Intergovernmental Oceanographic Commission
Reports of the Meetings of Experts and Equivalent Bodies

Joint Meeting of the Group of Experts on Effects of Pollutants (GEEP) and the Group of Experts on Methods, Standards and Intercalibration (GEMSI)

Moscow, USSR, 15-20 October 1990

UNESCO

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
3. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of «El Niño» *(Also printed in Spanish)*
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping *(Also printed in French and Spanish)*
12. Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica *(Spanish only)*
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in relation to Non-Living Resources *(Also printed in French and Spanish)*
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans *(Also printed in French)*
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities *(Also printed in Spanish)*
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of « El Niño » *(Also printed in Spanish)*
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN (OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic *(Also printed in French)*
54. Third session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico *(Also printed in Spanish)*
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping
59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
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IOC-UNEP-IMO/GGE (EP-MSI)/3
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TABLE OF CONTENTS

SUMMARY REPORT

ANNEXES

1. OPENING

1 The Chairman of the State Committee for Hydrometeorology of the USSR, Professor Yu. Izrael, opened the meeting at 10.00 hours on 15 October 1990. He welcomed the participants, experts, representatives of international organizations and observers. He noted that ocean processes were receiving increasing international attention not only in terms of marine pollution but also for their role in global climate change. Governments and administrators were now paying attention to the ocean sciences, not just the scientific community. He further noted that the USSR has developed large programmes related to climate change and anthropogenic pollution of the oceans. He expected that the present meeting would contribute to further development of the Global Investigation of Pollution in the Marine Environment (GIPME) Programme and its relationships to climate change issues.

2 The Secretary of the Intergovernmental Oceanographic Commission (IOC), Dr. G. Kullenberg, expressed his appreciation to Professor Yu. Izrael and Professor A. Tsyban for inviting this joint meeting of the GIPME Groups of Experts to Moscow. The purpose of the meeting was to bring together experts of the two Groups, the Group of Experts on Effects of Pollutants (GEEP) and the Group of Experts on Methods, Standards and Intercalibration (GEMSI), and experts from the Soviet Union as well as from other regions. He then welcomed the participants and noted that this was a very good opportunity in the context of developing East-West relationships, for the Groups to discuss how they could best contribute to important international developments and their follow-ups, such as the Second World Climate Conference, Geneva, October 1990, the Intergovernmental Panel on Climate Change, and the UN Conference on Environment and Development scheduled to take place in Brazil in June 1992. He also pointed out that linkage of large international programmes to the work of GEEP and GEMSI was necessary. He then noted the interest of certain coastal states and several international organizations, IOC, the United Nations Environmental Programme (UNEP) and the Food and Agriculture Organization (FAO), in developing a project for the protection of the Black Sea. It was also noted that IOC, through GEMSI, has made a proposal to the Scientific Committee on Antarctic Research (SCAR) for an extension of the Open Ocean Baseline Study to the Southern Ocean.

3 Dr. Kullenberg went on to say that another area that will have to be considered in order to contribute appropriate input is that of marine environmental education. He concluded his remarks by raising the question of whether the Groups' work programme, and the resources they require, were appropriate and whether the actions being taken were cost-effective. He invited the Groups to consider these matters.

4 The Chairman of GIPME, Dr. N. Andersen, expressed appreciation on behalf of GIPME to the hosts for inviting and hosting this meeting, and particularly for their warm hospitality. He stressed the significance of developing interactions with global change programmes. He noted recent decisions by the Governing Bodies of IOC and UNEP to co-sponsor GIPME and to establish a Joint Intergovernmental Panel for GIPME. He referred to the representation of the Group of Experts on Standards and Reference Materials (GESREM) at this meeting and indicated that the interactions with this Group should also be addressed. He pointed out that the Groups should consider a plan of activities that would produce, by the end of the decade, operational regional monitoring activities which could provide data addressing issues relating to climate change questions.

5 Professor Izrael then asked Dr. Andersen to assume the chairmanship of the meeting. Dr. Andersen invited the representatives of the co-sponsoring agencies UNEP, the International Maritime Organization (IMO) and the International Atomic Energy Agency (IAEA) to make statements.

6 The representative of UNEP's Oceans and Coastal Areas Programme Activity Centre (OCA/PAC), Dr. M. Gerges, addressed the meeting, outlining the thrust of the global and regional marine pollution monitoring programmes in the ten regions of the UNEP's Regional Seas Programme with respect to environmental assessment and management. He referred to the fruitful co-operation with IOC, IAEA and IMO, and expressed the hope that the two Groups of Experts would continue to provide the necessary support to the Regional Seas Programme. Dr. Gerges informed the meeting of the plans to launch an action plan for the Black Sea. Wishing the meeting every success, he stressed the importance of interaction between the Groups of Experts on the one hand, and on the other, between the Soviet scientists and the international expertise of the Groups, who for the first time were convening a joint meeting in the Soviet Union.

7 The representative of IAEA, Dr. L. Mee, noted the importance of having the meeting in the Soviet Union, a country bordered by some of the world's greatest oceans. He also noted that with increasing environmental awareness worldwide, a great deal is being asked of the UN System's Organizations, but adequate resources to respond are not provided at present. A quick mechanism of response should be devised.

8 The representative of IMO, Dr. R. Coenen, thanked the host institution for their invitation to hold the meeting in Moscow. He noted some specific needs of IMO and particularly of the Scientific Group on Dumping for scientific advice and guidance by GEEP and GEMSI.

2. ADMINISTRATIVE MATTERS

9 The Agenda was adopted with the following change. Agenda Items 5 to 8 would be discussed in the order 7, 8, 6 and 5, bringing the separate sessions of the group forward by one day. Dr. Andersen, Chairman GIPME, would chair the Plenary Sessions; Dr. B. Bayne, Chairman GEEP, would chair the GEEP Sessions and Dr. A. Knap, Chairman GEMSI, would chair the GEMSI Sessions.

10 The following rapporteurs were proposed and designated by the meeting: Dr. R. Coenen, Rapporteur for the Joint Session; Dr. R. Clarke, Rapporteur for the GEEP separate Session; and Dr. R. Dawson, Rapporteur for the GEMSI separate Session.

11 The IOC Technical Secretary for the meeting, Dr. A. Boussoulengas, introduced the documentation and informed participants of the proposed arrangements for the meeting.

3. GENERAL REVIEW OF GEEP INTERSESSIONAL ACTIVITIES SINCE GEEP-V

12 The Chairman of GEEP, presented an overview of the Group's intersessional activities since GEEP-V. He noted that most of the objectives were being fulfilled; more specifically the objectives were:

(i) To facilitate and enhance development of techniques for the quantitative measurement of biological effects on marine organisms;

(ii) To pursue evaluation of techniques in real situations in the field;

(iii) To disseminate these techniques to the scientific and user community at large via workshops and the preparation of manuals.

13 He pointed out that during the present meeting the Group would discuss these objectives and perhaps modify them according to the needs of the nineties. GEEP will have to address the role of natural communities in climate change.

14 A major intersessional activity was the joint International Council for the Exploration of the Sea (ICES)-IOC Sea-going Workshop on the Biological Effects of Contaminants in the North Sea, Bremerhaven, 12-30 March 1990. This was the third in the IOC series, the first being the Oslo Workshop (1986) and the second the Bermuda Workshop (1988). The fourth was planned for Xiamen, People's Republic of China in 1991 or 1992, the exact timing depending on the outcome of discussions with the Chinese authorities.

15 The Oslo and Bermuda Workshop, as well as having been published by IOC in its Workshop Reports Series, were also published as special issues of international scientific journals.

16 GEEP had successfully applied to the US Rockefeller Foundation to hold a discussion workshop at their Study Centre in Bellagio, Italy, (11-15 March 1991). This meeting will aim to evaluate the future role of biological effects studies of marine organisms and systems in the context of regional and global programmes for the study of climate change. GEEP has recognized that there is an important role here for GIPME and intends

to determine the most effective way forward, through discussions at Bellagio. GEEP, noting that the Rockefeller Foundation will be meeting accommodation costs only, requested that the sponsoring agencies provide resources to enable five GEEP Members to travel to and participate fully in this discussion meeting. They will report back to IOC/GIPME on the agreed features and applications of biological effects techniques on regional and global programmes investigating element and nutrient fluxes and their role in climate change.

3.1 REPORT ON ICES-IOC WORKSHOP ON THE BIOLOGICAL EFFECTS OF CONTAMINANTS IN THE NORTH SEA

17 The GEEP Chairman then invited Dr. A. Stebbing to present the results of the Bremerhaven Workshop. Dr. Stebbing noted that the Preliminary Report for the Workshop (Document IOC-UNEP-IMO/GGE(EP-MSI)/7) included little of the data from the Workshop, and he took the opportunity to summarize some of the data and preliminary results. The objectives of the workshop were primarily to test and compare sea-going biological techniques capable of detecting the effects of environmental contamination, that might be incorporated in monitoring programmes. The techniques cover a wide range including biochemistry, cell, histo- and gross pathology of the dab (*Limanda, limanda*); water quality bioassays using lamellibranch gametes and larvae and copepods, and sediment bioassays and techniques to detect change in benthic communities.

18 The sea surface microlayer received particular attention. Levels of copper, organotin and other substances therein were found to be much higher than at 0.5 m depth. Techniques tested during the workshop have been adopted in the North Sea Task Force Master Plan. GEMSI was asked by the Secretary IOC to discuss the issue of the sea surface microlayer and address the need for further studies.

3.2 REPORT ON TRAINING WORKSHOPS ON BIOASSAY TECHNIQUES AND STATISTICAL TREATMENT

19 Dr. R. Clarke described the two Training Workshops on "the Statistical Treatment and Interpretation of Marine Community Data" that had taken place intersessionally in Athens, Greece (September 1989), and Split, Yugoslavia (June 1990), as detailed in Document IOC-UNEP-IMO(GGE(EP-MSI)/9. These were developments of the first workshop of this format, in Piran, Yugoslavia (June 1988), the series being sponsored through FAO-UNEP-IOC in the framework of the UNEP Mediterranean Action Plan (Mediterranean Pollution Research and Monitoring Programme (MED POL Phase II). The scientific content of these workshops, provided by a GEEP lecturing and demonstrating team, was described. This drew on the practical experiences of the GEEP Oslo and Bermuda Workshops, and examples were given of the efficacy of modern statistical analyses (particularly methods on multivariate ordination) in demonstrating the effects of pollutants on biological communities of different types. A total of 20 participants from 10 Mediterranean countries participated in these workshops and their success could be attributed to the relevance of the material: all trainees had the opportunity to analyze data sets of their own, brought to the Workshop. Feedback from these analyses contributed to research developments which, in turn, improved the content of later workshops.

20 Dr. E. Gutierrez-Galindo reported on the Bioassays Workshop (Cartagena, Colombia, 11-24 June 1989) for 14 Spanish-speaking participants from the Wider Caribbean Region. This was an Instituto Nacional de los Recursos Naturales Renovables y del Ambiente (INDERENA)-UNEP-FAO-IOC Training Course (Document IOC-UNEP-IMO/GGE(EP-MSI)/8). Dr. M. Huerta acted as the IOC instructor. The introductory part of the course consisted of general lectures on principles used for development of coastal water quality criteria and on different types of bioassays. This was followed by practical work during which a selected number of bioassay techniques (acute toxicity test and sublethal effects-growth) was demonstrated and tried out by all participants.

21 As a follow up to the course, and according to a regional procedure on standardized bioassay techniques formulated and agreed during the course, the participants applied the bioassay techniques to specific local problems during a sixteen-month (July 1989-October 1990) research phase of the project carried out in thirteen national laboratories.

22 The results of the research phase will be reviewed and evaluated at a five-day workshop (Cartagena, Colombia, possibly in November 1991) organized for the participants in the research component of the project. The workshop will be expected to formulate a long-term programme for testing of biological effects of pollutants that can be adopted in national regulatory legislation of the Caribbean Region.

23 The IOC Technical Secretary informed the meeting of a Comision Permanente del Pacifico Sur (CPPS)-UNEP-IOC Regional Training Course on Toxicity Tests and Bioassay Techniques for the Study of Contamination in Marine Ecosystems, which was held in Valparaiso, Chile (24-28 July 1990), involving 24 participants from Southeast Pacific countries. The participants in the course recommended that, as a follow-up, a regional network of laboratories be formed for mounting bioassays techniques in the regions with the support of IOC, UNEP and the US Environmental Protection Agency (EPA) (Document IOC-UNEP-IMO/GGE(EP-MS)/8).

24 The representative of IAEA noted the need for measuring the experimental levels of chemicals involved in bioassay tests.

3.3 VULNERABLE AREAS

25 Dr. J. Gray presented a review of GEEP's activities concerning vulnerable areas.

26 GEEP, in response to a request from IMO, had given advice on criteria for designating areas vulnerable to damage from ships or ships' cargoes. Initially GEEP reviewed traditional methods, such as mapping, and pointed out the shortcomings of such an approach. More recently, GEEP endorsed the criteria produced by the International Union for the Conservation of Nature (IUCN) which GEEP felt gave a thorough review of criteria that IMO could use. The Marine Environment Protection Committee (MEPC) of IMO, at its twenty-ninth Session (12-16 March 1990) revised the criteria of its Draft Guidelines for the Designation of Special Areas for the Identification of Sensitive Areas taking into account advice received from GEEP. The guidelines will be considered with a view to adoption in July 1991.

27 GEEP contributed to the Malmo Seminar on Particularly Sensitive Areas, 24-28 September 1990, which recommended that the criteria for designating Particularly Sensitive Sea Areas be considered for inclusion in the UNEP Regional Seas Action Plans and other international conventions. GEEP believes that although the advice to IMO is now complete, aspects of vulnerability need to be developed further and GEEP will therefore maintain a continuing interest in this topic.

28 Dr. F. Alcazar noted that shipping already causes some problems to the mariculture industry in South Eastern Pacific coastal areas when iron-ore carrying ships discharge ballast water, thus introducing foreign species. Dr. Gray informed the meeting that such problems were addressed at the Malmo Seminar and will also be discussed in the forthcoming IMO-MEPC meeting.

4. GENERAL REVIEW OF GEMSI INTERSESSIONAL ACTIVITIES SINCE GEMSI-IX

29 The Chairman GEMSI, Dr. T. Knap, highlighted some of the main activities of the Group since GEMSI IX: the long planned Open Ocean Baseline Study had finally been initiated during a cruise of R/V *METEOR* in Spring 1990; the Workshop on the Use of Sediments in Marine Pollution Research and Monitoring had taken place in Dalian, China, April 1990; the manuals on the determination of petroleum hydrocarbons in sediments and on sampling, extraction and determination of chlorinated biphenyls in open ocean waters had been finalized; the quality assurance programme had made good progress particularly through co-operation with the IAEA/International Laboratory for Marine Radioactivity (ILMR).

30 Dr. Knap pointed out that interactions with GEEP, which started during the Bermuda Workshop, should be discussed and particular areas identified; interactions with GESREM should also be discussed during the meeting.

31 The Chairman of GEMSI then invited Dr. D. Schmidt, cruise leader, to present the first cruise report of the Open Ocean Baseline Study.

4.1 REPORT ON THE OPEN-OCEAN BASELINE STUDY

32 A report of the rationale for the choice of sampling locations during the cruise of the R/V *METEOR* was provided by Dr. D. Schmidt, together with a description of the sampling procedures and types of samples which had been processed by a team of 13 scientists.

33 The proposal of the R/V *METEOR* cruise participants to hold a meeting about one year after the cruise (see Agenda Item 10.1) was noted by Dr. Schmidt. This would provide the opportunity for an in-depth discussion of the data, provide for coherent evaluation of results, and prepare a joint, bi- or multi-lateral publication. It was considered necessary that about 20-30 experts from the analyzing laboratories should participate - approximately half from Europe and half from North America. This would also provide an opportunity for planning the second baseline cruise in 1992.

4.2 REPORT ON THE WORKSHOP ON THE USE OF SEDIMENTS IN MARINE POLLUTION RESEARCH AND MONITORING (DALIAN)

34 Dr. Dawson and Dr. H. Windom reported on the Workshop on the Use of Marine Sediments in Marine Pollution Monitoring, held at the Institute for Marine Environmental Protection, Dalian, China, (April 1990). A report of the day-to-day activities was provided. With an overall duration of 10 days and catering to 24 participants from a number of the IOC Sub-commission for the Western Pacific (WESTPAC) countries, the Workshop was viewed as successful in many regards. Difficulties were encountered in completing the complex suite of organic analyses and concern was expressed as to whether GEMSI was over-ambitious in attempting to cover all aspects of organochlorine analysis in complex matrices. Due to limited time, many techniques could only be demonstrated rather than applied by the individual participants. HPLC analysis at selected fluorescence wavelengths proved to be a practical and applicable analytical technique and clearly met the goals of the Workshop to demonstrate pronounced gradients of pyrogenic (e.g. benzo(a)pyrene) hydrocarbons along transects in Dalian Bay, which were highly correlated with parallel UV-fluorescence measurements. To date, the post workshop intercalibration effort had produced no results, with the exception of those from the organizing laboratory. The reason for this is the lack of the simplest of standards in the participating laboratories, and the provision of these must be a high priority issue for both GEMSI and GESREM.

35 The Workshop demonstrated that UV-fluorescence measurements of cleaned-up sediment extracts could be used to follow PAH gradients in sediments. HPLC-fluorescence proved to be a reasonably uncomplicated extension of these types of measurements, providing information on individual components (at this workshop centered around benzo(a)pyrene determinations). The lack of standards at the participants' laboratories is clearly the single largest handicap which prevents their full participation in intercalibration exercises. This is a matter that should be addressed by GESREM.

36 Most of the emphasis on the inorganic side of the Workshop was placed on the interpretation of trace metal data for sediments. This was accomplished in lectures. In addition, laboratory exercises devoted to evaluating different sample digestion procedures were carried out. This provided an opportunity for participants, working in groups, to compare results during the workshop. A follow-up intercalibration exercise was carried out using two sediment samples (one from an uncontaminated area and one from the inner part of Dalian Harbour) provided to each participant, along with a standard reference material, to be taken back to their home laboratory for analysis. Results have been obtained from 12 of the fourteen participants and three additional laboratories from the USSR (provided through a participant from that country). Preliminary evaluation of these results suggests that much of the intralaboratory variability is systematic. An attempt will be made to assess the cause for this variability based on a review of analytical procedures used by the participants.

37 GEMSI is still wrestling with the problems of analysis of organic contaminants, despite advances since the Panulirus Intercalibration Exercise (PANCAL 80) and this is manifested in poor returns from intercalibration exercises and difficulties at training workshops.

38 The Chairman reminded the Group of the original role of GEMSI, and how this has changed with time, with a gap widening between state of the art methodology development and what is practical in training. Dr. Mee reminded the Group of the linkage between expending resources on perceived problems. He said that it was necessary to look first at the sources, landbased or atmospheric, and establish the problem. It was pointed out that this may not necessarily be that easy in regions where diffuse sources are present.

39 The development of simple screening techniques should be one of the aims of future GEMSI activities. For instance, the current pesticide use pattern is dominated by organophosphate, carbonate and pyrethroid compounds currently not included in the GIPME list of contaminants. On the other hand, the conventional lists commonly dictate the choice of compounds which exclude the above classes; this was clearly a discrepancy. It was considered necessary for GEMSI to expand the list of compounds under its consideration to correct for this.

40 It was felt that, from an IOC viewpoint, the ICES-IOC intercalibration was disappointing. Only two of the IOC laboratories returned results and these laboratories have indicated their inability to take part in the next steps in the exercise due to equipment problems. Dr. J. Duinker felt that training in experts' laboratories, followed by site assistance, may be the only way that confidence and ability can be boosted with regard to participation in intercalibration exercises. The Chairman of GESREM, Dr. D. Jamieson, supported this view.

41 IOC is encouraged to continue developing training workshops with perhaps less ambitious objectives in terms of measurement with more emphasis on the assessment of contamination. The current International Mussel Watch concept could be the most cost-effective screening effort for identifying problems, although it would not be comprehensive for contaminants which were metabolized by bivalves.

4.3 QUALITY ASSURANCE PROGRAMME

42 Dr. G. Topping reported that a preliminary report of the results of the first stage of the ICES 4th Round Hydrocarbon Intercomparison Programme had been presented at the 1990 ICES Marine Chemistry Working Group (MCWG) Meeting. The second stage of this programme will assess the participants' ability to prepare standards and to quantify PAHs in a cleaned up extract of a sediment material.

43 He further reported that MCWG had been asked to prepare quality assurance procedures for the sampling and storage of sea-water for trace metals measurements. ICES had also been asked by the Oslo and Paris Commissions (OSPARCOM) to develop guidelines for the measurement of nutrients in sea-water. The draft guidelines were reviewed by the MCWG in February 1990, and amended by the Advisory Committee on Marine Pollution (ACMP) in June 1990.

44 An EEC Bureau of Community Reference (BCR) Meeting in the Netherlands, May 1990, drafted a project in support of the North Sea Co-ordinated Monitoring Programme. This is meant as a mechanism for the regular control of monitoring data.

45 Dr. Mee reported that guidelines on quality assurance in relation to marine pollution monitoring programmes using marine organisms, which had been compiled by GEMSI and discussed at GEMSI-IX, had been published by UNEP in the Regional Seas Reference Methods series (Document UNEP-IOC-IAEA-FAO: Reference Methods for Marine Pollution Studies No.57).

46 Dr. Mee informed the meeting that several intercalibration exercises are organized in support of the Regional Seas Programmes of UNEP from the IAEA/ILMR Laboratory. These are described in detail in Agenda Item 8.2.

47 The IOC Secretary drew the attention of GEEP and GEMSI to data quality assurance requirements and asked the Groups to address this issue. In the light of recent disappointing results from IOC laboratories in the ICES/IOC intercomparison exercise for the analysis of biphenyl congeners, the meeting felt that the suggestion made by Dr. Duinker in Agenda Item 4.2 should be given added emphasis.

4.4 STATUS OF GESREM INTERSESSIONAL ACTIVITIES

48 The Chairman of GESREM, Dr. Jamieson, reported on the Second Session of GESREM (Halifax, Canada, 22-25 January 1990) and on intersessional activities of the Group which had followed a Workplan adopted at GESREM-II (Document IOC-IAEA-UNEP/GGE(SRM)-II/3).

49 There had been 27 GESREM members and other participants at GESREM-II who represented eight major producers of certified reference materials and standards and international organizations or bodies that use them, including the IOC, UNEP, the National Oceanic and Atmospheric Administration (NOAA-USA), ICES and the Scientific Committee on Ocean Research (SCOR). Six other scientists from other major oceanographic research groups described the aims and plans for the Joint Global Ocean Flux Study (JGOFS) and the World Ocean Circulation Experiment (WOCE), and the Methods and Standards being developed for use in these studies (described later under Agenda Item 6.3), and the related work on CO_2 determinations being done for the SCOR-UNESCO-ICES International Assembly of Physical Sciences of the Ocean (IAPSO) Joint Panel on Oceanographic Tables and Standards (JPOTS).

50 Participants reported that worldwide demand for standards and reference materials for use in marine science was increasing rapidly and that this demand had doubled in the past three years. A major achievement had been the very recent publication by NOAA(USA), in loose-leaf format, of the world's most comprehensive catalogue (more than 400 pages), of relevant standards and reference materials (A. Cantillo, "Standard and Reference Materials for Marine Science", NOAA Technical Memorandum NOS OMA 51 (1989)). Since the 300 copies NOAA had printed were not considered enough to meet demand, the Group requested that the IOC Secretariat arrange for an immediate re-printing. This was done later and copies were available from IOC by the end of October 1990. The Group decided to work with NOAA to update this catalogue before the end of 1991, and at succeeding intervals of one or two years thereafter.

51 Other highlights of GESREM-II were the Group's agreement on 14 specific new requirements for standards and reference materials, some of which were not yet feasible, and that eight group members would intersessionally monitor progress in special aspects of reference materials development, so as to keep the entire Group informed (see such a report under Agenda Item 5.4).

52 A major achievement of GESREM-II and subsequent intersessional activity has been the agreement to co-operatively produce two marine bivalve tissue reference materials (GESREM-1 for trace metals, and GESREM-2 for xenobiotic organic parameters), and progress toward their production. The plan features the production of a large batch of certified samples to be distributed in block amounts to the agencies (IOC, UNEP, IAEA) who will financially support their production, and agencies (NIST(USA), NRC(Canada), IAEA and others) who will share the analytical work needed to certify the materials. It is expected that GESREM-1 could be available by the end of 1991.

5. INTERNATIONAL MARINE POLLUTION MONITORING PROGRAMMES REQUIRING ASSISTANCE FROM GEEP AND GEMSI

5.1 STATUS OF REGIONAL SEAS PROGRAMME AND ITS REQUIREMENTS

53 An extensive review of on-going and planned UNEP and UNEP-IOC Regional Seas activities was provided by Dr. Mee. Descriptions were given of the advances made in MEDPOL (Mediterranean), CEPPOL (Caribbean), CONPACSE (South-East Pacific), WACAF/2 (West/Central Africa), EAF (East Africa), ROPME (KAP Region), EAS (East Asian Seas), SPREPPOL (West Pacific) and the projected Black Sea monitoring programme.

54 Particular attention was paid to the changing basic strategy of these monitoring programmes. Insufficient financial and human resources at present do not allow immediate development of extensive monitoring networks. The pilot monitoring approach is the major thrust of these endeavours. Pilot monitoring is focussed on identified land-based sources of contaminants and embraces studies of sources, levels, effects and measures for control and

abatement. This approach permits the development of effective nuclei of marine environmental scientific groups within each region and focusses the limited available financial and logistic support on real problems. Successful results of pilot monitoring should attract further funding and allow the programme to be gradually expanded.

55 The role of GEMSI and GEEP in this development was regarded as critical. Integrated Coastal Zone Management (which is an essential requirement for sustainable development) requires valid expert advice for the identification of new contaminants, the provision of methodologies and for the determination of biological effects (in order to design management strategies and legislation).

56 The significance was explained of the UN Conference on the Environment and Development (UNCED, Rio de Janeiro, June 1992) on the future of all UN activities in marine studies. With present severe constraints in funding, the full co-operation of UNEP and IOC (as well as the other sponsoring agencies) will be critical. The recently initiated CEPPOL Project is a good example of how UNEP and IOC can cooperate in the planning, integration and implementation of joint regional seas activities. Similar co-operation is now envisaged in the Black Sea, where severe damage to the marine environment has already been reported.

57 GEEP has been very active in this programme, particularly in the Mediterranean Action Plan, but now feels the need of guidance from UNEP on how best to increase their involvement in other regions. It was considered crucial that GEEP contribute to the early stages of any new ' 'gical effect initiatives.

58 Some experts stressed the importance of good information dissemination by continued regional presence at GEEP Meetings and by taking any opportunities to invite a few trainees from other regions when mounting training workshops within a particular region.

5.2 STATUS OF MARPOLMON AND ITS REQUIREMENTS

59 The Technical Secretary, Dr. A. Boussoulengas, described the IOC MARPOLMON System, highlighting some of its more recent accomplishments, referring to Document IOC-UNEP-IMO/GGE(EP-MSI)/14. He noted that many activities taking place are being adjusted to identified regional needs. Methods, manuals, intercalibration exercises and workshops generated by GEEP and GEMSI serve as input and provide scientific support to the implementation of regional MARPOLMON components.

60 Close co-operation exists with the UNEP Regional Seas Programmes and with other regional bodies in the implementation of these activities. Training is of particular importance and the development of a project, in co-operation with IAEA/ILMR for the provision and maintenance of equipment is currently underway.

61 Dr. Boussoulengas described activities in IOCARIBE, the Mediterranean, WESTPAC, South West Atlantic, IOCINDIO and other regions. He noted that it was clear that needs by regional and national monitoring programmes were increasing. Some of the inputs by the Groups like the benthic marine community analysis courses in the Mediterranean under GEEP and the workshop on marine sediments in Dalian, China, under GEMSI have proved successful to varying degrees.

62 Plans to develop new projects or activities in regions presently not covered are being worked out (e.g. the Black Sea and the Southern Ocean).

63 The Chairman of GEEP emphasized that information at an early stage of the planning of activities is essential, to enable a more effective contribution from the Groups of Experts. This matter is *inter alia* achieved through the Action Papers prepared for each session of the IOC Governing Bodies.

5.3 THE STATUS OF MUSSEL WATCH AND ITS REQUIREMENTS

64 Dr. Dawson reported on the status of the International Mussel Watch Programme. After two years of planning by the International Mussel Watch Committee chaired by Professor E. Goldberg, partial funding for the initial operational phase (i.e. the Americas), is to be made available from IOC, UNEP and the US-NOAA. The programme is to measure persistent organochlorine pesticides and chlorobiphenyls in sentinel bivalves from

around the coast of the Caribbean, Central and South America, as the first step in the global programme. At the same time the on-going US NOAA-Status and Trends Programme will monitor the North American coastline, hence providing a North-South quasi-synoptic baseline of the contamination of the coastal environment. An informal request was previously made that samples from selected locations around the Canadian coasts and particularly in the Arctic, be analyzed at the same time by a mechanism yet to be established. With these samples full North-South coverage will be realized.

65 The logistics for the programme have been designed to achieve the highest level of data quality. All samples will be collected in a similar fashion by a collector working with scientists from laboratories in the regions.

66 Two laboratories, ILMR - Monaco and Geochemical Environment Research Group (GERG) - Texas A&M University, will be responsible for the analysis of returned frozen samples; the quality assurance programme will be overseen by GEMSI, and will involve periodic intercalibration between the two laboratories (organized by Dr. J. Farrington of the Woods Hole Oceanographic Institution and Dr. J. Duinker of the Institut fur Meereskunde, Kiel). Dr. Duinker will use high resolution confirmation techniques periodically to validate analyses and to examine "unusual" samples.

67 Sample material will be archived for future reference and production and use data gathered where practical.

68 The issue of accurate quantification of co-planar chorobiphenyl congeners was addressed in a short paper by Dr. Duinker. Although there are still outstanding problems, it was felt that GEMSI could perhaps respond in the event of any major crisis.

69 The programme is ambitious but timely, since it will provide a baseline on which to build regional monitoring programmes. Many of the UNEP Regional Seas Action Plans already contain commitments to conduct mussel watch-type programmes and, in many areas, groups and infrastructures are in place to ensure the programme's success. Specifically, the recent implementation of the CEPPOL Programme should expedite the logistics of collections in the Wider Caribbean. The structure and organization of the CPPS Region is likewise at the programme's disposal. Through contacts within GEMSI and IOC, there are assurances to facilitate collections along the South-West Atlantic coast (Brazil, Argentina and Uruguay).

70 Although a provisional list of sampling sites has been drawn-up, the actual locations (i.e. 80 stations in 25 countries) will be finalized after discussion with scientists in the regions, at meetings to be arranged in advance of the collections.

71 The requirements of GEMSI are to provide guidance on the quality assurance aspects of the programme as described above, to provide advice on the follow-up training and to assist in data analysis and interpretation. Assistance from GEEP will be sought on methods of statistical interpretation.

72 GEEP further recommends that consideration be given to collecting some frozen whole animals for analysis of biological effects using modern molecular biological/biochemical approaches. GESREM has offered assistance and will produce a manual on the use of standard reference materials specific to the needs of Mussel Watch.

73 All the current and planned Reference Methods on organochlorine analyses in biota and sediments are deemed to be highly appropriate to the aims of the current effort and future mussel watch programmes in this and other regions of the world.

74 The Chairman of GESREM informed the meeting that GESREM members were cooperating in the preparation of two bivalve tissue materials: GESREM-1 (see Agenda Item 4.4) for the determination of trace metals and GESREM-2 for the determination of organic contaminants. The latter is most appropriate for this and future Mussel Watch programmes.

75 The Chairman informed the meeting that in 1989 the IOC Assembly and, subsequently, the IOC Executive Council, had agreed that IOC support the programme. The meeting recommended that the first stage of the Mussel Watch Programme be set in motion, since it will form a vital foundation to all future monitoring programmes.

76 GEEP has in earlier meetings expressed an interest in contributing to this programme, applying appropriate biological techniques to measure the cellular condition of the mussels. Such techniques have advanced significantly in recent years, and are now feasible with fixed or frozen material. The Group remains keen to collaborate in this programme and resolved to express this eagerness to the GEMSI members involved in Mussel Watch.

77 The meeting recommended that the Mussel Watch Committee meeting be held in parallel with the next GEEP-GEMSI meeting.

5.4 THE STATUS OF THE HARMFUL ALGAL BLOOMS PROGRAMME AND ITS REQUIREMENTS

78 Dr. Gray reported on the IOC-FAO/OSLR (Ocean Science in Relation to Living Resources) *ad hoc* Group of Experts meeting on Harmful Algal Blooms, which was held in Paris, 31 January - 2 February 1990. He mentioned that there was no agreement on whether algal blooms were found to have expanded globally or not. Neither was there agreement on the link between eutrophication and algal blooms. He briefly explained the research needs in the fields of taxonomy and toxicology, and stressed the importance of a co-ordination network for algal blooms and the need for training and education as essential components of all harmful algal bloom programme activities.

79 In relation to the research needs in the field of toxicology, Dr. Jamieson informed the meeting that in 1989 the National Research Council of Canada (NRCC) completed the production of an instrument calibration standard and a tissue reference material for domoic acid (ASP) determinations. In progress in their very active programme for the analytical chemistry of marine neurotoxins are projects to produce tissue reference materials for the determination of PSP toxins and of DSP toxins, as well as related instrument calibration standards for both these classes of toxins. The NRCC has developed and published methods for the chemical determination of ASP, PSP and DPS, and is continuing to develop methods for the PSP and DSP toxins.

80 Dr. F. Alcazar and Dr. P. Gangaya stressed the importance of the harmful algal blooms issue, and a description was given of current monitoring in Chile for "brown tides", which had serious economic consequences for salmon fisheries and shell-fish culture.

81 In response to questions from several participants regarding the status of this programme, the IOC Technical Secretary explained that the person responsible for OSLR, Dr. J. Alheit, had completed his term in March . However, Dr. T. Osborne had recently been seconded by the US to the OSLR Programme and it can be anticipated that this will result in an increased activity.

82 The joint meeting recognized the requirement for a widely applicable methodology on algal bloom toxins and noted that the proposed reference method: "Determination of selected neurotoxins in marine organisms" had a potential author but lacked funding. It was agreed that this manual should be given a high priority and that appropriate financial support should be sought.

5.5 STATUS OF THE LONG-TERM MONITORING OF PHENOMENA ATTRIBUTABLE TO CLIMATE CHANGES AND ITS REQUIREMENTS

83 The UNEP representative, Dr. M. Gerges, provided information on the status of development of a joint UNEP-IOC-WMO Programme for the monitoring of phenomena related to climate change in the coastal zone and near-shore areas. A draft "Masterplan" has been prepared. Comments on the "Masterplan" were solicited from international and regional organizations, as well as from several oceanographic and meteorological institutions and all the co-ordinators of the regional Task Teams on implications of climate change. A meeting

of experts will be convened in December 1990 to further discuss and finalize the "Masterplan", taking into account the comments received by then by the Secretariats, with a view to submitting the final programme to the governing bodies of the co-sponsoring organizations for consideration.

84 In view of the importance of the phenomena and processes in the coastal areas to the prediction of global change and their effect on biological parameters, the Groups expressed the need to reflect their views on the relevant sections of the "Masterplan". To this effect, a copy of the "Masterplan" will be sent for comments to the Chairmen of GEEP and GEMSI.

5.6 ANY OTHER PROGRAMME PRESENTED BY CO-SPONSORING ORGANIZATIONS, IN PARTICULAR OTHER REGIONAL PROGRAMMES

85 No other programmes were presented or discussed.

6. OTHER INTERNATIONAL AND LARGE SCALE NATIONAL PROGRAMMES RELEVANT TO GEEP OR GEMSI

6.1 ECOMONOC

86 Professor A. Tsyban presented the Integrated Studies and Monitoring of Marine Ecosystems Exposed to Anthropogenic Impact and Global Climate Change (ECOMONOC) Programme (Document IOC-UNEP-IMO/GGE(EP/MSI)/Inf.1.). The goal of the ECOMONOC Programme is to assess the state of marine ecosystems in relation to anthropogenic impact and climate change, their assimilative capacity and to determine the global changes of ecological conditions in the World Ocean. The tasks of the ECOMONOC Programme include:

(i) investigations into biogeochemical contaminant cycles and the mapping of the distribution of contaminants;

(ii) assessment of the ecological consequences to the World Ocean of pollution in various geographical zones;

(iii) assessment of the assimilative capacity in key regions of the World Ocean; and

(iv) investigation of carbon cycle in the ecosystems of the World Ocean and the determination of its role in global climatic processes.

87 Professor Tsyban emphasized the links between ECOMONOC and JGOFS. ECOMONOC is carried out on both national and international levels. On the national level, investigations are mainly carried out in the coastal zone of the USSR. On the international level, investigations are carried out in the Baltic, Bering and Chukchee Seas and Central Pacific Ocean (including Caroline atoll). ECOMONOC includes studies of all components of the marine ecosystem and is based on the use of the concept of assimilative capacity of the marine environment.

88 The results of the programme obtained to date show that in water, biota and sediments of all areas studied, PCB's, DDT and HCB were detected, sometimes at high levels.

89 The role of marine micro-organisms to transform benzo(a)pyrene and PCB's has been determined in ecosystems located in arctic, subarctic, temperate and tropical areas.

90 As a result of contamination in some areas, some forms of micro-flora have been found which are able to synthesize metabolites possessing toxic and DNA-damaging properties, which in turn could constitute secondary contamination of the marine environment.

91 On the basis of investigations in the Baltic Sea, a preliminary assessment of its assimilative capacity with respect to organic contaminants and some toxic metals has been carried out. Calculations have suggested that the measured concentrations of PCB's, benzo(a)pyrene and lead in water are close to their "critical" concentration levels.

92 In the discussion on the ECOMONOC Programme, the members of GEEP and GEMSI expressed interest in particular in having access to the literature cited in the monograph which is currently in Russian, on the microbiological transformation processes in the water column, and on the relation of the contaminants with effects in the micro surface layer. It was recommended that the monograph "Anthropogenic ecology of the ocean", by Yu. A. Izrael and A. V. Tsyban, be translated into English.

93 Later discussion, particularly in connection with CPPS concerns, took up specific issues such as the role of assimilative capacity in a regulatory context. The Group was well aware of related Groups of Experts for Scientific Aspects of Marine Pollution (GESAMP) initiatives and would continue to follow these closely. Whilst the scope of the ECONOMOC study was much wider than legitimate GEEP concerns, there were nevertheless points which were highly relevant to GEEP activities.

6.2 GLOBAL OCEAN ECOSYSTEM DYNAMICS (GLOBEC)

94 Dr. Andersen drew attention to the document describing GLOBEC and informed the meeting that plans are underway to convene an IOC-SCOR Meeting on GLOBEC, which is a joint IOC-SCOR co-sponsored programme. However, he pointed out that resources are yet to be identified for catering to the extensive needs of the programme.

95 The Chairman of GEEP, in noting that GEEP could provide input to GLOBEC, identified another "Core" International Geosphere Biosphere Programme (IGBP), Land-Ocean Interactions in the Coastal Zone (LOICZ), as a programme considered by GEEP as one in which GIPME could contribute. (See also comments in Agenda Item 6.6.)

6.3 JOINT GLOBAL OCEAN FLUX STUDY (JGOFS)

96 Dr. Andersen informed the IOC meeting that the IOC Assembly and Executive Council decided that when the Scientific Plan of JGOFS was published, IOC should consider where and how it could contribute to the implementation of the programme (Resolution XIV-7; Para 112, EC-XXI Summary Report; Para 129, IOC-XV Summary Report; and Resolution XV-6). The action called for the Chairman of the Committee for GIPME to convene an *ad hoc* meeting to address the question. In this context, he noted that a Joint IOC-SCOR Consultation in September 1990 tentatively agreed that the JGOFS Process Study in the Indian Ocean could provide the first opportunity for IOC to provide assistance to the Programme; plans on JGOFS Equatorial Pacific Component have already been finalized. As a result, the *ad hoc* meeting referred to above is being planned for the end of November 1990, in Washington DC, at the time of the JGOFS Symposium on the North Atlantic Bloom Study and the JGOFS Steering Committee Meeting. GEMSI and GEEP Members will be nominated by GIPME to attend a subsequent planning meeting for the JGOFS Indian Ocean Process Study in Goa, India, early in 1991.

97 Dr. Jamieson noted that GESREM-II recommended that CO2 and pigment standards production be encouraged and further developed to meet the needs of JGOFS also. Dr. J. Calder then reported on Items 6.3.1 to 6.3.5.

6.3.1 Dissolved Oxygen

98 During a brief cruise to test the new WOCE water sampler, four oxygen-measuring teams conducted an intercomparison. Two teams used amperometric end-point titrators, one used a photometric end-point titrator, and one used the manual visual/starch end point titration. Preliminary evaluation of data indicates that all results agreed within 0.5%. However, there was a problem in the at-sea preparation of a working calibration standard, with one lab's standard unacceptably different (more than 0.1%) from the others. The four teams also

considered aspects of blanks and data processing algorithms. One of the objectives of this effort is to certify one of the automated titration methods as an official method of WOCE (and JGOFS) purposes. Until then, only the Carpenter-Winkler visual/starch titration of whole flask samples is acceptable to WOCE.

6.3.2 Nutrients

99 The study on stabilizing and packaging mixed nutrient standards being undertaken jointly by Dr. L. Gordon, Oregon State University, and the Alpkem Corporation is going slowly. New company ownership and internal restructuring may be responsible, although further work is promised. Dr. Gordon is attempting to take on the problem alone, but anticipates a long process. He has yet to find an effective, non-interfering poison.

100 Dr. Gordon has been working on a revised method for silicic acid in seawater that avoids the sensitivity to ambient temperature that plagues the current method. A viable method seems imminent and a publication is anticipated in the near future.

6.3.3 Carbon System Parameters

101 The U.S. Department of Energy (DOE) has awarded a contract to Dr. A. Dickson of the Scripps Institution of Oceanography for continuing the work initiated by the US National Science Foundation (NSF) on the preparation of standards for carbon dioxide in seawater. Initially these standards are primarily for the use of scientists being supported by the DOE to provide CO_2 measurements on the WOCE Hydrographic Programme cruises. A few samples may be available for others. The DOE technical officer has stated that the DOE expects to play a long-term, more widespread role in the distribution of such materials. Dr. Dickson has developed a protocol for preparation of CO_2 standards in 125 ml batches. Also, he has nearly completed the development of a method for total alkalinity using a coulometric back-titration procedure. Further coordination between GESREM and JPOTS is needed.

6.3.4 Pigments

102 Drs R. Bidigare and M. Kennicutt, of The University of Hawaii and the Texas A&M University respectively, are continuing their work on development of pigment standards. Results from the first JGOFS interlaboratory comparison for pigments are available and demonstrate that suitable standards can be prepared and stabilized. About 3500 ampules have been prepared, sealed under nitrogen and stored at -20°C. Measured pigment concentrations in these ampules have not varied significantly over the first year of storage. A publication on the intercomparison and stability study is planned for late 1990. The 1989 Annual Report for SCOR WG 78: Determination of Photosynthetic Pigments in Seawater, has been released. The Center for Culture of Marine Phytoplankton (Bigelow Laboratory for Ocean Sciences, U.S.) will seek funds to establish axenic cultures of alga with known pigment compositions to serve as "reference materials". A workshop on "The analysis and characterization of marine particles" will be held in late January 1991 at the University of Hawaii, under U.S. NSF and DOE support. Among other topics, analysis of pigments will be considered. It is hoped that the workshop report will be a state-of-the-art description of methods for sampling and analysis of marine particles.

6.3.5 General

103 The complete set of "*Core measurement protocols*" for the JGOFS programme will be published by SCOR. This document will include 20 chapters covering: meteorology and positioning; CTD, O2 probes, and fluorometry; oxygen titrations; nutrients; optics; CO_2; POC and PON; DOC; pigments and chlorophyll; bacteria and cyanobacteria; mesoplankton; microplankton; primary production by 14C; primary production by O2; new production by 15N; grazing by mesoplankton; grazing by microplankton; floating sediment traps; and moored sediment traps.

6.4 INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA (ICES)

104 Dr. Topping described briefly the proposed Master Monitoring Plan for 1988-1993 by the North Sea Task Force (NSTF), a joint body of ICES and OSPARCOM. An NSTF workshop was held in October 1989, to discuss the requirements for this plan which involved the collection of samples at fixed positions in inshore, intermediate and offshore areas. There is a list of mandatory and voluntary substances in the various matrices targeted by NSTF. A primary responsibility of the Task Force was the production of a Quality Status Report of the North Sea by the end of 1993.

105 In the context of GESREM and GEMSI, he referred to the Quality Assurance (QA) discussions at the NSTF workshop. He informed the members that following discussions with the EEC/BCR, a meeting on QA had been convened by BCR in December 1989. At this meeting, BCR agreed to consider the funding of a 3 year Pilot Programme on QA in relation to measurements of contaminants in marine samples as part of the NSTF Monitoring Programme.

106 Since this programme may be used as a model for future marine monitoring programmes, GEEP considered that it would be useful to undertake an in-depth review of the approaches and methods proposed for the biological effects monitoring component of the plan. This will be carried out as an inter-sessional activity in early 1991.

107 Accordingly, GEEP requested that the IOC Secretariat circulate the Plan (North Sea Environment Report no.3, March 1990) and the following documents referred to therein to members:

(i) ICES Coop. Res. Rpt. no. 160 (1988);

(ii) PARCOM 1989: Guidelines for monitoring in the vicinity of offshore platforms;

(iii) THAIN, JE: Oyster embryo bioassay (ICES Techniques in Marine Environmental Sciences)

(iv) ICES Coop. Res. Rpt. no. 166 (1989);

(v) GALGANI, F: EROD Measurements (ICES Techniques in Marine Environmental Sciences).

108 The GEEP review of the North Sea Monitoring Plan would be conducted on the basis of these documents and reported to IOC.

109 Dr. Stebbing noted that biological effects techniques are incorporated in the NSTF Master Monitoring Plan. GEEP believes that some more careful consideration is needed on the appropriate techniques to be used. GEEP has decided to examine this intersessionally as discussed in Agenda Item 9.

6.5 IGOM II: THE SECOND INTERNATIONAL SYMPOSIUM ON INTEGRATED GLOBAL OCEAN MONITORING

110 Dr. Andersen reported on the background leading to the proposed symposium, IGOM II, presently planned to be held in Leningrad, April 1991. He indicated that, despite beginning planning for the meeting more than a year in advance, few preparations for this Symposium had been made to date. An information paper will be hurriedly sent out requesting abstracts in the near future. He pointed out that up to 10-12 recognized experts would be invited to give keynote addresses, with discussions and recommendations to appear in a well written publication.

111 The Secretary IOC stressed the importance of delivering a tangible product to the forthcoming 1992 United Nations Conference on the Environment and Development at its Preparatory Committee meeting in August 1991. IOC and UNEP are expected to report on ocean observations in the context of climate change for these preparations.

112 Some members expressed concern over the concept of global ocean monitoring, reminding the Group that coastal zone concern far out-ranked concern over pollution issues of the open-ocean as was raised already at IGOM I.

113 In view of the concern that ocean monitoring is clearly a necessity in climate monitoring and has many connections with programmes such as JGOFS, it was agreed that this Symposium should proceed. However, the meeting recommended that the Symposium be more focussed and give more emphasis to the coastal zone and the land-sea boundary. The meeting made several specific recommendations concerning the aims and sections covered by the Symposium for consideration when preparing the second IGOM-II information letter. Recommendations on experts to be invited were also provided.

6.6 OTHERS

114 A number of IGBP Programmes (and putative programmes) were on the agenda for this joint GEEP/GEMSI Meeting, though the group queried the singling out of GLOBEC (a programme not yet confirmed) and JGOFS for discussion, whilst the (confirmed) LOICZ programme was not explicitly referred to.

115 Members felt that there was a strong role for IOC and GIPME in the IGBP programmes, but focussing mainly on coastal zones which, of course, are regions of current pollution impact. The emphasis in some programmes on the exchange of material across the shelf-break was felt to be somewhat misplaced. Within the LOICZ Programme, the dominant concerns were with the land-sea boundary. Study of the coastal zone was felt by the Group to be crucial in formulating prediction of global environmental change: processes taking place in the coastal seas form major components of the global picture, and these regions are also the repositories of contaminants which affect biogeochemical and nutrient cycles in, as yet, imperfectly understood ways. It is premature, therefore, to pose questions of how "known" global environmental change will affect coastal ecosystems; the converse question of how anthropogenic effects on the coastal seas affect global predictions, is more pertinent. The Group felt that IOC could make a useful contribution, in connection with the IGBP LOICZ Programme, in advancing this thinking because this programme deals with questions which are central to the activities of both GEEP and GEMSI, namely: (*inter alia*) to understand the consequences of pollution acting on key organisms and processes within the coastal ocean and shelf seas, for the rates of biogeochemical flux which contribute to the oceanic influence on global climate change. LOICZ required that levels of contamination in key coastal zones of the global land mass be quantified, and the effects of the contamination levels on carbon and nutrient fluxes be evaluated for incorporation in regional and eventually global models for climate prediction. These are common goals of GEEP and GEMSI. The meeting requested that IOC contributions to LOICZ, as well as other developing IGBP Programmes, be encouraged, and that opportunities for an involvement of GIMPE's Expert Groups, acting directly and through the regional programmes, be actively sought by IOC.

116 The Secretary IOC pointed out that two major IOC programmes, GIPME and OSLR, interact with IGBP programmes. It would be positive for the GEEP and GEMSI Groups to consider ways and means for specifically contributing to IGBP programmes.

7. ANALYSIS OF GEEP INTERSESSIONAL ACTIVITIES SINCE GEEP-V

7.1 STATUS OF MANUALS AND REFERENCE METHODS

7.1.1 Statistical Treatment and Interpretation of Marine Community Data

117 A draft manual on the Statistical Treatment and Interpretation of Marine Community Data by Drs. K.R. Clarke and R.M. Warwick was tabled and discussed. The manual has evolved from lecture notes used at three training workshops on the subject organized within the Mediterranean Action Plan (see Agenda Item 3.2). The manual focusses on the "why" and "how" of benthic community analyses: it describes the underlying rationale and illustrates the points with analyses of real data sets.

118 The statistical analyses are most conveniently performed with computer software compiled by the Plymouth Marine Laboratory (PML). This software is still at the "research" stage and requires some editing to become robust and "user friendly". It is estimated that this would require 3 person-months' programming effort. It was requested that IOC consider providing resources to complete this (together with user documentation). The estimated cost is $10,000. PML and/or IOC would then distribute the software on a cost-recovery basis (i.e. for disks, photocopying and postage).

7.1.2 Hepatic Mixed Function Oxidase Induction in Fish

119 A draft manual on Hepatic Mixed Function Oxidase Induction in Fish was tabled by Dr. R. Addison and discussed. This manual reviews the rationale for measuring various components of the fish hepatic mono-oxygenase system, and provides practical procedures for measuring EROD (ethoxy resorufin

O-de-ethylase) and related enzyme activities. This manual has been reviewed once, and will undergo a second round of reviews in early November.

120 The final draft will be available by mid-1991.

7.1.3 Scope for Growth Determination on Bivalve Molluscs

121 A manual on Scope for Growth Determination on Bivalve Molluscs prepared by Dr. Bayne was discussed. A first draft of this will be available by mid-1991.

122 All three manuals will be forwarded by the Chairman GEEP to IOC for printing and distribution.

7.2 WORKSHOP INTERCALIBRATION AND TRAINING

123 The Group briefly regarded this activity and agreed that nothing further to what was discussed under Agenda Item 3 was needed.

8. ANALYSIS OF GEMSI INTERSESSIONAL ACTIVITIES SINCE GEMSI-IX

8.1 STATUS OF MANUALS AND REFERENCE METHODS

8.1.1 Determination of Petroleum Hydrocarbons in Sediments

124 The Group recommended publication of the draft manual on the determination of petroleum hydrocarbons in sediments and congratulated the authors and the GEMSI sub-group on organics. Minor editorial changes are envisaged in conjunction with Dr. K. Burns.

8.1.2 Chlorinated Biphenyls in Open Ocean Waters

125 Likewise, the draft manual on chlorinated biphenyls in open ocean waters: sampling, extraction, clean-up and instrumental determination was adopted with congratulations being given to Dr. Duinker. It will be published in the IOC Manuals and Guides Series and not as a UNEP Reference Method since it deals with the open-ocean.

8.1.3 Guidelines for Monitoring Estuarine Waters and Suspended Matter

126 The view expressed by the UNEP Regional Seas Representative on the above document was that although it may be useful in estuarine studies, a substantial section is too descriptive and definitive for a reference method. Similar views were expressed by members of GEMSI, particularly Dr. Windom. The document as it now stands was not acceptable to the Group. However, it was recommended that a sub-group of GEMSI (with Dr. R. Wollast included) consider corrective measures required for a reference method on estuarine monitoring that would be particularly useful for the UNEP Regional Seas Programmes.

127 It is recommended that a small group of GEMSI members meet to develop a strategy for revising the Reference Method "Guidelines for monitoring estuarine waters and suspended matter". The meeting should coincide with the second International Symposium on the Biogeochemistry of Model Estuaries to be held in April 1991 on Jekyll Island, Georgia, to take advantage of GEMSI members in attendance and the relevance of the symposium.

8.1.4 Guidelines for Monitoring Chemical Contaminants in the Sea Using Marine Organisms

128 The status of the draft reference method for Guidelines for Monitoring Chemical Contaminants in the Sea Using Marine Organisms was described by Dr. Topping, who indicated that additions are expected to expand sections on planning and executing pilot studies. He offered the document for scrutiny at the session by possible

users from regional programmes. He also stated that he would be incorporating comments and amendments made by a number of scientists who had experience in monitoring studies.

8.1.5 Reference Method on Contaminant Monitoring Programmes Using Marine Organisms

129 The draft "Reference Method on Contaminant Monitoring Programmes Using Marine Organisms: Quality Assurance and Good Laboratory Practice", prepared by Dr. Topping, will be published within the month and only minor editorial changes are required.

8.1.6 Reference Methods and Materials

130 Dr. Mee introduced the new copy of the document Reference Methods and Materials. He specifically referred to the catalogue of reference methods and pointed out that a number of old reference methods had been discontinued because of their unreliability. Due to financial limitation within IOC-IAEA-UNEP, only high priority reference methods will be commissioned in future.

8.1.7 Determination of DDT by Packed Column Chromatography

131 Reference Method 14, Determination of DDT by Packed Column Chromatography, was reviewed by a sub-group. Corrections to the introductory text of Reference Methods and Manuals were charged to the review group for comments to be returned before the end of the meeting. A strategy for production of reference methods marked in the catalogue as "in preparation" was developed.

8.1.8 GEMSI review process

132 There was a general feeling that the review process by GEMSI was acceptable. However, delays are being experienced (up to years!) in commissioning, preparing and reviewing the manuals and difficulties are being experienced in meeting deadlines for the printing schedule at UNEP.

133 The Group reported on progress with the following reference methods since many of these are urgently required in furthering International Mussel Watch and its extension to regional activities.

Reference Method No. 12 Sampling

134 Dr. Mee requested that any updates, prior to reprinting (if warranted) be conveyed directly by members. Even in its present form, it is considered to be useful for the forthcoming International Mussel Watch Programme.

Reference Method No. 14

135 With regard to Reference Method No. 14, determination of DDT's and PCB's in selected marine organisms by packed column chromatography, UNEP had decided that this was an inappropriate method for their current series, but would keep a limited stock in the event that no other options were available in a developing laboratory. This is to be replaced by a much needed improved method for sample extraction and clean-up prior to instrumental analysis, which has been adequately described in the reference method. The proposed manual should be forward looking in that it should reference modern techniques of sample extraction and clean-up, some of which are not fully proven (e.g. supercritical extraction), some of which are advanced (e.g. HPLC clean-up, Gel permeation chromatography) and more readily accessible techniques employing column chromatography alumina, florisil and silica. The manual should take into account availability and restrictions on solvents in various regions. The manual is intended to cover not only the DDT family and PCB's as previously, but to extend to other classes of organochlorine compounds. A separate, but similar manual, will be prepared for the analysis of the same compounds in sediments, noting that this should be a simple variant of the already excellent manual on PAH in sediments (Reference Method no. 20). The authors of these manuals will be provided with clear instructions as to the desired content.

Reference Manual ("AI") Petroleum Hydrocarbons in Marine Organisms

136 This manual will likewise be prepared with a request to the author of the manual for analysis of marine sediment to make appropriate alterations.

137 A discussion on whether it would be possible to prepare a manual on analysis of lubricant oils in sea-water, a distinct request of the Barcelona Convention, included the use of a gas chromatograph of the unresolved complex mixture (UCM) envelope and their trace element signatures. A lack of substance evidence of unique signatures (organic or inorganic) leads GEMSI to recommend that this remain either a literature or basic research item. Dr. R. Weber agreed to review the available literature assisted by Drs. Jamieson and Calder.

138 The proposed manual on reagent and labware clean-up, both for organic and inorganic analysis, seems relatively straightforward to prepare, and may be gleaned from many existing texts and practices. Attention should be given to safety precautions under varying climatic conditions owing to the widespread dissemination of this type of manual.

139 It was recommended that other manuscripts and manuals requiring GEMSI's review, i.e. IOC Series publications, should be subject to the same routing procedure, via the respective sub-group chairmen.

140 The Group considered the document "Report of the IOC-FAO-UNEP review meeting on the persistent synthetic materials pilot survey". The document was widely approved by the Group as a useful basis for a manual which could be applied in all regions. The importance of such a manual was stressed and it was felt that this could provide the means for a valid assessment of the impact of beach litter worldwide. The Group was reminded of other guidelines prepared for beach debris surveys, particularly in the USA. The manual will be prepared and issued intersessionally with the highest priority.

8.2 WORKSHOPS, INTERCALIBRATION AND TRAINING

141 The experiences and results of the Workshop on the Use of Sediments in Marine Pollution Research and Monitoring, Dalian, China, 11-22 April 1990, were discussed extensively under a previous agenda item (4.2) both in plenary and in separate GEMSI Sessions.

142 Based on the discussions about the Workshop on the Use of Marine Sediments in Marine Pollution Monitoring, Dalian, GEMSI recommends that IOC make available resources to distribute standards to the participants of workshops and hence facilitate the analysis on the intercalibration samples.

143 The organizers recognized the lack of standards in participant's home laboratories to be the single largest handicap in the exercise. They would be contacting the participants with revised instructions if and when these standards were distributed.

144 Likewise assistance is also required in providing standards for the forthcoming intercalibration exercise to be held in the South West Atlantic between Argentina, Brazil and Uruguay, specifically for nutrients, trace metals and selected organic contaminants.

145 Dr. Duinker reported on the ICES-IOC-OSPARCOM Chlorobiphenyl Intercalibration Exercise. He noted that the first stage of this step by step learning exercise had now been completed and a detailed report of this work had been reviewed by MCWG at its 1990 meeting. The co-ordinators and authors of this report were Drs J. de Boer, J. C. Duinker, J. Calder and J. van der Meer.

146 The choice of the CB-congeners involved in the ICES-IOC intercalibration exercise was made at the MCWG 1988 meeting. A total of 60 out of 90 laboratories returned their results by the deadline, i.e. 30 June 1989. The response from ICES/JMG laboratories (50 out of 73 = 79%) was far better than that of the IOC laboratories (2 out of 17 = 12%). The two IOC laboratories have indicated their inability to participate in the second phase of the exercise due to technical problems.

147 Dr. Topping informed the Group of the current status of the ICES Intercomparison Programme on Analysis of Polycyclic Aromatic Hydrocarbons. The results from some of the 17 participating laboratories displayed high variability and indicated the need for some of them to optimize their instrumentation before undertaking the second stage of this exercise. A full report on the results of the first stage of this exercise will be available in February 1991 for review by MCWG and ACMP.

148 The second stage of this exercise is designed to assess the ability of the participants both to prepare their own standards and to analyze the individual PAH compounds in a cleaned-up sediment extract. Stages 3 and 4 of this exercise will deal, respectively, with an assessment of extraction and clean-up procedures and the ability to quantify PAHs in a natural sediment.

149 The IAEA Representative reported on the participation and returns from recent intercalibration exercises organized by the Monaco laboratory. The following exercises have been completed during the biennium:

(i) Mediterranean Deep-Sea Sediments

150 Samples were distributed to about 250 laboratories world-wide for trace metal analyses and 100 laboratories for chlorinated hydrocarbons. Response was very high for trace metals (130 labs) but low for trace organics (20 laboratories). The sample will be certified for about 15 metals but precision and accuracy of chlorinated hydrocarbon analyses were too poor to permit certification.

(ii) Tuna fish homogenate

151 A similar number of samples were distributed as for the sediment exercise. Response was slightly lower and trace element data were received from about 80 participants for trace metals and 24 participants for chlorinated hydrocarbons. The sample will be certified for about 9 trace metals and (as reference values) DDTs and some individual PCB congeners. Results for some elements (notably Cd) were still very poor but some improvements had been made. The low return of data from laboratories which received samples for organic parameters was noted.

(iii) Butyl-tins in sea-water

152 A recent exercise on natural and spiked sea-water (11 laboratories) had revealed encouraging results.

153 The following new exercise is underway:

Contaminated coastal sediments

154 The sample is currently being distributed for chlorinated and petroleum hydrocarbons, and trace metals. Regional exercises are being carried out using this material in the Caribbean (CEPPOL) and Mediterranean (MEDPOL).

155 The IAEA Representative described progress on interactive quality assurance programmes (involving training, instrument maintenance support and extended visits to Member State laboratories) carried on within the framework of UNEP, IOC and World Bank Programmes. He underlined the severe financial constraints on his laboratory for conducting new large scale intercalibration exercises and developing regional programmes.

156 GEMSI recommends that a meeting of up to six GEMSI members be convened intersessionally to conduct an evaluation of previous workshop and intercomparison exercises in order to develop a strategic plan for GEMSI activities over the next five-ten year period, taking due account of the need for close collaboration between GEMSI, GEEP and GESREM.

9. GEEP ACTIVITIES IN THE FORTHCOMING INTERSESSIONAL PERIOD

157 The following items should be considered as GEEP intersessional activities additional to these specifically identified in other agenda items, which are not repeated here.

9.1 MANUALS

158 The production of further manuals was discussed. It was felt that the next biological effects monitoring technique for which a manual should be prepared was metallothionein induction. GEEP will make a preliminary approach to Drs. C. Haux and K. Hogstrand (University of Goteborg) to test their willingness to prepare such a manual, and will then take the matter up with IOC in the most appropriate way.

159 GEEP was asked if they wished to comment on two manuals in preparation: UNEP-IOC-IAEA "AG", Guidelines for evaluating the effects of thermal discharges on the marine environment, and UNEP-IOC-IAEA, "AH", Guidelines for detecting and monitoring eutrophication in the marine environment. Three members of the group were keen to see the latter and Dr. Gray asked that three copies of "AH" be forwarded to him to facilitate this. The Group also undertook to identify someone who could give an informal opinion on "AG".

9.2 BREMERHAVEN WORKSHOP

160 In the follow-up to the ICES-IOC Sea-going Workshop held in Bremerhaven in March 1990, ICES has offered to host a Symposium in Copenhagen in September 1991 at which the results of the Workshop will be presented. The Symposium will be organized by the Planning Group for the Workshop headed for the Symposium by Dr. V. Dethlefsen, who has begun to make the necessary arrangements and has already circulated information to Workshop participants. The Group is keen to see this Workshop as a Joint IOC activity with ICES, from its inception to the presentation of the results, and requests IOC to consider supporting the participation of 10 scientists in the Workshop/Symposium at an estimated cost of $10,000.

161 Publication of the results of the Workshop is to be as a Marine Ecology Progress Series Special Volume for publication in 1992. The Oslo Workshop Special Volume (MEPS Vol. 46) required considerable effort in gathering the papers, their refereeing and editing. The Bremerhaven Workshop involved twice the number of scientists and although the papers will be shorter, the effort required in preparing the volume will be greater. As a result, support is requested from IOC to allow participation of 10 scientists at the concluding meeting (ca. $10,000) and to provide assistance in the editing and copy preparation of the published results (ca. $6,000).

9.3 INTERCOMPARISON OF BIOCHEMICAL MEASUREMENTS

162 The results of recent IOC and ICES sponsored Workshops, together with reports in the primary scientific literature, show that measurement of various biological effects can provide useful information on the impact of contaminants on marine systems. Such "biological effects measurements" are becoming increasingly popular, and their use is spreading. One such example is the incorporation of EROD (ethoxyresorufin O-de-ethylase, an indicator of fish hepatic mono-oxygenase activity) into the North Sea Task Force's Master Monitoring Plan.

163 A problem arising from the increased use of such biological effects measurements is the comparability of data. Unlike the situation in analytical chemistry, there is usually no "external standard" for biological effects measurements against which a laboratory can compare its own measurements. In the case of EROD, for example, there is no tissue preparation of known EROD activity which is stable enough to be distributed to several laboratories over a reasonable period of time for use as an external standard. Similar considerations apply to measurements of Scope for Growth in bivalves, or even to measurements of benthic community structure. As a result, the incautious use and interpretation of such measurements may lead to unjustified conclusions to the discredit of such indices of toxic stress.

164 There are a number of possible approaches to resolving this problem. The most practicable, at least in the short term, is for the users of the methods to agree on strictly controlled standardized procedures; in the longer term, other approaches are possible.

165 GEEP therefore plans to form an *ad hoc* group of 8-10 scientists who are actively involved in EROD measurements in fish as an index of marine environmental quality, with a mandate to:

(i) agree on standard procedures for EROD measurements, which would allow intercomparability between laboratories;

(ii) discuss other relevant approaches to establishing intercomparability of EROD measurements; and

(iii) carry out a practical intercomparison of EROD measurements.

166 This Group should meet as soon as possible in 1991. As a result, GEEP requested that funds be made available to support a 2-day meeting of 8-10 scientists who are routinely measuring EROD, with the aim of agreeing on common procedures and conditions for EROD measurements and examining alternative approaches to ensure comparability of such methods in the future.

9.4 WORKSHOP ON STATISTICAL ANALYSIS AND INTERPRETATION OF MARINE COMMUNITY DATA

167 The Group discussed arrangements for the final training workshop on "Statistical Analysis and Interpretation of Marine Community Data" in the series taking place within the Mediterranean Action Plan (see Agenda Item 3.2). This Workshop is likely to take place in Alexandria, Egypt, in 1991, possibly in April/May, and might also include some participants from the West African Action Plan of the UNEP Regional Seas Programme. After a succession of developments of the material, the format and content has now gelled and little difficulty is expected in mounting this final workshop of the series. Resources are not required from IOC for this activity.

9.5 FURTHER TRAINING WORKSHOPS IN THE MEDITERRANEAN

168 The need to widen the scope of training workshops, to encompass "biological effects" techniques other than community analysis, is now being appreciated in the Mediterranean Region, and GEEP has received a proposal to mount such a workshop. As with the community workshops, the activity would be supported and organized from the Athens Office of the Mediterranean Action Plan. The Group was keen to participate and, though the venue and date (likely 1992) are to be the subject of more detailed negotiation in November, it was agreed that such a workshop should attempt to cover both biochemical measurements on fish (e.g. EROD) and physiological energetics of bivalves ("scope for growth"). Limited field collection of biological material would be necessary, as would a venue with adequate facilities, particularly for the biochemistry. Laboratories in France and Yugoslavia were suggested as possible locations.

9.6 COMMUNITY ANALYSIS SOFTWARE

169 GEEP stressed the need to give the latest computer software tools for community analysis the widest possible circulation in the IOC regions. It was noted that the manual on "Statistical Treatment and Interpretation of Marine Community Data", nearing completion, would generate a substantial demand for software that could perform the methods advocated in a comprehensive and "user-friendly" way, and that a base of relevant software had been developed for the series of workshops under the Mediterranean Action Plan. However, this PC software requires additional work to finalize its user interface, remove known "bugs" and prepare user documentation. As a result, GEEP requested that financial support be provided to complete this work (ca. $10,000). The software package would then be available for distribution by IOC and/or the Plymouth Marine Laboratory at a price which would recover only marginal costs (disks, photocopying, postage, etc.).

9.7 CARIBBEAN AND SOUTH EAST PACIFIC WORKSHOP

170 As mentioned in Agenda Item 3.2, in reference to bioassay training courses in the Wider Caribbean and the South Eastern Pacific regions, priority attention has been given to date to acute lethal toxicity bio-assays as

a means for the assessment of coastal water quality. Additionally, IOC and UNEP have provided a substantial input for contaminant determinations (hydrocarbons and heavy metals) by means of three training courses in both regions.

171 As an active on-going programme, the last IOC-UNEP-CPPS Workshop in Vina del Mar, Chile, included guidelines for the establishment of water and effluent quality criteria currently used by US EPA, responding to the request and interest of the region to produce an action plan for the development of such water quality criteria that can be adopted in national regulatory legislation.

172 It is proposed by GEEP that future actions should include measurements (Scope of Growth, EROD, benthic community analysis) and the application of such measurements as set forth in the GEEP manuals. The Wider Caribbean and Southeastern Pacific regions present IOC and GEEP with areas which will provide suitable gradients whereupon a training course can be programmed, and which may include the introduction of the GEEP manuals to the enrichment of the on-going regional seas programme.

9.8 CHINA WORKSHOP

173 The combined research and training workshop planned for Xiamen, China, was considered in detail by the Group. Useful feedback was available from GEMSI, of experiences from the sediment chemistry workshop in Dalian. The detail of the Xiamen proposal remained unchanged from Annex IV to the Report of GEEP-V, though an updated costing exercise had shown the total cost of the present plan to be higher than the figure of $60,000 previously estimated. A funding shortfall was therefore inevitable and it was agreed that further progress would be limited until firm confirmation had been received from the Third Institute at Xiamen of all local costs expected to be paid by IOC. Whilst IOC would expect to contribute towards accommodation costs for the 15 researchers/instructors and 15-20 trainees (of whom 5-7 would be expected to come from outside China), they would not be able to assist the host institute in the acquisition of equipment for the workshop (for example, the 4 to 5 IBM-compatible PCs necessary for the 8-10 trainees in community analysis). It was also felt important that details such as the standard of accommodation be clearly specified by the host institute at this time. The GEEP Chairman had therefore requested that the Representative from Xiamen forward to him this detailed information from the Third Institute and SOA as soon as possible. Whilst the Xiamen Workshop still featured strongly in the rolling plan of activities over the next 2 years, GEEP had to reassess its priorities continually in the light of budgetary constraints and it now seemed possible that the remaining financial uncertainties would delay this workshop until 1992. The Group was keen, however, to reaffirm its commitment to the form of joint research and training workshop that the Xiamen proposal represented; it was clearly acknowledged that financial support from IOC for these relatively costly ventures had already shown significant returns. In addition to major research gains, they had made possible effective (and cost-effective) workshops of a purely training nature, from which the UNEP Regional Seas programmes had greatly benefitted.

9.9 CONTAMINATION OF THE SEA SURFACE MICROLAYER

174 With reference to earlier requests to GEMSI and to concerns about possible effects of contamination in the sea surface microlayer and with reference to results from the ICES-IOC Bremerhaven Workshop indicating toxic effects of microlayer contamination by metals and organotins, Dr. Kullenberg requested GEMSI to reconsider the microlayer question in their own session. Their conclusion, following discussion, was that GEMSI was not convinced of the biological significance of sea surface microlayer contamination. The case as it exists was therefore reviewed by GEEP; it depends on evidence of three kinds:

(i) it has frequently been demonstrated that increased levels of contaminants occur in the sea surface microlayer relative to those at a depth of 0.5 m;

(ii) the Bremerhaven Workshop data showed that not only is there enhancement of metals (e.g. Cu and Pb) in the microlayer offshore, but that the same water samples were toxic to lamellibranch larvae in short term bioassays;

(iii) it remains to be shown to what extent the enhanced levels of toxic contaminants in the microlayer exert a toxic effect on the indigenous biota, although there is ample evidence from the literature of eggs, larval stages and plankton being exposed.

175 GEEP considered the microlayer question important in the light of the impact of the burning of toxic wastes by vessels and coastal incinerators. GEEP also noted the worldwide investigations of microlayer contamination by Professor Tsyban and colleagues. It was agreed that as an intersessional activity, GEMSI would be passed evidence that contributed significantly to the microlayer question and that a position paper would be prepared for the next meeting of GEEP and communicated to GEMSI.

9.10 COST-EFFECTIVENESS OF GEEP ACTIVITIES

176 Following the suggestion by the Secretary IOC that the GIPME Groups of Experts look seriously at the cost-effectiveness of their activities, GEEP discussed possible indices which could be used to measure this. This might include, on the research side, publications in the open literature and citations to these, relative to the cost of the workshops that spawned them. On the training side, the cost per trainee could be viewed in the light of a satisfaction rating by trainees; the latter was assessed for the Mediterranean Workshop Series by anonymous questionnaire returns from participants. Relevant citation figures etc would be gathered as an intersessional activity and communicated directly to the IOC Secretariat.

10. GEMSI ACTIVITIES IN THE FORTHCOMING INTERSESSIONAL PERIOD

10.1 OPEN OCEAN BASELINE

177 The planned extensions of the Open Ocean Baseline were discussed during the GEMSI Session. These included sampling locations in the North Atlantic provided that the offer for shiptime on the CSS *HUDSON* (Canada) was firm for 1992. It was decided that planning for this cruise could be a matter for discussion at the proposed meeting in Jekyll Island in April 1991 (see below). In separate sessions, GEMSI strongly supported the view that a continuation of the Atlantic Open Ocean Baseline Survey was essential. For the deepwater stations part ("Segment 1"), two further cruises are envisaged, one in the Northern Atlantic, one in the Western Atlantic.

178 Following a discussion on whether to pursue the original plan to concomitantly determine a baseline for organochlorines, since only Dr. Duinker's laboratory was in place to take part, the Group urged Dr. Duinker to consider participation in any future baseline studies. If the required pumps can be obtained in time, Drs. Farrington and Knap would also be in a position to participate and hence alleviate any concern that only one analyst was performing the measurements.

179 Freons could possibly be sampled as ancillary ocean tracers, and Dr. Knap promised to approach an appropriate analyzing laboratory. IAEA, Monaco, offered to do any necessary radionuclide work aboard the cruise.

180 A proposal to SCAR to conduct a baseline study of the Antarctic and Southern Atlantic Ocean in the near future was discussed after a brief presentation by Dr. J. M. Bewers who had prepared a proposal. The Group supported the extension of the open ocean baseline studies to these important regions of water mass formation.

181 It was recommended that a meeting be convened on Jekyll Island, Georgia, USA (April 1991), to consider the results of the first leg of the Open Ocean Baseline Study and to conduct detailed logistical planning for the second leg. The time chosen will be the week immediately following the Second International Symposium on the Biogeochemistry of Model Estuaries which will be attended by several participants in the Open Ocean Baseline Study.

10.2 SEA-SURFACE MICROLAYER

182 GEMSI noted that test organisms at the Bremerhaven Workshop responded more dramatically to exposure to collected sea-surface microlayer samples than to sea-water collected at a depth of 0.5 m: given the

relative thickness of the microlayer and the actual concentration factors involved, the biological effect would seem to be minimal.

183 The Group discussed a number of areas for the next intersessional period, some of which could interact with GEEP and others as a continuation of existing programmes.

10.3 INTERNATIONAL MUSSEL WATCH PROGRAMME

184 Due to the latest experimental design of the International Mussel Watch Programme, which will probably allow collection of frozen whole organisms (in most instances), and recognizing that novel molecular/biochemical techniques can now be applied with frozen tissues to investigate biological effects, it was recommended that the International Mussel Watch Committee consider some GEEP involvement in the Programme. The extent and details of this arrangement will be developed in co-operation with the Committee and the Director, Dr. Farrington, and should have minimal impact on the currently available funding for International Mussel Watch.

10.4 WORKSHOPS, INTERCALIBRATION AND TRAINING

10.4.1 Brazilian Intercomparison Exercise

185 The discussion ranged over the broad principles of how the coordinating laboratory should conduct such an exercise, to the details of what the participants would have to do to produce satisfactory results. On the basis of the discussion, a number of action points were identified.

186 Dr. Topping will advise on appropriate standards to be used in the exercise. GEMSI recommended that IOC and UNEP provide support for the purchase of such standards.

10.4.2 Guidelines for the Measurements of Nutrients in Sea-Water

187 Dr. Topping described the draft guidelines that had been produced by ICES for OSPARCOM laboratories to assist them in the forthcoming work in the North Sea. The Group members from the regional seas laboratories thought that such guidelines would be useful for their colleagues, but that they would have to be modified to cover work in the tropical seas and the different objectives of programmes in these areas. Dr. Topping agreed to send a copy of these guidelines to the sub-group members before the end of October 1990, so that they could review the document and send their amendments or suggestions for additions or improvements to him by the end of December 1990. On receipt of these responses, Dr. Topping would send an amended version of these guidelines to IOC-UNEP Secretariats for distribution to regional seas laboratories.

10.4.3 Proposed River Input Workshop/Symposium

188 Dr. Windom briefly summarized a proposed river input workshop/symposium to be held for the WESTPAC Region in November 1991. The aim of this exercise is to bring together scientists from the region to assess river input of nutrients to the marine environment in relation to different land based activities. The subject and design for the workshop was developed during an Expert Consultation of WESTPAC scientists held in Dalian during April 1990. Dr. Windom requested the comments and suggestions of GEMSI Members on any aspect of the Workshop.

10.4.4 Goa Workshop

189 Dr. S. Gupta informed the Group of a workshop planned in 1991 to be held in Goa as part of the Pollution Monitoring Research Control and Prevention Programme for the Coastal and Marine Environment in the Indian Ocean Region. This is part of a programme under consideration for funding by DANIDA and IOC for development programmes in the IOCINDIO Region. Assistance from GEMSI was requested in the design of some aspects of the Workshop. During discussions it was felt that April 1991 gave too short a lead time to permit significant input, i.e. assistance with training in trace metals and selected organic contaminants in

sediments. Standards and reference materials (nutrients, tracemetals and selected organics), would be required in advance.

190 GEMSI Members expressed their willingness to make appropriate manuals, reports and key literature available to the organizers. It was felt that GEMSI should make an effort to assist in developments in this important region, since it would be an important first step in promoting the extension of International Mussel Watch and other major programmes.

10.5 MASS-BALANCE

191 GEMSI reviewed its recent and planned activities in the context of mass-balance construction. It was concluded that the philosophy inherent in the mass-balance approach underlies the design of all recent and future GEMSI activities. Accordingly, as a complement to earlier work on the improvement of measurements of contaminants in the marine environment, recent and planned workshops emphasize either inputs (e.g. river fluxes) or removal pathways (sediments) for monitoring and assessment purposes. These various foci are required for both the implementation of the GIPME Programme, which stresses mass-balance construction as a valuable component of contamination assessment, and the UNEP Regional Seas activities. The recent stress on boundary fluxes within GEMSI activities reflects the conclusions and recommendations of IOC Technical Report No. 25.

10.6 BIOAVAILABILITY

192 The topic of bioavailability of contaminants in sediments was considered by the Group to determine what scientific initiatives might enable identification of fractions of sedimentary substances that potentially affect marine organisms. It was agreed that the subject was of relevance both to the GIPME Programme and the UNEP Regional Seas activities. The Group was advised, however, that the ICES Advisory Committee for Marine Pollution had established a Study Group to investigate bioavailability and sediment quality criteria. The Group will meet in March 1991, under the chairmanship of a GEMSI Member, Dr. Windom. It was decided to await the outcome of the first ICES Study Group Meeting before determining what GEMSI activities would be warranted in the field. Drs Windom and Topping will provide intersessional liaison with the ICES activities.

10.7 INDIVIDUAL ORGANIC CONTAMINANTS

193 The Group discussed the future aims of the sub-group in the light of the needs of the UNEP and IOC programmes. It was felt that most of the activities of the sub-group were in line with these needs. In light of the decreasing importance attributed to contamination of the marine environment by oil, and an excellent manual on the determination of hydrocarbons in sediments, to be followed soon by a corresponding manual for marine animals, this aspect will be given lower priority in future activities. Concern was expressed that oil decomposition products methodology may be too sophisticated for the needs of regional programmes.

194 Following a contribution from Dr. Mee and Dr. J. Readman on pesticides with relatively low residence time in the marine environment, more attention should be given to this class of contaminants (carbamates, etc.).

195 The importance of atmospheric flux studies was discussed, and it was felt that the sub-group should focus on this problem at the planned intersessional meeting.

196 The desirability for representatives of the sub-group to take part in the second leg of the open ocean programme was discussed, and it was considered that a baseline for Organic Contaminants (OCs) in open ocean waters is urgently needed. Dr. Duinker was asked to participate, even if his group would be the only group that would be ready to take part. Dr. Knap expressed the view that he and Dr. Farrington might be in a position to take part by 1992.

197 The planned International Mussel Watch Programme was discussed at length (see Agenda Item 5.3).

198 Considerable attention was given to the review of a number of Reference Manuals. The outcome of this discussion is given under Agenda Item 8.1.

199 It was considered that a large number of problems have to be discussed by the sub-group at an intersessional meeting planned for 1991.

200 Recognizing the importance of the further development of analytical methods for specific individual component analysis, it was recommended that the organics sub-group meet to suggest strategies for the analysis of "new contaminants" and contaminants perceived to have limited persistence in marine ecosystems but major biological effects.

201 Moreover, considering the perceived change of agrochemical usage patterns worldwide and the demonstrated presence of less persistent pesticides in the marine environment, GEMSI recommended the development of simple screening procedures for these compounds, and the inclusion of such analytes in the GIPME and UNEP Regional Seas programmes. It is recognized that individual experts in the analysis of these specific components may be called on.

11. EVALUATION OF THE PAST INTERSESSIONAL ACTIVITIES OF GEEP AND GEMSI

202 The Joint Group discussed the positive results and problems encountered in the implementation of planned activities. There were successes and some failures; the greatest problems were associated with the analysis of trace organic compounds (see discussions in Agenda Item 8.2).

203 The intercalibration exercises with trace metals in sediment were very successful, as were the training exercises for trace metal analyses. The greatest failure in the intersessional period was the IOC participation in the ICES-IOC-OSPARCOM Intercomparison exercise on the analysis of chlorobiphenyl congeners in marine media - first step, when only 2 of 17 IOC laboratories returned data. Of those two, both had to withdraw from the second phase due to failure of analytical equipment. The Group will investigate the reason for these problems during the next intersessional period by letter and questionnaire to the participants. A sub-group of GEMSI Members with experience in these exercises over the past 10 years will be convened in the intersessional period in order to develop strategies for future studies. This group will be convened by the GEMSI Chairman.

204 The Group agreed that GEMSI should reappraise the current approach for providing training through workshops and intercalibration exercises. GEMSI has been effective in transferring strategies for pollution monitoring studies to regional programmes and this should remain a major thrust. Training in analytical chemistry may be best achieved in established laboratories. GEMSI should, in an advisory role, strive to "certify" selected regional laboratories through such training. These laboratories may then be a focal point for quality assurance programmes in the respective regions.

205 Comments by GEEP on the past inter-sessional activities are recorded in section 7.

12. PROGRAMMES OF GEEP AND GEMSI PROPOSED FOR THE FORTHCOMING INTERSESSIONAL PERIODS

206 The proposed actions of the two groups for the coming inter-sessional period(s) have been discussed under Agenda Items 9 and 10.

13. FUTURE GEEP-GEMSI INTERACTIONS AND INTERACTIONS WITH GESREM

13.1 GEEP-GEMSI INTERACTIONS

207 During the course of the meeting, the opportunity for considering joint GEEP and GEMSI activities over the coming two to three years was welcomed. The following topics, in particular, were discussed jointly and appropriate actions agreed between the two Groups of Experts.

13.1.1 Mazatlan Study

208 GEEP and GEMSI share a common aim to relate, in a cause/effect manner, the exposure of organisms to specific pollutants and the associated toxic response. As scientific understanding advances in both groups, so the achievement of this common aim becomes ever more feasible. In such circumstances members of both groups would wish to demonstrate such cause/effect relationships experimentally, and to transfer appropriate techniques to other scientists via workshops.

209 Such an opportunity now exists in a study currently carried out by representatives of GEMSI at Mazatlan in Mexico. This project aims to quantify the sources, distribution and fate of organophosphate pesticides. These compounds are known to elicit specific effects on target and non-target organisms viz. the inhibition of the important enzyme acetychlorinesterase. This is common ground, therefore, between GEMSI and GEEP. In addition, other organic compounds, applied in the agricultural catchment of Mazatlan, and which eventually enter the coastal lagoons of this area, may also be impacting biological targets.

210 The two Expert Groups clearly recognize the value of a joint practical workshop in this area. This workshop would aim to achieve the following objectives:

(i) to link on-going mass balance studies of pesticides and other organics with measurements of their biological effects;

(ii) to evaluate the general levels of biological impact within the local lagoons, with respect to both invertebrate and vertebrate species, and associated communities or organisms;

(iii) to train participants from this and other regions in the use of both chemical and biological analytical techniques relevant to such studies.

211 Considering the obvious advantage of a joint GEEP-GEMSI collaboration project on the sources, distribution and fate of organophosphate pesticides and other contaminants in the marine environment, the Group recommended that a Joint Steering Committee be formed to plan a Workshop/Training Exercise on this subject. A candidate site at present is Mazatlan, Mexico, and time for the proposed exercise is November 1992.

13.1.2 Coral Reefs

212 Both Expert Groups are aware of the concern felt within the Caribbean Region about the fate of local coral reefs. In particular, the plans adopted by CEPPOL are seen as seeking quantitative means of evaluating the current and longer term status of animal and plant communities comprising the reefs. Recent developments within GEEP of sensitive statistical methods to describe community structure, its change in time and space, and to relate structural attributes to environmental variables, are highly relevant in this context, particularly when applied in conjunction with measurements promulgated by GEMSI.

213 The two groups therefore recommended that GEEP participation in the formulation and execution of such projects in the Caribbean area be encouraged, and that a representative of GEEP be invited to attend the next relevant planning meeting of CEPPOL to explore the details of a GEEP complement to anticipated GEMSI involvement. Specifically, it was recommended that one or two GEEP experts in the above noted techniques be invited to participate in the relevant studies within the region, including the design of observational and monitoring projects, the compilation of data on species composition within the coral reef communities, and the statistical evaluation and the interpretation of these data.

13.1.3 International Mussel Watch Programme

214 The International Mussel Watch Programme is of interest to both GEMSI and GEEP, and these Groups recognize that recent developments in the protocols proposed for sample collection have the added advantage of having a biological input to this project which is more realistic than hitherto viz. the application of molecular techniques of cytotoxicity analysis to suitably fixed or frozen tissue sections. These biological techniques reflect

the considerable advances made recently in this topic of cellular and molecular toxicology, and here again the meeting recognizes a fertile area for joint GEMSI/GEEP action.

215 The meeting therefore drew the attention of the International Mussel Watch Steering Committee to these potentials for collaboration between chemists and biologists and invites the Steering Committee to initiate discussions with GEEP to effect appropriate contributions.

13.1.4 Bioavailability

216 Another topic of key interest to both GEEP and GEMSI is the "bioavailability" of contaminants, for it is clear that detailed chemical and biological understanding are essential if we are to be able to make predictive statements concerning the likely biological consequences of increased levels of contamination in the environment. This is particularly true of the fate and effects of contaminants within sediments. The two Expert Groups desire to pursue this common interest.

217 In discussing the most appropriate mechanism for such a collaboration, the Groups are aware of recent ICES initiatives to set up a Study Group to discuss biological availability; both Groups are to be represented in this Study Group and therefore consider it sensible to await the outcome of the discussions before agreeing further action. No firm recommendations are therefore made at this point, but the joint wish of both Groups to convene a workshop to explore aspects of bioavailability, linked to biological impact, at the appropriate time, is affirmed, and GEMSI and GEEP offer the suggestion that Chile would provide a most suitable venue.

13.1.5 Ecotoxicology

218 Finally, both GEEP and GEMSI share a further primary aim, referred to earlier (13.1.1), of relating specific elements within particular classes of contaminants to specific biological responses. This topic comprises a key element in current research in ecotoxicology, and is eloquently represented by studies convened by GIPME on the analysis of congeners of PCBs. Here again is an interface between chemical insight (and appropriate method development) and biological understanding, and GEMSI and GEEP are eager to explore it.

219 The two Groups eventually agreed, therefore, to undertake joint discussions to identify relevant research opportunities, prior to putting forward specific recommendations for action. The discussions will be led by Dr. Duinker (GEMSI) and Dr. Addison (GEEP).

13.2 GEMSI-GESREM INTERACTIONS

220 GEMSI suggested continuation of the interaction with GESREM on suggestions and uses of standards and reference materials to be used within the UN System. GEMSI agreed with the offer made by GESREM at its Second Session, that the mandate of GESREM be broadened to include the task to "Provide advice on those aspects of quality control which require the preparation and/or use of certified and other reference material". Recognizing that GEMSI will, in part, be overseeing certain areas of the International Musselwatch Programme, GESREM is encouraged to work on providing bivalve reference material GESREM-2 for trace organics as well as providing GESREM-1 for trace metals in bivalve tissue for other studies, and to develop an easy-to-understand workbook on the proper use of standards and reference materials, using examples specific to the International Musselwatch Programme.

14. GIPME-VII SCIENTIFIC SYMPOSIUM AND SCIENTIFIC COMMITTEE SESSION AND THE ROLE OF THE GROUPS OF EXPERTS

221 The Chairman of the Committee for GIPME, Dr. Andersen, made reference to recent decisions by the governing bodies of IOC and UNEP to co-sponsor the GIPME Programme and to establish a Joint IOC-UNEP Intergovernmental Panel for GIPME. The Committee for GIPME will be retained and the Groups of Experts will continue reporting to the Committee. This will be a subject of discussion at GIPME-VII which will be held in Paris, 21-25 January 1991. No decision had been taken yet on having a scientific symposium prior to the Committee Session. However, the continuation of such symposia will also be addressed.

15. OTHER MATTERS

222 No other matters were raised.

16. ADOPTION OF THE SUMMARY REPORT

223 The Draft Report was discussed and adopted in Plenary Session on 19 October 1990. The Meeting granted the Secretariat the usual editorial licence for finalizing the report.

17. CLOSURE

224 Dr. Andersen thanked the hosts of the meeting, placing particular emphasis on their hospitality and assistance with numerous matters. He also thanked the participants for their time and hard work during the week. He closed the meeting at 18.45 hours, 19 October 1990.

ANNEX I

AGENDA

1. **OPENING**

2. **ADMINISTRATIVE MATTERS**

3. **GENERAL REVIEW OF GEEP INTERSESSIONAL ACTIVITIES SINCE GEEP-V**

   3.1 REPORT ON ICES-IOC WORKSHOP ON THE BIOLOGICAL EFFECTS OF CONTAMINANTS IN THE NORTH-SEA
   3.2 REPORT ON TRAINING WORKSHOPS ON BIOASSAY TECHNIQUES AND STATISTICAL TREATMENT
   3.3 VULNERABLE AREAS

4. **GENERAL REVIEW OF GEMSI INTERSESSIONAL ACTIVITIES SINCE GEMSI-IX**

   4.1 REPORT ON THE OPEN-OCEAN BASELINE STUDY
   4.2 REPORT ON THE WORKSHOP ON THE USE OF SEDIMENTS IN MARINE POLLUTION RESEARCH AND MONITORING (DALIAN)
   4.3 QUALITY ASSURANCE PROGRAMME
   4.4 STATUS OF GESREM INTERSESSIONAL ACTIVITIES

5. **INTERNATIONAL MARINE POLLUTION MONITORING PROGRAMMES REQUIRING ASSISTANCE FROM GEEP AND GEMSI**

   5.1 STATUS OF REGIONAL SEAS PROGRAMME AND ITS REQUIREMENTS
   5.2 STATUS OF MARPOLMON AND ITS REQUIREMENTS
   5.3 THE STATUS OF MUSSEL WATCH AND ITS REQUIREMENTS
   5.4 THE STATUS OF THE HARMFUL ALGAL BLOOMS PROGRAMME AND ITS REQUIREMENTS
   5.5 STATUS OF THE LONG-TERM MONITORING OF PHENOMENA ATTRIBUTABLE TO CLIMATE CHANGES AND ITS REQUIREMENTS
   5.6 ANY OTHER PROGRAMME PRESENTED BY CO-SPONSORING ORGANIZATIONS, IN PARTICULAR OTHER REGIONAL PROGRAMMES

6. **OTHER INTERNATIONAL AND LARGE SCALE NATIONAL PROGRAMMES RELEVANT TO GEEP OR GEMSI**

   6.1 ECOMONOC
   6.2 GLOBAL OCEAN ECOSYSTEM DYNAMICS (GLOBEC)
   6.3 JOINT GLOBAL OCEAN FLUX STUDY (JGOFS)

      6.3.1 Dissolved Oxygen
      6.3.2 Nutrients
      6.3.3 Carbon System Parameters
      6.3.4 Pigments
      6.3.5 General

   6.4 INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA (ICES)
   6.5 IGOM II: THE SECOND INTERNATIONAL SYMPOSIUM ON INTEGRATED GLOBAL OCEAN MONITORING
   6.6 OTHERS

12. **PROGRAMMES OF GEEP AND GEMSI PROPOSED FOR THE FORTHCOMING INTERSESSIONAL PERIODS**

13. **FUTURE GEEP-GEMSI INTERACTIONS AND INTERACTIONS WITH GESREM**

13.1 GEEP-GEMSI INTERACTIONS

13.1.1 Mazatlan Study
13.1.2 Coral Reefs
13.1.3 International Mussel Watch Programme
13.1.4 Bioavailability
13.1.5 Ecotoxicology

13.2 GEMSI-GESREM INTERACTIONS

14. GIPME-VII SCIENTIFIC SYMPOSIUM AND SCIENTIFIC COMMITTEE SESSION AND THE ROLE OF THE GROUPS OF EXPERTS

15. OTHER MATTERS

16. ADOPTION OF THE SUMMARY REPORT

17. CLOSURE

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ANNEX III

BRAZILIAN INTERCOMPARISON EXERCISE FOR NUTRIENTS

(1) A coordinating laboratory will have to be appointed to run the exercise, evaluate the results and produce a report.

(2) Before the exercise is conducted, the coordinating laboratory would have to do the following work:

(a) Prepare a draft timetable for the exercise and send it to Dr Topping for comment;

(b) Contact potential participants and inform them about the exercise - its purpose, proposed timetable and proposed deadlines for analysis and submission of results;

(c) Prepare sufficient quantity of a stock standard for each of the nutrients so that each participant could use this stock standard for calibration of nutrient measurements. Ideally, each participant should use SAGAMI standards for this work and a recommendation to this effect is given in the GEMSI report;

(d) Carry out appropriate tests on the seawater and sample containers to ensure that the sample sent to participants is stable over a period covering the preparation of the sample and its analysis by participants. A test period of 2-3 weeks would be appropriate;

(e) Prepare a reporting format for participants so that they can submit results in a standardised way. This sheet should contain a section in which the participant can provide details of the analytical procedure used for the measurement of nutrients;

(f) Prepare a note for participants on the procedure to be adopted by them for the analysis of samples and the return of data;

(3) Assuming all action points under (2) are completed satisfactorily, the coordinating laboratory should distribute the samples to all participants and to the experienced laboratories* which had agreed to assist in this exercise. A copy of the reporting format (e), a copy of the protocol for this exercise (f) and instructions for the use of stock standards (c) should be sent with each sample**.

(4) The coordinating laboratory should telephone or fax each participant at the start of the exercise to remind them of the exercise and its deadline for the reporting of results.

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** If the GEMSI Guidelines are available at this time, a copy of these should be included in this package.