further suggestion was the adoption of standard methods for the study of, for example, coastal erosion. It was pointed out that the existing sea-level/tide gauges were not generally being calibrated and the data were not therefore comparable.

57 Appreciable concern was expressed over the significant imbalance existing in the region in the level of development of marine science. Equatorial Africa is considered to be substantially behind in this respect.

58 It was agreed that a great effort to sensitize governments was required and that this could be achieved by two approaches: (i) the participants should inform their respective governments of the issues raised, and the recommendations made, at this Workshop; and (ii) the IOC should address the Report of the Workshop and other relevant documentation to the highest possible level of government. Emphasis should be placed on the economic (development) advantages to be expected as a result of the implementation of regional/subregional research projects.

## 5.2 OPTIMIZATION OF THE USE OF RESEARCH VESSELS AND PLATFORMS

59 The IOC Assistant Secretary explained the current efforts of the IOC to address this problem, noting particularly the proposed IOC-FAO International Workshop on the Improved Uses of Research Vessels to be held in Lisbon from 28 May to 2 June 1984 with the support of the Norwegian Agency for International Development (NORAD). He invited the participants to suggest themes for discussion at such a Workshop.

60 At the national level, two main kinds of problems were evoked: the high cost of acquiring a specialized oceanographic research vessel; and the great difficulty and cost of maintaining and operating such a vessel. Another difficulty experienced in their operation was that such vessels often belonged to one national entity, such as a ministry, which was loathe to let another entity use it. There is, therefore, a need for national concertation and co-ordination. It was thought that it would be much harder to co-operate at the regional level if it was still problematical at the national level. Even though fishery research was among the high priorities of most countries of the region, it was much cheaper to purchase a trawler 3 or 4 years old, of which many are available, particularly in the Gulf of Mexico region, and to strip it and fit it for basic oceanographic and fisheries research, than to purchase a sophisticated modern purpose-built research vessel. The suggestion was thought to be at least half as costly.

61 With regard to the operation of a small number of vessels on a regional or subregional basis, it was believed that there would be appreciable difficulty due to transfer of operating funds from co-operating countries to the operating country (or countries), and that the same problems (obtaining and paying for spare parts, skilled crew, appropriate maintenance), would still have to be faced and could not always be solved by money. Nevertheless, it was pointed out that CECAF had conducted some special surveys using a small number of ships, and this had been successful.

62 The participant from Spain (Instituto Español de Oceanografía) informed the Workshop that Spanish research vessels could be made available for co-operative regional or subregional studies, but it was recognized that this, while offering certain useful possibilities, was not a substitute for co-operation in the use of vessels from the countries of the western African region itself.

63 The Observer from Denmark informed the Workshop of the problems experienced in his country in optimizing the use of research vessels. These problems were not unlike those experienced in the western Africa region: lack of funds, lack of staff, substantial shore-side infrastructure (quays, workshops, maintenance, calibration and intercalibration of instruments).

64 It was generally agreed that there was no easy solution unless a substantial amount of external funding was made available for the operation of regional research vessels.

### 5.3 SUPPORT TO ONGOING AND PLANNED RESEARCH PROJECTS AND OCEAN SERVICE ACTIVITIES

65 The IOC Assistant Secretary invited the participants to identify, as far as possible, training needs or training opportunities.

66 The Representative of Unesco, Mr. B. Mwaiseje, outlined the current training activities of the Division of Marine Sciences, referring particularly to the Major Inter-regional Project on Research and Training Leading to Integrated Management of Coastal Systems (COMAR) and three regional Workshops organized by Unesco in Western Africa, on: Coastal Lagoons, Estuaries and Mangroves; Methodology of Estuarine and Mangrove Research; and Control of Coastal Erosion (in collaboration with UN(DIESA) and UNEP). He informed the participants that, after some difficulties, Unesco and ECA had worked out their respective roles, following the Unesco-ECA Workshop on the Present State and Future Development of Marine Sciences and Technology in Africa, (Addis Ababa, June 1981), in which IOC also cooperated.

67 Some participants stressed the importance of relating training to existing projects, but in some countries no appropriate marine science project or activity was going on, often because of a lack of trained personnel. A way had, therefore, to be found to overcome this vicious circle.

68 Others believed that training could only be useful after an adequate infrastructure has been built up, even if this consisted only of a basic oceanographic laboratory. Some thought that there was a major need for support for laboratories in terms of equipment and supplies, and if necessary for assistance in maintenance services; the IOC Trust Fund and the Voluntary Assistance Programme (VAP) could, it was believed, be used for such a purpose. It was also stressed that scientists from African countries must work on African problems, and that a solid basis in one of the principal sciences of oceanography (physics, chemistry, biology, geology) was more important than more specialized studies.

69 Nevertheless, the importance of very specific training as a means of solving particular problems was recognized. It was generally agreed that the co-operative activities should be relatively simple but effective, notably sea-surface temperature and sea-level measurements.

70 Several speakers mentioned training opportunities in the framework of the IOC's Training, Education and Mutual Assistance in the Marine Sciences (TEMA). Brazil was in a position to offer training courses in oceanography and hydrography, through a one-year course with the Brazilian Navy, although civilians take these courses, as well as Navy officers.

Brazilian universities offer 4-year courses in oceanography to M.A. level, as well as in Marine Biology and Marine Geology; these universities offer a PhD course in marine geology. Courses are given in the Portuguese language for which special courses are offered to trainees who do not speak Portuguese. Application for such training should be made through Brazilian embassies. The University of Bordeaux offers training of 2-3 weeks duration on various methods in marine geology, particularly of the coastal zone (shoreline erosion, morphology, etc.); these methods are not necessarily sophisticated. This training will be made available through the Secretary of IOC. The Workshop was reminded of the five fellowships in marine science offered by the Spanish Government for candidates from western African countries, also in the context of the IOC programme of Training, Education and Mutual Assistance in the Marine Sciences.

71                    These offers will be brought to the attention of Member States by the Secretary of IOC.

6.                    FUTURE DEVELOPMENT OF MARINE SCIENCE CO-OPERATION IN THE CENTRAL EASTERN ATLANTIC

72                    The IOC Assistant Secretary informed the Workshop that, at the Eleventh Session of the IOC Assembly (Unesco, Paris, October-November 1979), at the request of the countries of the region, the IOC, by Resolution XI-18, instructed its Secretary to arrange, in collaboration with the Division of Marine Sciences of Unesco, for a Workshop on Marine Science Co-operation between countries of the Atlantic coast of Africa and any other interested IOC Member States. The Assistant Secretary outlined the IOC mechanism or regional subsidiary bodies available for such co-operation, as well as relevant experience in other ocean regions in which such IOC mechanisms have been set up. He invited participants to identify requirements for, and comment on, co-operative marine scientific research and related activities in the central eastern Atlantic, as well as to advise on the desirability of strengthening co-ordinated action among the various international agencies concerned with marine scientific affairs in the region, in order to develop the scientific basis required for the efficient exploitation and conservation of the marine resources and environment of the region.

73                    The lack of local infrastructure, funding, equipment and manpower was evoked as a rationale for postponing the building up of a Programme Group for Western Africa. The Workshop, nevertheless, considered such an argument as likely to prevent West African countries from moving towards improving their own situation with regard to marine sciences. It was believed that, whatever this situation might be, it was possible to improve it through co-operation between countries in the Region, on the grounds that: (i) some important data could be easily gathered by very simple means, and (ii) unexploited data on the region were known to be numerous and not very difficult to obtain.

74 The imperative of many countries in the region to control better the exploitation of the living resources in territorial waters and in their exclusive economic zones, it being recognized that resources were often part of a regional resource, was put forward as a reason for the development of regional co-operation not only with respect to the ecology of exploited stocks but also to the climatic implications of certain studies. The recognized importance of fisheries to many of the national economies of the region, and thus of regional fishery research, led the Workshop to consider that such research should be closely co-ordinated with the activities of the FAO Fishery Committee for the Eastern Central Atlantic (CECAF). It was pointed out that FAO has been invited to co-sponsor the IOC programme of Ocean Science in Relation to Living Resources (OSLR), which would probably include, in due course, study of the relationship between fish stocks and variation in the marine environmental parameters in this region, in which case co-operation with CECAF would be essential and for which an analogous IOC regional subsidiary body would be a considerable advantage. The required research in the region goes beyond living marine resources research, and includes research on marine pollution, the marine climate and non-living resources.

75 The variety and range of such research implies that, at a certain stage of its implementation, a regional co-ordinating mechanism will be required. The Workshop participants recommended that if the IOC decided to convene an intergovernmental meeting for a regional co-ordinating mechanism, it should do so in a country of the Western African region.

#### PROPOSALS FOR CO-OPERATIVE STUDIES

76 Regarding coastal ocean dynamics and climate (Agenda Item 3.2), the Workshop proposed the establishment, along the west coast of Africa, including the offshore islands, of a network of coastal stations (if possible, at least two per country) judiciously sited to reflect open-sea conditions and local coastal phenomena but not subject to non-marine factors such as river mouths. The measurements undertaken at these coastal stations should have a double objective: ecological on the one hand; climatological on the other. These coastal stations should be organized so as to be able to generate very long time-series of data.

77 The parameters to be measured at these stations are, in order of difficulty of acquisition of data:

- coastal sea-surface temperature.
- coastal sea-surface salinity.
- sea level measured by tide gauge.
- a temperature profile to a depth of several tens of meters over the continental shelf.
- a vertical salinity profile, likewise.
- a vertical profile of nutrient salts and dissolved oxygen, likewise.
- a vertical current profile, likewise.

78 Such a network of coastal oceanographic stations should be complemented by a network of meteorological stations measuring, at least, the wind speed and direction. Bearing in mind the influence, on upwelling, of wind stress, along the west coast of Africa, locally and in the western Atlantic,

the acquisition of data on useful meteorological parameters should be extended to South America. This would imply the extension of regional co-operation to international co-operation; in effect, an east-west co-operation.

79 The study of the variations in certain mechanisms implies a judicious choice of a working time scale; that required for the study of upwelling is not the same as that for the study of interannual variations in mean sea level, which is a low-frequency phenomenon.

80 Another useful activity is the evaluation of temporal variation in mean values of meteorological parameters by 10<sup>2</sup>-squares.

81 It was noted that the establishment of such a network of stations would contribute significantly to Atlantic Ocean Climate Studies being planned by the Joint SCOR-IOC Committee on Climatic Changes and the Ocean (CCCCO), and the coastal stations would, therefore, also benefit from the association of activities.

82 Regarding marine ecosystems and living resources (Agenda Item 3.3), the participants, although aware that the evaluation of fish stocks is the responsibility of CECAF, recognized that many kinds of research relating to fish stocks, especially basic ecological research, were not conducted by CECAF itself. It was also recognized that the study of the food chain, which is a fundamental area of research, is very complex and difficult to carry out and does not necessarily result in a better understanding of the stocks. This type of research, which was thought not likely to have an early impact on national development, was set aside for the time being.

83 From the ecological standpoint, it was agreed that upwelling in the Gulf of Guinea is still poorly known, with respect to its mechanisms and its impact on the stocks exploited in Ghana and the Ivory Coast, in particular, and that it should form the basis of a co-operative sub-regional research project. From the physical oceanographic standpoint, a study of the coupling between the variation in this upwelling and the variations in the "Southern Oscillation" should be made.

84 Therefore, approached at once from the standpoint of mechanisms and their ecological significance, the study of upwelling in the Gulf of Guinea would reinforce the study of coastal dynamics, and could become a component of the IOC programme of Ocean Science in Relation to Living Resources (OSLR).

85 Regarding continental margins and non-living resources (Agenda Item 3.4), the Workshop participants recognized that numerous data on bathymetry, sedimentation and sea-floor structure exist but are not available, and that they could be assembled and analysed, and thus lead to significant progress in this field.

86 In this light, the bathymetry of western African continental margin would appear to be particularly promising, since regional co-operation in this field is relatively easy. An effort of co-ordination is required to assemble all the useful bathymetric data on the continental shelf, to quality-control them from the standpoint of the quality of the measurement and the precision of of positioning, to plot on the chosen scale the echosounder recordings and

draw the bathymetric contours. The same work should then be done for the continental slope and margin, although this would doubtless require the collection of additional data.

87 An essential element in this work is the choice of a single scale for all the bathymetric charts of the continental margin of western Africa.

88 Another field in which fruitful regional co-operation could be set up is the preparation of mineralogical charts, which would promote co-ordination of similar studies throughout the region.

89 Regarding marine pollution research and monitoring (Agenda Item 3.5), the Workshop participants noted that a co-operative programme is being undertaken in the region in this field within the UNEP Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the West and Central African Region, in which FAO, IOC and other organizations are involved. This programme had been proposed by the IOC-FAO-WHO-UNEP Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas (Abidjan, 2-9 May 1978). The Workshop participants considered that the recommendations of the Abidjan Workshop were still valid and decided not to recommend any new marine pollution projects.

7. ADOPTION OF THE SUMMARY REPORT

90 The Workshop participants adopted the draft Summary Report in its French and English versions. In doing so, they agreed that the IOC Secretariat should be free to adjust it editorially from the point of view of correctness of points of information and presentation in accordance with IOC style, as well as to harmonize the French and English versions.

8. CLOSURE OF THE WORKSHOP

91 The Chairman, in closing the Workshop, thanked the participants for their constructive spirit during the debates. He stressed the importance of sensitizing the governments of the western African region to the needs for marine scientific co-operation in the eastern central Atlantic, and asked the participants to do their best to bring the recommendations of the Workshop to the attention of their respective national authorities concerned.

92 He thanked the supporting staff and secretariat, and the Director of the Centro Costero de Canarias for the excellent services and hospitality given to the Workshop.

93 Dr. Gómez Gallego, on behalf of the Instituto Español de Oceanografía, the Centro Costero de Canarias, expressed his satisfaction with the outcome of the Workshop and renewed his Government's offer of collaboration in the future.

94 The Chairman closed the Workshop at 16.30 on 16 December 1983.

ANNEX I

AGENDA

1. Opening of the Workshop
2. Administrative arrangements
  - 2.1 Designation of a Chairman, Vice-Chairman, and Rapporteurs
  - 2.2 Adoption of the Agenda
  - 2.3 Conduct of the Workshop, time-table and documentation
3. Review of the marine scientific activities in the region and future research
  - 3.1 State of activities in Member States
  - 3.2 Coastal ocean dynamics and climate
  - 3.3 Marine ecosystems and living resources
  - 3.4 Continental margins and non-living resources
  - 3.5 Marine pollution research and monitoring
4. Requirements for, and development of, ocean services
  - 4.1 Integrated Global Ocean Services System (IGOSS)
  - 4.2 Documentation and information exchange
5. Training, Education and Mutual Assistance (TEMA) in the Marine Sciences
  - 5.1 Implementation, in the region, of the Comprehensive Plan for a Major Assistance Programme to Enhance the Marine Science Capabilities of Developing Countries
  - 5.2 Optimization of the use of research vessels and platforms
  - 5.3 Support to ongoing and planned research projects and ocean-service activities
6. Future development of marine science co-operation in the central eastern Atlantic
7. Adoption of the Summary Report
8. Closure of the Workshop

ANNEX II

SUMMARY OF RECOMMENDATIONS

Subject and Agenda Item	Nature of Recommendation
Coastal ocean dynamics and climate (3.2)	The establishment of a network of coastal oceanographic/meteorological stations along the west coast of Africa, including offshore islands, for ecological and climatological purposes.
Marine ecosystems and living resources (3.3)	It is premature to undertake complex studies of food chains, but an ecological study of upwelling in the Gulf of Guinea, with respect to its mechanisms and its impact on fish stocks, should be undertaken. A study of the coupling between variations in such upwelling and in the "Southern Oscillation" should also be made.
Coastal margins and non-living resources (3.4)	Available data on bathymetry, sedimentation and sea-floor structure should be assembled and analysed, first for the continental shelf and eventually for the continental margin and slope. Mineralogical charts should be prepared.
Marine pollution research and monitoring (3.5)	The recommendations of the IOC-FAO-WHO-UNEP Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas (Abidjan, 2-9 May 1978) are still valid and a co-operative programme on marine pollution is being undertaken under the UNEP Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the West and Central African Region; therefore, no new projects should be undertaken.
Documentation and information exchange (4.2)	IOC should organize a regional seminar on marine science information infrastructure.
Future development of marine science co-operation in the central eastern Atlantic (6)	The variety and range of research recommended implies that, at a certain stage of its implementation, a regional co-ordinating mechanism will be required. If IOC decides to convene an inter-governmental meeting for such a mechanism, it should do so in a country in the western African region.

✕ The recommendations made by the Workshop are embodied in the text; they are briefly summarized here for ease of reference.

ANNEX III

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LISTE DES PARTICIPANTS  
LISTA DE PARTICIPANTES

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ANNEX IV

	OCEANOGRAPHY				MARINE ECOLOGY				MARINE GEOLOGY AND GEOPHYSICS		MARINE POLLUTION			RESEARCH VESSEL
	Dynamics	Sea Level	Hydrology (hydroclimate)	Chemistry	Primary Production	Secondary Production	Marine Biology	Benthos	Geology	Geophysics	Oil Pollution	Heavy Metals	Erosion	
Angola			x	x?			x				x?			x
Benin		x												
Cameroun			x				x							
Cape Verde (2)														
Congo	x	x	x	x		x					x			x (1)
Gabon	x?		x?	x?		x	x	x	x		x			
Gambia (2)														
Ghana		x	x			x	x						x	x
Guinea	x	x	x	x	x	x	x	x	x	x		x		x
Guinea-Bissau (2)														
Ivory Coast	x	x	x			x	x	x	x					x (1)
Liberia (2)														
Mauritania			x	x			x				x			x
Morocco			x				x	x	x		x			x
Nigeria			x	x			x		x		x			x
Senegal			x				x	x	x		x			x
Sierra Leone						x	x						x	
Sao Tome & Principe (2)														
Togo		x	x				x							x (1)
Zaire (2)														

(1) Shared between Congo, Ivory Coast and Togo.

(2) No information available.

ANNEX V

LIST OF ACRONYMS

ASFA	Aquatic Sciences and Fisheries Abstracts
ASFIS	Aquatic Sciences and Fisheries Information System
CCCCO	Committee on Climatic Changes and the Ocean (SCOR-IOC)
CECAF	Fishery Committee for the Eastern Central Atlantic
CINECA	Cooperative Investigations of the Northern part of the Eastern Central Atlantic
CNEXO	Centre National pour l'Exploitation des Océans
COMAR	Major International Project on Research and Training leading to Intregrated Management of Coastal Systems
ECA	Economic Commission for Africa
FAO	Food and Agriculture Organization of the United Nations
GEBCO	General Bathymetric Chart of the Oceans
IAEA	International Atomic Energy Agency
IEO	Instituto Español de Oceanografía
IGOSS	Integrated Global Ocean Services System
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data Exchange
MARLPOLMON	Marine Pollution Monitoring Programme
MEDI	Marine Environmental Data Information Referral System
OSLR	Ocean Science in Relation to Living Resources
TEMA	Training, Education and Mutual Assistance in the marine sciences
UN	United Nations
UN(DIESA)	Department of International, Economic and Social Affairs of the United Nations

UN(OETB)	Ocean Economics and Technology Branch of the United Nations
UNEP	United Nations Environment Programme
Unesco	United Nations Educational, Scientific and Cultural Organization
WACAF	Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the West and Central African Region
WCRP	World Climate Research Programme
WHO	World Health Organization
WWW	World Weather Watch