Intergovernmental Oceanographic Commission

Workshop Report No. 62

Second Workshop of Participants in the Joint FAO-IOC-WHO-IAEA-UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2 - First Phase)

Accra, Ghana, 13-17 June 1988

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IOC Workshop Reports

The Scientific Workshops of the Intergovernmental Oceanographic Commission are usually jointly sponsored with other intergovernmental or non-governmental bodies. In each case, by mutual agreement, one of the sponsoring bodies assumes responsibility for publication of the final report. Copies may be requested from the publishing bodies as listed below.

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 Santitham Bangkok 2, Thailand	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)
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)
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)
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
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
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
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)
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
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
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)
11 Suppl.	Collected contributions of invited 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
12	Report of the IOCARIBE 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
13	Report of the IOCARIBE 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
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
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)
16	Workshop on the Western Pacific, Tokyo, 19-20 February 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Russian
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
17 Suppl.	Papers submitted to the Joint 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
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 (out of stock) French Spanish (out of stock) Russian
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
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
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
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
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
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)
25	Workshop on the Intercalibration 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)
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
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
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
29	WESTPAC Workshop on Marine biological methodology Tokyo, 9-14 February 1981.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
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
31	Third International Workshop on Marine Geoscience Heidelberg, 19-24 July 1982	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish
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
32 Suppl.	Papers submitted to the 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

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SUMMARY REPORT

ANNEXES

1. OPENING OF THE WORKSHOP

The Second Workshop of Participants in the Joint FAO-IOC-WHO-IAEA-UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2) was opened by Mr. Ansa-Otto on behalf of the Provisional National Defense Council (PNDC) Secretary for Transport and Communication, at 10.00 on Monday, 13 June 1988, at the Hotel Ambassador in Accra.

The Workshop was attended by 29 participants from 10 countries (Senegal, The Gambia, Sierra Leone, Côte d'Ivoire, Ghana, Benin, Nigeria, Cameroun, Congo and Gabon). The List of participants is given in Annex III.

Lt.Col. (Rtd) Ms. Christine K. Debrah, Executive chairman of the Environmental Protection Council (EPC) welcomed the Participants and the members of the Secretariat from the sponsoring United Nations Agencies.

The Chairman of the opening Session, Mr. C. Dorm-Adzobu, Director of Programmes at EPC passed on the floor to Mr. T. Taka, the FAO Regional Representative for africa, who addressed the Workshop by emphasazing the need for marine environmental control in this region because of the increasing marine pollution thus threatening marine resources and human health ir the region.

The Representative of the Intergovernmental Oceanographic Commission (IOC), Mr. S.K. Jensen, welcomed the participants on behalf of the Secretary of IOC and expressed, on behalf of the organizers, his gratitude to the Ghanaian Authorities for their willingness to host the Workshop.

The Representative of the United Nations Environment Programme, Mr. M. Gerges, addressed the meeting on behalf of the co-operating United Nations Agencies. He reviewed the development of the Action Plan for the protection and development of the marine and coastal areas of West and Central Africa. Mr. Gerges highlighted the objectives of the WACAF/2 Project for marine pollution monitoring in the region, and emphasized the importance of the present workshop in consolidating the results obtained from the first phase of the project, and in formulating recommendations for its future development on the basis of experiences gained and the discussions during the workshop itself. Mr. Gerges expressed sincere appreciation and gratitude of UNEP and all agencies to the Ghanaian Authorities for kindly accepting to host the meeting and - particularly to the Environmental Protection Council and the Institute of Aquatic Biology for their able support to the workshop. He wished the participants all the success and declared the scientific part of the workshop officially open.

2. ELECTION OF CHAIRMAN, VICE-CHAIRMEN AND RAPPORTEUR

Mr. M.A. Odei (Ghana) was unanimously elected as Chairman for the Workshop. Mr. J.F. Makaya (Congo), Mr. D. Ba (Senegal) and Ms. N.I. N'Jie (The Gambia) were unanimously designated as Vice-Chairmen and Mr. F.E. Ikome (Cameroun) wad designated as Rapporteur.

3. ORGANIZATION OF THE MEETING

The Representative of IOC informed the participants on the servicing arrangements and the working hours for the workshop sessions were settled. He also introduced the list of documents as listed in Annex II.

4. ADOPTION OF THE AGENDA

The Provisional Agenda was adopted without any amendments. The Agenda is given in Annex I to this report.

5. DEVELOPMENT AND STATUS OF WACAF/2

The Co-ordinator of the WACAF/2 Project, Mr. T. Orekoya, of the Food and Agriculture Organization of the United Nations (FAO), presented a consolidated report on the development and the status of the WACAF/2 Project since its start.

Mr. Orekoya reminded the Workshop of the objectives of the project given in the Project document. The long-term objectives were:

(i) To establish a co-ordinated marine pollution monitoring programme, based on intercomparable methods, to be used for the assessment of the sources, levels and effects of pollutants on marine life and health;

(ii) To compile an inventory of the sources and amounts of pollutants reaching the coastal waters of the region from land-based sources;

(iii) To encourage and support the training of regional scientists and technicians in methods and techniques related to the assessment and evaluation of marine pollution;

(iv) To encourage and support the exchange of information on techniques, data and interpretation; and

(v) To contribute to the International Global Environment Monitoring System (GEMS) as it applies to the world's oceans.

The short-term objectives were outlined as follows:

(i) To arrange and organize appropriate training of scientists and technicians from the region;

(ii) To provide necessary equipment (and maintenance) for pollution monitoring activities as listed in the budget;

(iii) To arrange for appropriate intercalibration exercises between laboratories participating in pollution monitoring; and

(iv) To plan and begin field collection and analysis of samples for various pollutants.

Mr. Orekoya further reviewed the execution of the various project components separately and stated the main achievements and the difficulties encountered in the project. He also referred to shortcomings in the execution of the project and gave some proposals for improvement of the implementation of the project. His report is given in Annex IV.

6. THE STATE OF THE CONTAMINATION IN THE MARINE ENVIRONMENT IN THE WEST AND CENTRAL AFRICAN REGION

The scientific results obtained during the first phase of the project were presented. The presentations were given by the responsible scientist from each laboratory. The scientific reports from the participating laboratories are published as a supplement to this report. A summary of the scientific results of the project is given in Annex V.

6.1 LEVELS OF METALS, CHLORINATED HYDROCARBONS AND PETROLEUM COMPONENTS IN MARINE BIOTA

6.1.1 Individual Scientific Reports by Responsible Scientists

Seven scientific reports were presented by the participating scientists (Côte d'Ivoire, Sierra Leone, Nigeria, The Gambia, Ghana and Cameroun). Three of the presented reports were on organochlorines and four dealt with trace metal levels in marine organisms (see Annex II).

6.1.2 Data Quality Assurance

The Representative of the International Atomic Energy Agency (IAEA) reviewed the results obtained during the data quality assurance intercalibration exercises carried out in the region during the first phase (see Annex VI).

The results received are still within acceptable range. However, there seems to be a trend for values to be higher than the range of finally certified concentrations. Considering that most results were clearly better in the second exercise, after equipment service, part of the earlier deviation might be attributed to instrument malfunctions.

These results can be regarded as fairly encouraging for the future development in the West and Central African marine pollution monitoring programme.

6.2.3 Review of Work and Summary of Results

The Co-ordinator of WACAF/2, Mr. Orekoya, gave a summary of the results obtained during the first phase.

Mr. Orekoya further reviewed the results and noticed the great variations in the reported results from some of the laboratories. It was therefore emphasized that attention should be given to quality assurance and good laboratory practice measures in the future.

6.2 OBSERVATIONS OF OIL SLICKS AND TAR ON BEACHES, SAMPLING AND ANALYSIS OF FLOATING TAR AND BASIC OCEANOGRAPHIC OBSERVATIONS

6.2.1 Individual Scientific Reports by Responsible Scientists

Six scientific papers were presented (Côte d'Ivoire, Congo, Senegal, Ghana, Nigeria and Cameroun) (See Annex II). The results presented were mainly obtained by collection of tar on beaches. Some of the papers also included basic oceanographic observations. One paper was submitted but not presented since the principal investigator was unable to attend the meeting (Nigeria). In addition detailed workplans from two laboratories were submitted (The Gambia, Benin).

6.2.2 Data Quality Assurance

A brief presentation of adequate quality assurance measures in relation to collection of tar on beaches was given by the representative of IOC. It was emphasized that the use of common sampling methods is very essential in these studies. Other relevant aspects such as storage and transportation of samples, good laboratory practice etc. were outlined.

6.2.3 Review of Work and Summary of results

The representative of IOC gave a short summary of the results obtained during the first phase (see Annex V). The results on tar on beaches show considerable variations within the region. The variations probably reflect differences in input levels from offshore sources.

It was noted that strong emphasis should be put on the development of the basic oceanographic studies in order to better understand the spreading and transportation of tar balls in the coastal environment.

6.3 MONITORING OF MICROBIAL QUALITY OF RECREATIONAL WATERS

6.3.1 Individual Scientific Reports by Responsible Scientists

Results from work carried out in coastal waters in four countries (Senegal, Ghana, Benin and Gabon) were presented (Annex II). A workplan for another laboratory (The Gambia) was presented. The results indicated heavy faecal pathogen levels in some of the sampling areas.

6.3.2 Review of Work and Summary of Results

The representative of the World Health Organization Mr. K.O. Iwugo reviewed the work pointing out that since the studies under this component have just begun to be carried out in many of the laboratories it was felt that a continued monitoring period was still needed in order to generate sufficiant results on which firm statements can be given. First set of results is summarized in Annex V.

The Representative of WHO also informed the meeting that a group training workshop on the practical aspects of the microbiological monitoring of coastal waters and seafood will be held in Accra from 20 - 22 June 1988 and that WHO intends to publish the proceedings.

7. REGIONAL REVIEW OF THE STATE OF THE MARINE ENVIRONMENT IN WEST AND CENTRAL AFRICA

Mr. Charles Biney presented a Regional Review of the State of the Marine Environment in West and Central Africa, prepared by a task team of which he was a member.

The review was carried out in connection with a recent global assessment of the state of the marine environment in the framework of Working Group No. 26 of the IMO-FAO-UNESCO-WMO-WHO-IAEA-UN-UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). The regional review will be published in UNEP Regional Seas Reports and Studies.

In his presentation Mr. Biney outlined the major marine pollution sources. In this connection it was mentioned that textiles, food, petroleum and mining account for approx. 95% of the pollution in this region. Further he reviewed the estimated levels of pollutants in this marine environment, and finally he called for marine pollution control measures to be established.

8. FUTURE DEVELOPMENT IN MARINE POLLUTION RESEARCH AND MONITORING

8.1 PROGRAMME PROPOSED FOR WACAF/2 - PHASE II

The Chairman introduced this subject and invited the meeting to make proposals and recommendations for future work under WACAF/2 Phase II.

Participants referred to the objectives of the project and noted that during the first phase of the project for most of the components of WACAF/2 the short-term objectives had been met. For the next phase of the project it was felt that monitoring in the marine environment should continue to provide a sound data base on the state of pollution. Such monitoring, however, should now be focused on coastal waters, lagoons and estuaries where pollution effects were more likely to occur than in open waters. Data delivered from monitoring would now have to be linked to information on sources of pollution, transport pathways and fate of pollutants and on biological effects of pollution. This would necessitate the inclusion of a strong research component into the project activity, which would result in a better understanding of marine pollution problems in the region, the identification of pollutants of regional and local relevance, and estimation of pollution loads in coastal waters.

Ultimately the continued monitoring of pollution, combined with relevant research activities, would be expected to provide a valid tool for environmental management and become a basis for actions at national and regional level to prevent, control and abate marine pollution. For each of the four components of the project, participants agreed upon specific recommendations for the continuation of pollution monitoring and the initiation of research activities.

COMPONENTS A/B (METALS AND ORGANOCHLORINES)

A. It was agreed to continue studies on levels and trends of trace metals and organochlorines with emphasis on substances of local importance and on nearshore coastal waters, lagoons and estuaries. Specific aspects of the monitoring programme should be:

(i) geographic expansion of the project's coverage by mutual exchange of samples between laboratories equipped for either metal or organochlorine analysis.

(ii) Continuation of data quality assurance programmes and regular intercalibration exercises.

(iii) Proposing alternative simplified analytical methods specifically adapted for use in the region, for consideration in the development of the revised Reference Methods for Marine Pollution Studies.

B. A research programme was proposed to assess the hazards posed by selected substances to particularly exposed environments such as coastal lagoons, including the following steps:

(i) identification of sources of pollutants.

(ii) Quantification of pollutants reaching the aquatic environment.

(iii) Calculation of pollution loads and of potential environmental distribution of the pollutant.

(iv) Verification of levels of pollutants in biota, sediment, and where possible, in water by chemical analysis.

(v) Evaluation of potential damage to aquatic life through review of toxicity data.

(vi) Establishment of water quality criteria.

(vii) Calculation of "safe" effluent standards.

(viii) Compilation of "black" and "grey" lists of pollutants for environment management purposes.

COMPONENT D (MICROBIAL POLLUTION)

Since the objectives of the first phase of the project, to provide baseline data on the degree of pollution of coastal waters, have not yet been fully met, emphasis of this component will be generally maintained.

The agreed objectives of the next phase therefore are:

(i) to continue with "minimum monitoring" of the coastal bathing waters of the West and Central African Region using such basic microbial parameters as the total coliforms, faecal streptococci, faecal coliforms and possibly Clostridium perfrigens.

(ii) To extend the microbial monitoring programme to include the salmonell, the shigell and possibly Vibrio cholerae.

(iii) To apply the established microbial techniques developped during the monitoring of the coastal bathing waters to the analysis of seafood.

(iv) To encourage some of the laboratories to carry out applied research studies aimed at assessing the suitability of some of the microbial monitoring parameters for the assessment of the quality of coastal waters and seafood.

(v) To attempt to correlate some of the microbial parameters with the basic water quality parameters such as pH, temperature, alkalinity, dissolved oxygen, hardness and salinity.

8.2 GENERAL RECOMMENDATIONS

The Second Workshop of WACAF/2 further made the following general recommendations:

(i) To continue the process of training of scientific personnel and technicians. The training in the second phase of the project should however be based on the following criteria:

a) To fill gaps of training, carefully identified to meet the actual manpower requirements for the effective implementation of the various components of the project.

b) Priority should be given to scientists who are not yet trained or whose laboratories joined the project recently, or to upgrade previously trained personnel on newly developed methodologies.

c) Training should lead to the acquisition of credible data on the state of the marine environment.

d) Training should be gradually centered in the region. To this effect two or more developed laboratories could be selected in the region with adequate personnel and technical backup which could provide the future training of participants in the region.

(ii) To create a co-ordination mechanism between laboratories of the same country participating in the various components of the project. In each country all laboratories participating in WACAF/2 may select from amongst their scientist a senior scientist who will act as a "scientific co-ordinator for WACAF/2", whose task will be to liaise between WACAF/2 participants, assess the progress made in the implementation of the project activities at a national level. The national scientific co-ordinator for WACAF/2 would also lobby to increase his country's participation in the project and relate adequately with Government authorities within his country such as Focal Points for UNEP and the WACAF Action Plan as deemed necessary.

(iii) Any expansion of the network of participating institutions should be decided on the basis of present status of development of each component and the need for improving the geographic coverage for the respective components.

(iv) To ensure the convening of regular meetings of the scientists involved in the project to review the progress of the project and to discuss scientific results and any practical problems encountered in the implementation of the project.

(v) Exchange of information should be assured between laboratories participating in the same component in the different countries on the one hand, and between WACAF/2 participants and the participants in similar projects in other regions on the other hand. The Committee on Seas of the African Ministerial Conference on the Environment (AMCEN) could play a role in setting up the inter-regional mechanism for exchange of information at the African level.

(vi) The maintenance service for equipment provided through the project to the laboratories participating in the various components should be continued. It was however suggested that in order to improve the maintenance service, an electronic engineer from the region should be trained and put at the disposal of the project.

9. OTHER BUSINESS

The Representative of UNEP, Mr. M. Gerges, in his capacity as the Secretary of the Committee on Seas of the African Ministerial Conference on the Environment (AMCEN) reviewed the history and activities of the Committee, with special reference to its First meeting held in Algiers, 25-27 May 1987, which was attended by four experts from the WACAF Region, selected in concultation with the Chairman of the Steering Committee of the Action Plan.

Mr. Gerges further explained that the main purpose of the Committee is to promote the co-operation between the four Regional Seas Action Plans in Africa, namely: the Mediterranean, the Red Sea and Gulf of Aden, WACAF and East Africa. The Committee also endeavors to solicit additional funds for on-going projects of these action plans or for new projects contributing to the protection and development of the African coastal and marine environment and its resources. The participants were also briefed on the forthcoming meeting of the Committee planned to be held in Cairo, Egypt, later this year, which will consider among other issues the possible mechanisms for exchange of information and expertise between the four African sub-regions and ways and means for strenghtening the interregional co-operation at the African level.

The project co-ordinator, Mr. T. Orekoya, invited comments on the usefullness and future form of the WACAF/2 Newsletter. Participants were of the opinion that the Newsletter should continue to be produced with special emphasis on scientific results obtained in the region. Participants were urged to submit scientific contributions regularly to ensure continued publication of the Newsletter.

10. ADOPTION OF THE REPORT

The draft report was reviewed, amended and approved by the participants. Editorial improvements were entrusted to the Secretariat.

11. CLOSURE

Formal statements were given by the Workshop Chairman and the Representative of the EPC Executive Chairman Mr. C. Dorm-Adzobu, and followed by closing remarks from the Representative of UNEP on behalf of the co-operating agencies.

In his closing remarks, Mr. M. Gerges highlighted the success of the Workshop in achieving its objectives and further encouraged the participants to consolidate their efforts in the forthcoming phase of the project. He thanked the participants for their contributions, the Ghanaian authorities for all assistance and facilities provided and to all those who made the success of the Workshop a reality. A vote of thanks was given by Mr. D. Ba (Senegal) after which Mr. Gerges declared the workshop officially closed at 13:00 hours on 17 June 1988.

ANNEX I

AGENDA

1. **OPENING**

2. **ELECTION OF OFFICERS**

3. **ORGANIZATION OF WORK**

4. **ADOPTION OF THE AGENDA**

5. **DEVELOPMENT AND STATUS OF WACAF/2**

6. **THE STATE OF THE CONTAMINATION OF THE MARINE ENVIRONMENT IN THE WEST AND CENTRAL AFRICAN REGION**

   6.1 LEVELS OF METALS, CHLORINATED HYDROCARBONS AND PETROLEUM COMPONENTS IN MARINE BIOTA

      6.1.1 Individual scientific reports by responsible scientists

      6.1.2 Data quality assurance

      6.1.3 Review of work and summary of results

   6.2 OBSERVATION OF OIL SLICKS AND TAR ON BEACHES, SAMPLING AND ANALYSIS OF FLOATING TAR AND BASIC OCEANOGRAPHIC OBSERVATIONS

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8. FUTURE DEVELOPMENT IN MARINE POLLUTION RESEARCH AND MONITORING

9. OTHER BUSINESS

10. ADOPTION OF THE REPORT OF THE WORKSHOP

11. CLOSURE

ANNEX II

LIST OF WORKING DOCUMENTS*

IOC/WACAF/2-II/1	Agenda (Annex I to Workshop Report)
IOC/WACAF/2-II/2	Annotated Provisional Agenda
IOC/WACAF/2-II/3	Workshop Report
IOC/WACAF/2-II/4	List of Documents
IOC/WACAF/2-II/5	List of Participants
IOC/WACAF/2-II/6	Development and Status of WACAF/2. Evaluation of the First Phase of the Project
IOC/WACAF/2-II/7	Quality Assurance in relation to the determination of metals, chlorinated hydrocarbons and petroleum components
IOC/WACAF/2-II/8	Scientific Results of WACAF/2. Evaluation of data output of First Phase 1984-1987
IOC/WACAF/2-II/9	Future development of WACAF/2. Proposals by the Joint Secretariat
IOC/WACAF/2-II/10	Individual scientific reports from Responsible Scientists:

A. LEVELS OF METALS, CHLORINATED HYDROCARBONS AND PETROLEUM COMPONENTS IN MARINE BIOTA

Metongo, S. (Côte d'Ivoire). Metaux lourds dans les organismes marins

Sawyerr, V.H.O. (Sierra Leone). Pesticides in Marine Organisms for Coastal Waters of Sierra Leone

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* This list is for reference only.
No stocks of these documents are maintained.

Ba, D. (Senegal). Report to WACAF/2 Workshop from Laboratoire de Chimie et Toxicologie, Faculté de Médecine et de Pharmacie, Université de Dakar

Osibanjo, O. (Nigeria). Chlorinated Hydrocarbons Levels in Marine Fishes and Shellfishes of Nigeria.

Jallow, S. (The Gambia). Monitoring of Organochlorine Pesticides in the Gambia.

Biney, D. (Ghana). Trace Metals in the Shrimp Penaeus Notealis from the Coastal Waters of Ghana.

Coulibaly, M. and Kone, S. (Côte d'Ivoire). Surveillance continue de la pollution du milieu marin dans les régions de l'Afrique de l'Ouest et du Centre.

Mbome, L.I. (Cameroun). Heavy Metals in Marine Organisms from Limbé and Douala.

B. OBSERVATIONS OF OIL SLICKS AND TAR ON BEACHES, SAMPLING AND ANALYSIS OF BASIC OCEANOGRAPHIC OBSERVATIONS

Kouassi, A.K. (Côte d'Ivoire). Echantillonage du Goudron de plage stations de Mondoukou, Gbamale et le Grand Lahou.

Makaya, J.F. (Congo). Evaluation quantitative de boules de goudron sur les plages de Pointe Noire.

N'Diaye, P. and Sow, I. (Senegal). Echantillonage des boulettes de goudron dans la région de Dakar.

Biney, C.A. and Amayibor, E. (Ghana). Monitoring of dispersed petroleum hydrocarbons and tar on beaches in Ghana.

Ibe, A.C. et.al. (Nigeria). A Study of Tar Ball Loading and the influencing Oceanographic Factors at Badagry Beach 1984-1988.

Ikome, F.E. and Angwe, A. (Cameroun). Tar Balls on Beaches as an indication of hydrocarbon pollution in the Cameroun West Coast.

Enyenihi, U.K. et.al. (Nigeria). The levels of stranded pelagic tar residues on the Ibeno Beach, Nigeria.

C. MONITORING OF MICROBIAL QUALITY OF RECREATIONAL WATERS

Babadounga, J.P. (Gabon). Surveillance bactériologique des eaux côtières

N'Jie, A. (The Gambia). Report from the Water Control Division, Dept. of Water Resources, Banjul.

Djedji, A. (Benin). Rapport scientifique concernant l'exécution du projet WACAF/2 en République Populaire du Bénin.

Sow, I. et Melle Fagamou Sy (Senegal). Surveillance microbiologique des eaux côtières.

Afoaka, S.N. et.al. (Ghana). Observations on Bacteriological Quality of Bathing and Fishing Waters in Ghana.

ANNEX III

LIST OF PARTICIPANTS

EXPERTS FROM THE REGION

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ANNEX IV

DEVELOPMENT AND STATUS OF WACAF/2

Evaluation of the First Phase of the Project

MONITORING OF POLLUTION IN THE MARINE ENVIRONMENT
OF THE WEST AND CENTRAL AFRICAN REGION
WACAF/2

STATUS AND DEVELOPMENT OF WACAF/2

CONTENTS PAGE

DEVELOPMENT AND STATUS OF WACAF/2

1. Introduction

The Abidjan Convention for the Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region was adopted in March 1981 and the Convention and Protocol came into force in August 1984. The recommendations of the Second Meeting of the Steering Committee for the Marine Environment of West and Central Africa in April 1982 led to the preparation of the Project Document on the Joint FAO/IOC/WHO/IAEA/UNEP Project of Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2, Pilot Phase) which was signed in 1982. The pilot phase was to last two years but the research agreements with the laboratories which were essential for the commencement of the project, were not signed until 1984/85. Thus, the pilot project began effectively then, and the project duration was extended by one year to October 1985. Subsequently, the first meeting of the Contracting Parties to the Abidjan Convention recommended the continuation of the project in its first phase, and approved funding for it from the Regional Trust Fund.

The project is part of the programme of UNEP's Regional Seas Programme for the region (WACAF Action Plan) and FAO acts as the lead UN Agency for Project WACAF/2, with the following components (and the respective UN Agency implementing it):

- WACAF/2-A Analysis of heavy metals, chlorinated hydrocarbons, and petroleum components in marine biota (FAO);
- WACAF/2-B Intercalibration exercises for sampling and analytical techniques (IAEA, in cooperation with FAO);
- WACAF/2-C Observations of oil slicks and tar on beaches, sampling and analysis of floating tar balls and basic oceanographic measurements (IOC)
- WACAF/2-D Monitoring of the microbiological quality of recreational waters and seafood (WHO)

2. Participating Institutes, and Provision of Equipment and Consumables.

2.1. By April 1988, the total number of national research laboratories and/or university departments and institutes taking part in the project stood at 23 in 10 countries (Appendix A).

2.2. Present equipment status (major or minor, non-expendable) in the different components are as follows:

WACAF/2-A and B: 4 Gas chromatographs, 4 Atomic Absorption Spectrophotometers, 2 freeze dryers, 1 Electricity Generator; 1 ECD Detector, 10 digestion bombs, 4 additional vapour generation kits for the existing AAS's, 1 Oven, 1 homogeniser, and 1 high-capacity gas purifier (As at April 1988, only one - the AAS in Senegal - was not working).

WACAF/2-C: 4 current meters, 1 water level recorder, 1 conductivity cum salinity meter, 3 surface tar samplers, 16 beach

tar-sampling equipment (top loading balances, anemometers, test sieves, measuring tapes), 4 Nansen water bottles, 1 portable pH meter, 4 deep sea reversing thermometers, 1 spectrophotometer, and 1 microkjeldahl stand have been distributed to various laboratories in the region in 1987.

WACAF/2-D: Equipment were initially supplied to countries and not laboratories; three countries benefited from this in 1983 - Cote d'Ivoire, Nigeria and Senegal. Two additional sets of microbiological monitoring equipment were provided for the laboratories at Benin and Ghana, and equipment for others are being processed.

Appendix B shows the expenditure on equipment and training by country, and project component.

3. Training Courses & Workshops; Experts/Consultants used in WACAF/2

3.1. Training Courses: There were a number of individual training courses which were held in various analytical chemistry laboratories. Thus, many of the scientists in WACAF/2-A and B were trained at Varian (the equipment suppliers) in Zug in Switzerland, the University of Siena in Italy, and IAEA Marine Environmental Studies Laboratory in Monaco. A training workshop was held in Lagos for WACAF/2-C, by the IOC. The workshop which was on Observations of Oil Slicks and Tar Ball on Beaches and Basic Oceanographic Measurements, was from 22-30 November 1987, and was attended by 18 participants from 9 countries. The report of the workshop will be published by the IOC of Unesco in 1988. In addition, two scientists from Senegal were given short individual training courses (21 April-1 May and 2-24 May) in marine oil pollution control at Brest, France. The first Scientific Workshop for participants in the project was organised by the IOC of Unesco in Dakar, Senegal, from 28 October to 1 November 1985, at the Unesco Regional Office for Africa. It was attended by 23 scientists from the region. It is estimated that about 35 scientists would be participating in the Second Scientific Workshop in Accra from 13-17 June 1988. In Component D, as part of the renewed efforts of WHO, a training workshop is planned for Accra from 20-22 June 1988, just after the Scientific Workshop.

3.2. Experts/Consultants Services Used in WACAF/2: (Appendix C). Fifteen consultants and experts (including the coordinators) have been on various missions to the region since the beginning of the project in 1983. Three others were used in Europe for the project's execution. These are summarized under the different components giving the dates and countries visited and the purpose of the missions in Appendix C.

3.2.1. WACAF/2-A: Five experts and two coordinators of the project have

visited the region beginning with the fact-finding mission of Messrs Bacci, Barisic and Osibanjo to assess the capability and needs of laboratories which had been accredited to the project by their respective National Focal Points for UNEP activities in 1983, the visit of the first coordinator of the project, Dr Nauen, in 1984 to four laboratories to meet the scientists and know their difficulties at first hand, the consultants Drs Bacci and Gaggi in September 1985 to help scientists prepare for the first scientific workshop in Dakar, and ending with the visit of the new coordinator, Dr Orekoya, to the eight laboratories in October/November 1987 to familiarize himself with the laboratories, their problems and the personnel and to meet the scientists working in WACAF/2-C at the Lagos Training Workshop. Also, in 1986, Dr Naeve, Senior Fisheries Resources Officer combined a mission to Africa with visits to laboratories in Cameroon, Ghana, Cote d'Ivoire and Sierra Leone.

3.2.2. WACAF/2-B: Drs Raquin and Fukai were recruited in the later part of 1986 at Monaco to assist in the intercalibration exercises for WACAF/2-A laboratories. In 1987, Mr Barisic visited six of the eight laboratories taking part in WACAF/2-A and repaired or revived equipment that were faulty.

3.2.3. WACAF/2-C: Four experts/consultants have been used in this component since 1983. They were Drs Linden, Metivier Ibe and Soares. Drs Linden and Metivier made the first assessments of needs and capabilities of laboratories for component C in the countries of the region while Dr Soares performed the same service for The Republic of Benin. The services of Dr Ibe were used to organise the Lagos Training Workshop.

3.2.4. WACAF/2-D. Three consultants have visited different countries in the region; Dr Mujeriego in 1983, to identify laboratories in the three countries - Cote d'Ivoire, Nigeria and Senegal - designated to participate in the component, Dr Geisler in 1987 to advise on the needs of the Republic of Benin for participation, and Dr K. Iwugo to The Gambia, Senegal, Sierra Leone, Ghana and Benin, to assess the current status of activities of the participating laboratories in those countries.

4. Data Collection, Handling and Reporting

4.1. WACAF/2-A: Some of the recommendations made at the first workshop were that specific organisms should be selected for sampling and analyses, in order to have a basis for comparisons of results in different parts of the region and results should be sent in on the recommended data sheet and format, to make for easy compilation and evaluation. The laboratories in three countries were unable to do this because they had no functional equipment; these had broken

down in 1986 and were only repaired at the end of 1987. Three others did not have results either because trained personnel was unavailable until 1987, or had adverse conditions such as incessant power cuts and/or lack of water. The generator purchased for one country in 1986 was yet to be installed by November 1987 because, according to the scientists collaborating in the project, they lacked funds (which should have been made available by her government) to purchase cables and other materials needed to connect it up. One laboratory was unable to get the samples it needed for analysis because it did not have access to marine biota sources. Arrangements have been made for the laboratory to be supplied with samples by a sister laboratory, from its research vessels. Thus data from this component for the duration of the project has been small, but what was submitted have been analysed, and would be presented at the Second Scientific Workshop in June 1988.

4.2. WACAF/2-B: There have been two intercalibration exercises during the project life. The first was fairly successful, with responses from all the laboratories except one, and unexpected (but welcome) contributions from another. These results were in the first years of the project when equipment were still functioning properly. The response to the second intercalibration exercise has not been as good as it should because most of the equipment had stopped working for one reason or the other. However, three laboratories sent in results (or parts of it) for heavy metals and one for organochlorines and these were evaluated. Analyses of the first and second exercises show that great variability existed in the performances and results from the laboratories. This was expected especially at the beginning, and greater emphasis is being put on laboratories following instructions precisely and as laid down in the methodologies outlined in the Reference Methods. The results are discussed in greater detail in the scientific evaluation of the project to be presented to the participants at the Second Scientific Workshop.

4.3. WACAF/2-C: During the Lagos Training Workshop on Basic Oceanographic Measurements, many participants raised the problem of inadequate funding for scientists to reach sites which would give better data (infrequently-used beaches etc), or the provision of funds to purchase fuel (for boats etc); and while it was explained that such contributions are the responsibility of the respective governments, the answer did not satisfy some. However, data production and submission has been frequent. The data collected by laboratories in the region up to 1988 have been compiled and analysed by Dr S. Jensen of the Marine Pollution Research and Monitoring Unit, IOC, Unesco. The data showed considerable variation, and there was not enough of it for in-depth statistical analysis. Similar variability have been

observed in other parts of the world where such work have been done and data need to be collected for a longer time and from more countries before definitive statements can be made about the trend in oil pollution in the region. As was mentioned earlier, this component has the largest number of cooperating laboratories.

4.4. WACAF/2-D: The progress of this component has been hampered due to frequent change of the desk officers responsible for the project. This has meant that those laboratories that needed assistance could not get them and could not begin to produce results. Now, WHO-AFRO has assigned a consultant to deal with WACAF/2-D matters. Consequently, equipment requests from laboratories in the countries that signed on have either been, or are being processed.

5. Project Publications

5.1. The WACAF/2 Newsletter, which started out in June 1984, as a quarterly issue (every three months), was reduced to publication every four months in 1986 for reasons of economy and because communications problems cause items for publication to take long to arrive. Its objectives - a means of information exchange, presentation of preliminary and interesting results, and discussion of environmental issues relevant to WACAF/2 and the region as a whole - remain unchanged. To date thirteen issues have been produced (Vol. 1, Nos 1-3 1984; Vol. 2, Nos 1-4 1985; Vol. 3, Nos 1-3 1986 and Vol. 4, Nos 1-3 1987). The next issue (Vol. 5, No 1) will be published after the scientific workshop of June 1988 and it will carry, apart from news about the workshop, summaries of results obtained in WACAF/2 First Phase.

5.2. The proceedings of the First Scientific Workshop held in Dakar in 1985 were published in the final form by the IOC of Unesco as IOC Workshop Report No. 41.

6. Summary, Conclusions and Recommendations

There were several achievements during the first phase of the project and these are listed under the various components which make up WACAF/2.

6.1. WACAF/2-A:
Presently, there are eight laboratories participating in the component and of these, six were supplied either with a gas chromatograph (for pesticide and chlorinated hydrocarbon residue analysis) or an atomic absorption spectrophotometer (for trace metals analysis), and one with both types of instrument. All equipment were supplied with consumables and material needed to begin work immediately. The eighth laboratory had independent source for trace element analysis and it was supplied with

accessories when they were asked for.
Twelve scientists from the region were trained on methodologies for carrying out the studies in various centres of excellence outside the region. As a result, there have been some contributions to establishing the background levels of the pollutants in the marine environment of the WACAF region.

6.2. WACAF/2-B:
Under this component, intercalibration exercises were carried out and the results showed that the laboratories performed adequately, although with room for improvement, and their performance was comparable to those laboratories in other parts of the world where such exercises have been carried out. The laboratories were also introduced to the concept of data quality assurance and intercalibration exercises were carried out among them. Harmonization was achieved by the acceptance and adherence to the the UNEP Reference Methods for Marine Pollution Studies.

6.3. WACAF/2-C:
The number of participating laboratories increased from six in 1983 to twelve in 1988, the largest growth in any component. The scope of study has been expanded from measurement of tar ball deposition on beaches to include basic oceanographic observations and measurements. Of the twelve laboratories, seven have been fully equipped to carry out the mandate of the component.
In 1987, two scientists from the region were trained outside the region on oil pollution monitoring, and a training workshop was organised in Nigeria for eighteen scientists from different countries in the WACAF region. The workshop showed what degree of excellence could be achieved within the region, using materials and facilities available within it.

6.4. WACAF/2-D:
The late start in putting together the requirements of the laboratories taking part in this component has meant that some of the accredited laboratories have only just been equipped to start work. Five laboratories have been so equipped and seven countries are now registered with the component.
At the beginning of the project, two scientists took part in an intercalibration exercise for a similar project in Spain to acquaint them with the objectives and types of results expected of their laboratories.

The overall achievements of the pilot phase of the project were:

(i) The basis of a network of cooperating laboratories from different countries was established in each of the components;
(ii) 23 (Twenty-three) national institutions from ten countries are now participating in the project;

(iii) Equipment and materials have been supplied to eight laboratories in component A, seven in component C and five in component D;

(iv) One scientific workshop and a training workshop have been organised in the region and this has fostered greatly the spirit needed to create an effective network and regional cooperation between the laboratories;

(v) Some data have been produced for baseline values, and while they are not sufficient, they provide enough information on which to base long-term monitoring to provide the true background levels; and

(vi) A mechanism for controlling data quality has been started among the laboratories.

The project had its shortcomings during this phase, but some of these could be attributed to it being the first of its kind in this field in the region. The main ones were:

(i) Coordination of the work of the different agencies, and cooperation between them could be greatly improved, so that the work of each component compliments the others; at the same time, funding of the project was not continuous, thus leaving periods during which no activities, no purchases or equipment maintenance could be done;

(ii) Maintenance of equipment used in component A could not always be done at the time the instruments broke down for reasons of cost, and optimizing each visit of the engineer to the region.

(iii) Data output from the laboratories in the same component has been delayed partly because of "down-time" of equipment (for which late budget release can be blamed partially), and partly due to inadequate attention to the set-down procedures;

(iv) The response of some of the laboratories to requests for information concerning the projects was indifferent (as if the project were not taken seriously), although avenues exist for speeding up information transfer (pouch systems, etc) in all the countries of the region; coordinating agencies can only take action on information received and not information imagined; and

(v) The laboratories lacked facilities which should have been provided by their respective governments as part of the counterpart contributions of the countries.

The following recommendations are put forward as vital for the success of a second phase of the project, if there is to be one.

A. There must be better utilization and optimization of equipment in place and greater attention need to be paid to the quality of data produced by the laboratories. In addition, there must be a greater awareness in the laboratories of why the project is being carried out, and to what use the data would be put.

B. Contracting Parties must endeavour to ensure that their laboratories are able to fulfil the roles assigned to them by providing the support needed

as specified in the project documents. Internal coordination between National Focal Points (and Ministries) for UNEP activities and the agencies responsible for funding laboratory activities must improve if laboratories are to function properly.

C. The various components of the project must be coordinated and funded in a more efficient way and each component should not run in isolation but must be made to cooperate with others to achieve the objectives of the project. In addition, the results obtained from the project should be integrated with other projects under the WACAF Action Plan.

D. The importance and role of the Focal Point for UNEP's activities in each country cannot be overemphasised and must be recognised and used for achieving these stated objectives.

APPENDIX A

List of Laboratories and Institutions participating in WACAF/2: April 1988

BENIN	1.	Service d'hygiene des Eaux et des Aliments, Direction Laboratoires d'Analyses Medicales, BP 418, Cotonou: WACAF/2-D.
CAMEROUN	2.	Institut de recherches medicales et d'etudes des plantes medicinales (IMPM), BP 6130, Yaounde; (i) Centre de nutrition and (ii) Centre d'etudes plantes medicinales (CEPM): WACAF/2-A and B (heavy metals and pesticides).
	3.	Station de recherches halieutiques de Limbe, BP 77, Limbe: WACAF/2-C and supply of samples for WACAF/2-A.
	4.	Centre Pasteur (National Public Health and Reference Laboratory, B.P. 1274, Yaounde: (WACAF/2-D)
The CONGO	5.	Centre ORSTOM de Pointe Noire, BP 1286, Pointe Noire: WACAF/2-C.
COTE D'IVOIRE	6.	Centre de Recherches Oceanographiques, 29 rue des Pecheurs, BP V18, Abidjan: WACAF/2-A, B (heavy metals and pesticides) and C.
	7.	Laboratoire Central de Nutrition Animale (LACENA), 06 BP 353, Abidjan 06: WACAF/2-A and B (heavy metals only).
	8.	Laboratoire National de Microbiologie, Centre Medical des Gens de Mer, Abidjan: WACAF/2-D
GABON	9.	Centre national antipollution, Ministere de l'environnement et de la protection de la nature, Libreville. WACAF/2-C and D.
The GAMBIA	10.	Department of Water Resources, Marine Parade, Banjul in cooperation with Department of Fisheries: WACAF/2-A and B (pesticides only).
	11.	Department of Fisheries, 6 Marine Parade, Banjul: WACAF/2-C.
GHANA	12.	Institute of Aquatic Biology, P O Box 38, Achimota: WACAF/2-A, B (heavy metals only) and C.
	13.	Department of Microbiology, University of Ghana, Accra in cooperation with Noguchi Memorial Institute for Medical Research: WAC/AF2-D.
	14.	Department of Zoology, University of Cape Coast, Cape Coast: WACAF/2-C.
NIGERIA	15.	Department of Chemistry, University of Ibadan, Ibadan: WACAF/2-A and B (pesticides, petroleum hydrocarbons and heavy metals).
	16.	Institute of Oceanography, University of Calabar, Calabar:

WACAF/2-C.

17. Physical and Chemical Oceanography Division, Nigerian Institute for Oceanography and Marine Research, Victoria Island, PMB 12729, Lagos: WACAF/2-C.

SENEGAL

18. Laboratoire de Chimie Analytique et Toxicologie, Faculte de Medecine et de Pharmacie, Universite de Dakar, Dakar: WACAF/2-A and B (heavy metals only).
19. Institut Fondamental de l'Afrique Noire, Department de biologie marine, Universite de Dakar, Dakar: WACAF/2-C.
20. Division de Prevention et Controle de Pollution et Nuisance, Direction de l'Environnement, Rue Carnot, Dakar: WACAF/2-C.
21. Laboratoire de microbiologie de l'Ecole Nationale superieure Universitaire de Technologie (ENSUT), Universite de Dakar, Dakar: WACAF/2-D.

SIERRA LEONE

22. Institute of Marine Biology and Oceanography, Fourah Bay College, Private Mail Bag, Freetown: WACAF/2-A and B (pesticides only).
23. Department of Botany, Fourah Bay College, Private Mail Bag, Freetown: WACAF/2-D.

APPENDIX B

EXPENDITURE ON EQUIPMENT, CONSUMABLES & SPARES BY COUNTRY 1983-87 IN US $

WACAF2-A

PERIOD	SENEGAL	GAMBIA	S/LEONE	C.IVOIRE	GHANA	BENIN	NIGERIA	CAMEROUN	CONGO	TOTAL
1983-84	33 000	33 000	33 000	33 000	38 000	-	36 000	6 000		212 000
1986	9 000	-	11 000	18 000	5 000	-	5 000	43 000		91 000
1987	3 000	3 000	1 000	38 000	3 000	-	7 000	3 000		58 000
TOTAL	45 000	36 000	45 000	89 000	46 000	-	48 000	52 000		361 000

WACAF2-B

1983-87	2 000	2 000	2 000	2 000	2 000	-	2 000	2 000		14 000
	INTERCALIBRATION CONSUMABLES FOR ALL LABORATORIES (LINE 5100)									7 085

WACAF2-C

PERIOD	SENEGAL	GAMBIA	S/LEONE	C.IVOIRE	GHANA	BENIN	NIGERIA	CAMEROUN	CONGO	TOTAL
1983-87	4 000	-	-	7 000	11 000	-	15 000	-	6 000	43 000

WACAF2-D

PERIOD	SENEGAL	GAMBIA	S/LEONE	C.IVOIRE	GHANA	BENIN	NIGERIA	CAMEROUN	CONGO	TOTAL
1983-84	4 000	-	-	4 000	-	-	4 000	-	-	12 000
1987	6 000	-	-	-	13 000	4 000	-	-	-	23 000
TOTAL	61 000	38 000	47 000	102 000	72 000	4 000	69 000	54 000	6 000	460 085

EXPENDITURE BY APPROVED UNEP BUDGET REVISION DOCUMENTS

ORGANIS*	1983	1984	1985	1986	1987	TOTAL
FAO	211 198	12 385	10 401	69 270	56 662	359 916
IOC	12 000	-	-	34 000	21 069	67 069
WHO	12 000	1 329	1 553	751	7 404	23 037
IAEA	-	3 319	(41)	8 674	1 551	13 503
TOTAL	235 198	17 033	11 913	112 695	86 686	463 525

APPENDIX C

SERVICES OF CONSULTANTS/EXPERTS USED IN WACAF/2

No	NAME	COUNTRIES VISITED	DATES	PURPOSE
WACAF/2-A				
1.	E. Bacci	Senegal, The Gambia, Sierra Leone, Ghana, Cote d'Ivoire and Nigeria	02/84	To explain project arrangements obtain proposals for biota species fpr study, consumables requirements, manpower training needs, status of existing equipment, and capability of laboratories and personnel.
2.	T. Barisic	-ditto-		
3.	O. Osibanjo	-ditto-		
4.	C. Nauen	Senegal, The Gambia, Benin and Cameroon		To discuss implementation of of WACAF/2 and difficulties encountered by the laboratories, and discuss participation of Cameroon in the project.
5.	E. Bacci	Cameroon, Cote d'Ivoire and Senegal	09/85	To assist scientists in the presentation of results for the WACAF/2 Scientific Workshop.
6.	C. Gaggi	Gambia, Ghana, & Sierra Leone		
7.	E. Tutuwan	FAO, Rome.	12/85	Short term consultant to codinate the project after the Workshop.
8.	H. Naeve	Sierra Leone, Cote d'Ivoire, Ghana and Cameroon	06/86	To visit laboratories and find out continuing difficulties encountered in obtaining desired results in the components.
9.	T. Orekoya	Senegal, The Gambia, Sierra Leone, Ghana, Cote d'Ivoire, Benin, Nigeria and Cameroon.	11/87	To familiarise himself with the laboratories and the scientists in the region; to arrange participation of new laboratories and meet WACAF/2-C scientists.
WACAF/2-B				
10.	R. Fukai	IAEA, Monaco	09/86	Intercalibration exercises
11.	R. Raquin	IAEA, Monaco	10/86	Intercalibration exercises
WACAF/2-C				
12.	O. Linden	Cote d'Ivoire, Nigeria and Cameroon	12/83	Identification of laboratories advice on site selection.
13.	B. Metivier	Senegal, Benin, Congo and Zaire	12/83	-ditto-
14.	C. Ibe	Nigeria	11/87	Training Workshop in Lagos

15. G. Soares	Benin	12/87	Advice on participation and needs of national laboratory
WACAF/2-D			
16. R. Mujeriego	Senegal, Cote d'Ivoire and Nigeria	09/83	Advice on participation of national laboratories and needs.
17. R. Geisler	Benin	01/87	Determination of ideal sites for sampling, and requirements of national laboratory.
18 K. Iwugo	Senegal, The Gambia, Sierra Leone, Ghana and Benin	02/88	Familiarisation with problems in execution of component and to plan for training workshop.

ANNEX V

SCIENTIFIC RESULTS OF WACAF/2

Evaluation of data output of First Phase

1984-1987

INTRODUCTION

The Abidjan Convention for the Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region was adopted in 1981 and came into force in August 1984. The recommendations of the Second Meeting of the Steering Committee for the Marine Environment of West and Central Africa in April 1982 led to the preparation of the Project Document on the Joint FAO/IOC/WHO/IAEA/UNEP Project of Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2, Pilot Phase) which was signed in April 1983. The project is part of UNEP's Regional Seas Programme for the region (WACAF Action Plan) and the different components of this project are:

WACAF/2-A	Analysis of heavy metals, chlorinated hydrocarbons, and petroleum components in marine biota (FAO);
WACAF/2-B	Intercalibration exercise for sampling and analytical techniques (IAEA in cooperation with FAO);
WACAF/2-C	Observations of oil slicks and tar on beaches, sampling and analysis of floating tar balls and basic oceanographic measurements (IOC)
WACAF/2-D	Monitoring of the microbiological quality of recreational waters and seafood (WHO)

When the project was conceived, the underlying assumption was that data generated within the project should provide the basis of statements about the marine environment of the region, and to give coastal states an awareness of, and a platform to base legislation against marine pollution. It was also the intention to assist national research centres and laboratories to develop their capabilities to participate in the programme as a whole, while providing information on the pathways and trends in pollution of the marine environment of the region. The concept is similar to others which have tried to achieve similar goals elsewhere. The assumption was also made that problems which would be encountered in the project would be tackled in the same way as it had in other regions.

Participating laboratories in the project were national ones from the region, and were accredited to the project through the National Focal Points in the respective countries. A summary of the results obtained in the first phase (1984-87) by the participating laboratories in WACAF/2 have been analysed and are presented here.

WACAF/2-A

At the beginning of the project, available funds were not enough to assist all the countries in the region which requested assistance in setting up infrastructural needs for the different components especially WACAF/2-A. Therefore eight laboratories were selected - with the approval of the National Focal Points for UNEP activities in the countries - and seven were allocated either an Atomic Absorption Spectrophotometer (for trace metal analyses), or a Gas Liquid Chromatograph (for chlorinated hydrocarbon and/or pesticide

residues), and associated expendable and non-expendable equipment for commencement of study. Most of these were in place by the end of 1984 after the research agreements had been signed, and were expected to generate enough data for presentation at the first workshop in November 1985. Subsequently, various factors made it difficult to continue at the same rate in data collection. This paper examines data submitted within the purview of the project and compares these results with those from other regions of the world and with results from other workers in the region. The greatest investments (in terms of funds) have been into this component. Laboratory numbering are the same as used since the inception of the project and during the first workshop's intercalibration exercise. Additional laboratories have been numbered as they presented data.

Results presented (Table 1) for chlorinated hydrocarbons have come from two laboratories; one set of data was for July 1985, and the second spanned the period of 1984 to 1987. There seemed to be considerable differences in the residue levels found in the same species; while these variations may be possible, there is not enough data to say as much. In some cases, it was necessary to rank the numbers and discard the outliers before doing any analyses, but this was possible only if there was enough analyses done. In Lab 7, DDT varied in fish from 15-142 ug/kg FW, in Lab 6, from 1.5-8.0; PCB 30-98.3 and 21-67; HCH 14-45 and 0.3-4.9 and Heptachlor 3.8-28 and 0.1-3.6 respectively. Despite these seeming differences, the values are comparable to those reported elsewhere (UNEP, 1986). The highest values reported for DDT and PCBs were in shrimps and the lowest in the Pseudotolithus senegalensis. While the values are lower than those obtained in the MEDPOL Project, there is not enough data to affirm this. However, as these seem to be among the few sets of published data available for pesticide residues in marine biota in the region they should serve as basis for the comparison to future analyses of the background levels.

The response for trace element analyses has been adequate, with data returns from all the laboratories which signed for the component, albeit at infrequent intervals, and some data from laboratories that are not yet signed on to this component. Some trends can be seen from the data; the levels found of some trace metals are given below for all the laboratories in the region in Table 2.

The values for one of the trace elements were extremely high (Zinc in Crassostrea gasar from two of the laboratories); but statistical analyses showed that the spread of the data obtained was also very high, making it difficult to determine what the real value was. However, the level of mercury reported in the species would seem to corroborate findings by other workers - high levels in tuna fish (about 0.3 $mg.kg^{-1}$ FW) and lower figures in the rest. Doi and Ui (1974) quoted figures of 0.24 $mg.kg^{-1}$ for the yellowfin tuna while Gras and Montain (1982) reported similar values, but surprisingly high values of total mercury in Epinephelus aeneus (0.36 $mg.kg^{-1}$). The WACAF/2 laboratories had values much the same as elsewhere but extreme variability. As data continue to be generated, a pattern may emerge; there is some data but barely enough to indicate what trends there is. This is because there is not enough geographical spread in what results are available.

WACAF/2-B

The results from this component are presented in a separate paper by IAEA. In order to improve the quality of the data of the laboratories, the Marine Environmental Studies Laboratory has decided to approach the problem from another angle - the "Split-sample" method, in which half the sample, after pre-treatment, is sent to the laboratory in Monaco for analyses, and the other half is analysed in the laboratory in the region. In this way, it is easier to determine where human error may have been introduced - before, during or after pre-treatment. There was not adequate warning to the laboratories when an attempt was made at this in October/November 1987, and equipment were just being put to use then. It is hoped that the next attempt would be more successful. If this approach is coupled with global intercalibration exercises, laboratories in the region should be in a better position with regards to the quality of their data.

WACAF/2-C

The results of work done in this component are presented elsewhere by the IOC of Unesco.

WACAF/2-D

The only set of results available was from Senegal and was presented at the workshop in Senegal in 1985. However, there has been some difficulties (both administrative and logistic) in the setting up in place equipment required for the component. Recently, new laboratories have been equipped, and a mission has just been completed to the laboratories involved. When there is a new phase to the project, there should be considerable input from this component.

CONCLUSIONS

The scientific data presented by Component A up to the end of the first phase indicated that marine pollution of biota of the WACAF region is not alarming; there is evidence of background levels of various pollutants, but that the concentrations are similar to those of other regions (UNEP, 1986; Wood, 1975). There is independent evidence from other workers in the region that some of the levels found in marine biota during the project are not too far from the expected (Kakulu et al., 1987), but emphasis must be placed on having data that can be relied on. It can be assumed that with increasing industrialisation in the region, more and more industrial wastes would end up in the coastal waters via the rivers, lagoons, estuaries or creeks which open to the sea. Therefore, a shift in emphasis from open-water monitoring (which definition can be agreed upon; e.g. offshore, greater than 2 kilometres) to inshore waters would provide the needed data to show the need for stringent control of industrial waste disposal into the aqueous ecosystem. As most coastal countries tend to concentrate their industries in the coastal region, more and more stress will be put on the brackish and near-shore waters. The first phase of the project, despite its shortcomings has shown - although not conclusively - that the levels of the pollutants that are considered

potentially hazardous to man through the food chain are relatively low. More research need be done to determine what is the fate of pollutants in the marine and brackish water ecosystems.

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TABLE 1. ORGANOCHLORINE RESIDUES IN BIOTA FROM WACAF REGION

LABORATORY 6 — ug.kg^{-1} fresh weight

SPECIES	TOTAL DDT MEAN(SD)	TOTAL DDT RANGE	TOTAL PCB MEAN(SD)	TOTAL PCB RANGE	TOTAL HCH (+LIN) MEAN(SD)	TOTAL HCH (+LIN) RANGE	HEPT+HOX MEAN(SD)	HEPT+HOX RANGE	L_t (or W_t MEAN(SD)	L_t (or W_t RANGE
SPSP	1.5(0.5)	1.11-1.79	21.0(20.9)	6.3-35.8	0.3(0.1)	0.2-0.45	0.1(0.07)	0.08-0.13	30.2(5.2)	24.2-33.9
PSSE	4.4(2.9)	1.01-9.03	71.0(44.7)	20.0-150.0	4.9(1.5)	1.2-7.3	3.6(2.2)	2.3-5.7	24.0(2.0)	21.4-26.0
CYNO	2.3(1.4)	1.21-4.23	26.4(10.0)	15.2-38.8	1.5(2.0)	0.2-4.4	0.8(1.1)	ND-3.06	27.7(1.6)	25.5-29.0
ETFI	8.0(4.9)	3.5-14.7	67.1(77.9)	10.2-175.3	0.6(0.3)	0.2-1.0	2.2(2.6)	ND_4.8	25.4(0.5)	25.0-26.1
CRGA	125.8(37.1)	99.6-152.1	204.5(116.7)	122.0-287.0	2.7(2.1)	1.3-4.3	3.6(0.8)	3.0-4.2	0.08(0.01)	0.06-0.09**
PENO*	12.4		63.6		1.1		0.36		0.02	

LABORATORY 7 — ug.kg^{-1} fresh weight

SPECIES	TOTAL DDT MEAN(SD)	TOTAL DDT RANGE	TOTAL PCB MEAN(SD)	TOTAL PCB RANGE	TOTAL HCH (+LIN) MEAN(SD)	TOTAL HCH (+LIN) RANGE	HEPT+HOX MEAN(SD)	HEPT+HOX RANGE	L_t (or W_t) MEAN(SD)	L_t (or W_t) RANGE
THOB	27.4(2.7)	23.6-29.8	53.3(4.3)	49.2-58.2	14.0(3.3)	12.4-18.0	3.8(0.6)	2.9-4.4	38.9(3.9)	35.3-43.4
PSSE	15.6(2.1)	13.2-19.5	30.4(23.3)	14.5-74.2	18.1(7.6)	12.2-31.4	9.8(4.5)	5.5-16.0	20.7(0.7)	19.5-21.6++
EPAE	43.8(10.5)	35.0-60.4	52.0(4.5)	48.5-60.2	21.5(6.9)	16.0-34.2	11.3(6.4)	5.6-22.9	35.4(2.4)	33.2-40.3
CYNO	54.2(9.7)	37.1-67.7	98.4(2.8)	94.3-102.2	37.9(7.7)	29.3-53.3	16.0(2.1)	13.0-18.5	10.1(0.8)	9.0-11.4
CYSE	76.4(6.4)	67.8-86.8	93.9(5.6)	84.3-100.2	45.6(10.5)	35.2-59.4	28.5(4.7)	23.4-35.5	13.8(0.6)	12.9-14.4
SAMA	142.2(15.7)	130.5-166.4	70.3(5.7)	67.0-71.1	16.8(4.5)	12.7-23.3	11.0(2.5)	9.2-12.8	15.8(1.4)	15.1-17.8++
PENO	93.9(12.9)	91.2-109.8	94.3(4.2)	89.8-100.1	38.4(4.1)	31.6-43.9	22.1(6.4)	13.9-29.7	0.031(0.007)	.026-0.042**

KEY: SPSP - Sphyraena sphyraena; THOB - Thunnus obesus; PSSE - Psedotolithus senegalensis; EPAE - Epinephelus aeneus; CYNO - Cynoglossus monodi; CYSE - Cynoglossus senegalensis; ETFI - Ethmalosa fimbriata; SAMA - Sardinella maderensis; CRGA - Crassostrea gasar; PENO - Penaeus notialis; ++ - outliers excluded; * -one value only; ** - W_t weight (not L_t)

TABLE 2: TRACE METAL CONTAMINATION OF BIOTA IN WACAF REGION

(mg.kg^{-1})

LAB	Cd		Cu		Hg		Zn		L_t (or *W_t)	
NO	MEAN(SD)	RANGE	MEAN(SD)	RANGE	MEAN(SD)	RANGE	MEAN(SD)	RANGE	MEAN(SD)	RANGE
					Crassostrea gasar					
2	0.36(0.15)	nd-0.75	24.04(8.41)	6.34-42.09	0.049(.029)	0.011-0.103	1732.8(1754.9)	53.5-2643.0	*161.6(58.2)?	53.5-326.9
3	0.567				0.064					
4	0.92(0.45)	0.31-1.90	4.94(3.47)	0.65-13.42	0.12(0.13)	nd-0.47	764.7(405.2)	206.8-1568.0	*51.3(14.3)	19.3-69.0
					Pseudotolithus senegalensis					
1	2.70(0.19)	2.56-2.83	13.77(1.10)	12.99-14.54			16.26(0.06)	16.22-16.30	27.0(5.5)	23.5-31.0
2	0.85(1.62)	nd-7.58	2.80(4.19)	nd-17.20	0.15(0.15)	0.025-0.73	7.92(6.86)	2.62-29.37	34.7(6.7)	20.0-51.0
3+	0.024(0.041)	nd-0.072			0.09(0.009)	0.081-0.098			29.7(0.29)	29.5-30.0
5			0.32(0.16)	nd-0.60	0.07(0.07)	nd-0.20	3.62(1.12)	2.55-4.78	30.7(4.3)	25.0-35.0
X**	nd		0.60(0.69)	0.11-1.83	0.024	nd-28	2.67(0.82)	1.58-3.62	*198.7	
					Penaeus notialis					
2	nd		6.12(1.78)	3.72-11.49	0.043(0.02)	0.014-0.081	18.86(7.32)	6.40-34.49	*43.0(23.2)	13.0-77.0
3	nd				0.063				4.4	
4	nd		4.68(3.75)	1.00-12.75	0.14(0.11)	nd-0.36	15.80(3.41)	14.78-19.61	*10.3(5.3)	6.0-22.0
5			4.16(1.19)	2.38-6.18			5.71(0.55)	4.57-6.33	*10.2(1.2)	8.8-12.2
X**	0.02(0.03)	nd-0.03	4.69(1.61)	3.30-7.90	0. 034	nd-0.062	9.74(3.82)	5.32-16.26		
					Pagellus bellottii					
2	nd		1.21(1.07)	nd-4.29	0.22(0.14)	0.07-0.79	4.35(3.39)	1.84-15.80	23.7(4.4)	14.0-31.0
4	nd		0.57(0.13)	nd-0.80	0.14(0.13)	nd-0.33	3.93(1.36)	2.30-6.00	21.1(1.3)	19.0-22.3
					Epinephelus aeneus					
4	0.14(0.08)	nd-0.38	0.51(0.04)	nd-0.60	0.098(0.007)	nd-0.24	3.51(1.16)	1.82-5.53	46.7(2.2)	44.0-50.0
5			0.40(0.27)	nd-0.84	0.06(0.04)	nd-0.11	2.88(0.38)	2.23-3.24	36.2(6.5)	29.0-45.0
					a - Thunnus albacares; b - Thunnus aleteratus; c - Thunnus obesus					
a			3.04(2.77)	nd-8.66	0.33(0.18)	0.04-0.71	6.46(1.46)	4.09-9.24	130.6(32.2)	54.9-160.6
b	nd		0.59(0.22)	nd-1.05	0.33(0.22)	0.08-0.60	4.07(1.55)	1.01-5.38	38.8(9.8)	32.0-58.0
c	0.16 & 0.30		0.48 & 3.72		0.13 & 0.28		6.80 & 15.54		40	
					Sardinella maderensis					
			1.15(0.32)	nd-1.46	0.073(0.035)	0.04-0.17	5.19(2.23)	2.78-10.46	18.0(1.5)	15.5-21.0
			0.52(0.08)	nd-0.80	0.11(0.09)	nd-0.28	7.10(1.60)	4.01-9.00	24.8(2.6)	21.0-29.0

3+ - Data is from Pseudotolithus elongatus; X** - from Kakulu et al., 1987; ? - Oysters weighed with shells?)
Laboratory numbering is as used since project inception and first workshop)

ANNEX VI

SUMMARY REPORT ON INTERCALIBRATION EXERCISES CARRIED OUT IN THE FRAMEWORK OF THE JOINT FAO-IOC-WHO-IAEA-UNEP PROJECT ON MONITORING OF POLLUTION IN THE MARINE ENVIRONMENT OF THE WEST AND CENTRAL AFRICAN REGION (WACAF/2)

Introduction

In the awareness of IAEA's broad experience gathered in its Analytical Quality Control Service over many years, the Agency in particular, its International Laboratory of Marine Radioactivity, has also been given the responsibility for the analytical quality assurance in projects on monitoring contaminants other than radio-nuclides, in the framework of the Regional Seas Programme. In recent years, this has more specifically been a task of the Marine Environmental Studies Laboratory, a section of IIMR in April 1986, dealing with all commitments related to non-radioactive contaminants in the marine environment, usually in the framework of UNEP Regional Seas Programme components.

For the joint FAO/IOC/WHO/IAEA/UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2), the first intercalibration exercise was initiated on the samples MA-M-2/TM (mussel powder) and MA-A-3/TM (shrimp powder) on trace element and MA-M-2/OC (mussel powder) and MA-A-3/OC (shrimp powder) on organochlorine determinations in April 1985. The exercise was terminated in time for the First Workshop of participants in WACAF/2, Dakar, 28 October - 1 November 1985.

The second exercise on the samples MA-WA-1/TM and MA-WA-1/OC for the determination of trace metals and organochlorines, respectively, was initiated in July 1986 and was finished in May 1988, just in time for the Second Scientific Workshop for Participants in WACAF/2, Accra, 13-17 June 1988. The long duration of this latter exercise had to be readjusted to the urgent need of equipment maintenance and repair services to be rendered to many of the participants before they could analyse the sample.

It has never been envisaged by MESL to intercalibrate results on petroleum hydrocarbon measurements in biota since the lead agency in the project, the Food and Agriculture Organization of the United Nations (FAO) has not yet started to implement this project component.

The majority of results received were on trace metals only, and those received on organochlorines do not allow for any statistical evaluation (one set of data arrived timely enough for consideration).

Hence, only results on trace elements are referred to here.

Results and Discussion

The details of the results of the 1st exercise may be extracted from IOC Workshop Report No. 41, Annex IV, UNESCO 1986, and for the second exercise, from the report on that exercise presented to the Accra Workshop.

The results are summarized in Tables 1a and 1b for the first exercise and in Table 2 for the second exercise.

One striking, obvious fact is that the reporting of data was much better in the first exercise, when almost all participants submitted reports, than in the second exercise. A possible explanation may be seen in the fact that some participants informed IIMR about their repair service needs approximately 1-1/2 years before the service engineer could really assist them, due to lacking funds. Hence, a serious psychological impact appears comprehensible, though not justified.

Another possible explanation may be, that some participants clearly felt their own training needs.

TABLE 1a: WACAF MUSSELS MA-M-2/TM

	Laboratory 1	Laboratory 2	Laboratory 3	Laboratory 4	Laboratory 5	Laboratory 6	Concentration and confidence interval
Cadmium	1.80	3.05 (4.9%)	2.01 (6.0%)	2.72 (16.5%)	1.31 (7.6%)	1.48 (17.6%)	1.32 (1.16-1.54)
Chromium	6.38	-	-	-	-	-	1.25 (0.95-1.62)
Copper	8.77	10.4 (14.4%)	-	5.80 (8.6%)	7.04 (5.3%)	7.70 (7.3%)	7.96 (7.53-8.44)
Iron	363	-	-	-	-	186 (2.2%)	256 (229-268)
Mercury	1.43	1.58 (18.4%)	1.24 (15.5%)	0.67 (19.4%)	1.23 (15.4%)	-	0.95 (0.85-1.06)
Manganese	72.4	-	-	-	-	56.4 (3.9%)	67.1 (60.7-75.3)
Nickel	12.1	-	-	-	-	2.52 (10.7%)	1.40*(0.89-2.04)
Lead	2.24	1.52 (112%)	-	5.4 (24.1%)	6.5 (18.5%)	11.5 (13.0%)	1.92*(1.53-2.50)
Zinc	238	296 - (7.4%)	-	161 (7.5%)	68.1 (4.8%)	298 (1.8%)	157 (157-167)

*Information value (non-certified) for concentration of Pb and Ni in MA-A-2/TM reference material. The results are in mg/kg/dry material.

TABLE 1b: WACAF SHRIMPS MA-A-3/TM

	Laboratory 1	Laboratory 2	Laboratory 3	Laboratory 4	Laboratory 5	Laboratory 6	Consensus values(1)
Cadmium	2.39	2.09± (14.8%)	1.11 ± (2.7%)	0.72± (16.7%)	0.37± (13.5%)	<0.1	0.63± (11.1%)
Chromium	4.64	-	-	-	-	-	1.11± (32.4%)
Copper	27.0	22.1 ± (10.0%)	-	21.1 ± (8.1%)	21.6 ± (3.7%)	23.3 ± (6.)%)	22.0 ± (3.2%)
Iron	78.7	-	-	-	-	41.4 ± (6.5%)	55.9 ± (5.9%)
Mercury	1.88	2.17± (25.8%)	2.19 ± (1.8%)	1.77± (11.9%)	2.63± (10.6%)	-	1.79± (13.4%)
Manganese	3.63	-	-	-	-	3.67± (7.1%)	4.03± (7.2%)
Nickel	12.1	-	-	-	-	0.26±(15.4%)	1.50± (36.6%)
Lead	2.84	2.27± (13.7%)	-	3.10± (25.8%)	2.45± (4.9%)	0.26±(15.4%)	-
Zinc	149	143 ± (4.9%)	-	78.7 ± (1.9%)	38.5 ± (4.2%)	157 ± (7.6%)	65.7 ± (3.8%)

(1) Provisional consensus values for the concentration of some elements (not certified). Confidence intervals are given for a significance level 0.05. The results are in mg/kg dry material.

TABLE 2: WACAF FISH MUSCLE TISSUE MA-WA-1/TM

	Laboratory No. 3		Laboratory No. 4		Laboratory No. 9			
	A	B	A	B	A	B	MESL	ADD
Cadmium	0.77 ± 8.4%	<0.02	–	0.1	–	0.35	0.10 ±	(128%)
Chromium	–	–	–	–	–	4.34	0.87 ±	(77%)
Copper	4.68 ± 5.7%	3.81 ± 8.5%	–	2.72 ± 12.5%	–	13.6	3.35 ±	(35%)
Iron	158 ± 0.7%	117 ± 7.8%	–	90.0 ± 8.3%	–	151	102 ±	(24%)
Mercury	0.64 ± 4.7%	0.05 ± 5.0%	0.66 ± 7.1%	0.60 ± 5.0%	–	–	0.50 ±	(33%)
Manganese	–	2.86 ± 6.2%	–	–	–	7.68	2.8 ±	(40%)
Nickel	–	–	–	–	–	2.19	0.6 ±	(99%)
Lead	–	2.60 ± 8.9%	–	1.40 ± 25%	–	3.16	4.6 ±	(33%)
Zinc	128 ± 1.5%	89.8 ± 10.9%	–	109 ± 3.8%	–	99	106 ±	(19%)

The results are in mg/kg dry material.

A = first run
B = second run

Even though MESL staff are well prepared to provide any such training, if requested and funds are made available, the outcome of particularly the second exercise clearly evidences that at least two of the regional laboratories are well capable of presenting fairly high quality analytical results. Bearing in mind the costs of transportation and subsistence at Monaco, as compared to the same costs within the region, it would require a careful investigation as to whether such training on trace element analysis could not better be provided in one of these two regional laboratories.

On the other hand, the almost total lack of reports on organochlorines certainly demands an in-dept investigation into the reasons. The necessary repair services can only explain part of the reasons, since both the AAS and GC equipment were repaired at the same time, and the laboratories, apparently most dedicated to their work, who had reported results inspite of sometimes faulty equipment on their first run, did not hesitate to report on their repetitive second run, resulting also in even better results.

This clearly evidences the need for a continuous maintenance and emergency repair service which can only be provided if funds are available in time.

No.	Title	Publishing Body	Languages
32 Suppl.	Papers submitted to the 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
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
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
35	CCOP/SOPAC-IOC-UNU Workshop on Basic Geo-scientific Marine Research Required for Assessment of Minerals and Hydrocarbons in the South Pacific *Suva, Fiji, 3-7 October 1983*	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
36	IOC/FAO Workshop on the Improved Uses of Research Vessels Lisbon, 28 May - 2 June 1984	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
36 Suppl.	Papers submitted to the IOC-FAO Workshop on Inproved Uses of Research Vessels Lisbon, 28 May-2 June 1984	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
37	IOC/Unesco Workshop on Regional Co-operation in Marine Science in the Central Indian Ocean and Adjacent Seas and Gulfs Colombo, 8-13 July 1985	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
37 Suppl.	Papers submitted to the IOC/Unesco Workshop on Regional Co-operation in Marine Science in the Central Indian Ocean and Adjacent Seas and Gulfs Colombo, 8-13 July 1985	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
38	*IOC/ROPME/UNEP* Symposium on Fate and Fluxes of Oil Pollutants in the Kuwait Action Plan Region Basrah, Iraq, 8-12 January 1984	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
39	CCOP (SOPAC)-IOC-IFREMER-ORSTOM Workshop on the Uses of Submersibles and Remotely Operated Vehicles in the South Pacific Suva, Fiji, 24-29 September 1985	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
40	IOC Workshop on the Technical Aspects of Tsunami Analyses, Prediction and Communications Sidney, B.C., Canada, 29-31 July 1985	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
40 Suppl.	IOC Workshop on the Technical Aspects of Tsunami Analyses, Prediction and Communications *Submitted Papers* Sidney, B.C., Canada, 29-31 July 1985	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
41	*First Workshop of Participants in the Joint* FAO/IOC/WHO/IAEA/UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2) Dakar, Senegal, 28 October - 1 November 1985	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
42	IOC/UNEP Intercalibration Workshop *on Dissolved/Dispersed Hydrocarbons* in Seawater Bermuda, USA, 3-14 December 1984 (in press)	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
43	IOC Workshop on the Results of MEDALPEX and Future Oceanographic Programmes in the Western Mediterranean Venice, Italy, 23-25 October 1985	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
44	IOC/FAO Workshop on Recruitment in Tropical Coastal Demersal Communities Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986	IOC, Unesco Place de Fontenoy 75700 Paris, France	English (out of stock) Spanish
44 Suppl.	IOC/FAO Workshop on Recruitment in Tropical Coastal Demersal Communities - *Submitted Papers* Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
45	IOCARIBE Workshop on Physical Oceanography and Climate Cartagena, Colombia, 19-22 August 1986	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
46	Reunión de Trabajo para Desarrollo del Programa «Ciencia Oceanica en Relación a los Recursos No vivos *en la Región del Atlantico* Sudoccidental Porto Alegre, Brazil 7-11 de Abril de 1986	IOC, Unesco Place de Fontenoy 75700 Paris, France	Spanish
47	IOC Symposium on Marine Science in the Western Pacific: The Indo-Pacific Convergence Townsville, 1-6 December 1986	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
48	IOCARIBE Mini-Symposium for the Regional Development of the IOC-UN (OETB) Programme on "Ocean Science in Relation to Non-Living Resources (OSNLR)"	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
49	AGU-IOC-WMO-CPPS Chapman Conference: An International Symposium on *"El Niño"* Guyaquil, Ecuador, 27-31 October 1986	IOC, Unesco *Place de Fontenoy* 75700 Paris, France	English
50	CCAMLR-IOC Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, particularly Krill (organized in collaboration with SCAR and SCOR) Paris, France, 2-6 June 1987	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
51	CCOP/SOPAC-IOC Workshop on Coastal Processes in the South Pacific Island Nations, Lae, Papua-New Guinea, 1-8 October 1987	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
52	SCOR-IOC-Unesco Symposium on Vertical Motion in the Equatorial Upper Ocean and its Effects upon Living Resources and the Atmosphere Paris, 6-10 May 1985	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
53	IOC Workshop on the Biological Effects of Pollutants Oslo, 11-29 August 1986	IOC, Unesco *Place de Fontenoy* 75700 Paris, France	English
54	Workshop on Sea-level Measurements in Hostile Conditions Bidston, UK, 28-31 March 1988	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
55	IBCCA Workshop on Data Sources and Compilation *Boulder, Colorado, 18-19 July 1988*	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
56	IOC/FAO Workshop on Recruitment of Penaeid Prawns in the Indo-West Pacific Region (PREP) Cleveland, Australia, 24-30 July 1988	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
57	IOC Workshop on International Co-operation in the Study of Red Tides and Ocean Blooms Takamatsu, Japan, 16-17 November 1987	IOC, Unesco *Place de Fontenoy* 75700 Paris, France	English