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**IMO / FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP
JOINT GROUP OF EXPERTS ON THE SCIENTIFIC ASPECTS
OF MARINE POLLUTION
- GESAMP -**

REPORTS AND STUDIES

No. 31

1987

REPORT OF THE SEVENTEENTH SESSION

Rome, 30 March – 3 April 1987



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IMO/FAO/Unesco/WMO/WHO/IAEA/UN/UNEP
Joint Group of Experts on the Scientific Aspects of Marine Pollution
(GESAMP)

REPORT OF THE SEVENTEENTH SESSION

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1987

NOTES

1. GESAMP is an advisory body consisting of specialized experts nominated by the Sponsoring Agencies (IMO, FAO, Unesco, WMO, WHO, IAEA, UN, UNEP). Its principal task is to provide scientific advice on marine pollution problems to the Sponsoring Agencies and to the Intergovernmental Oceanographic Commission (IOC).
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DEFINITION OF MARINE POLLUTION BY GESAMP

"Pollution means the introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) which results in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of sea water and reduction of amenities".

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| 17. | The evaluation of the hazards of harmful substances carried by ships. (1982). <u>Rep.Stud. GESAMP, (17):pag.var.</u> |
| 18. | Report of the thirteenth session, Geneva, 28 February - 4 March 1983. (1983). <u>Rep.Stud. GESAMP, (18):50 p.</u> Available also in French and Spanish |
| 19. | An oceanographic model for the dispersion of wastes disposed of in the deep sea. (1983). <u>Rep.Stud. GESAMP, (19):182 p.</u> |
| 20. | Marine pollution implications of ocean energy development (1984). <u>Rep.Stud. GESAMP, (20):44 p.</u> |
| 21. | Report of the fourteenth session, Vienna, 26-30 March 1984. (1984). <u>Rep.Stud. GESAMP, (21):42 p.</u> Available also in French, Spanish and Russian |
| 22. | Review of potentially harmful substances. Cadmium, lead and tin. (1985). <u>Rep.Stud. GESAMP, (22):114 p.</u> |
| 23. | Interchange of pollutants between the atmosphere and the oceans (part II). (1985). <u>Rep.Stud. GESAMP, (23):55 p.</u> |
| 24. | Thermal discharges in the marine environment. (1984). <u>Rep.Stud. GESAMP, (24):44 p.</u> |
| 25. | Report of the fifteenth session, New York, 25-29 March 1985. (1985). <u>Rep.Stud. GESAMP, (25):49 p.</u> Available also in French, Spanish and Russian |
| 26. | Atmospheric transport of contaminants into the Mediterranean region. (1985). <u>Rep.Stud. GESAMP, (26):53 p.</u> |
| 27. | Report of the sixteenth session, London, 17-21 March 1986. (1986). <u>Rep.Stud. GESAMP, (27):72 p.</u> Available also in French, Spanish and Russian |
| 28. | Review of potentially harmful substances. Arsenic, mercury and selenium. (in press). <u>Rep.Stud. GESAMP, (28)</u> |
| 29. | Review of potentially harmful substances. Organosilicon compounds (Silanes and Siloxanes). (1986). Printed in limited number only by IMC, but published also as <u>UNEP Reg.Seas Rep.Stud., (78):24 p.</u> |
| 30. | Environmental Capacity. An approach to marine pollution prevention. (1986). <u>Rep.Stud. GESAMP, (30):49 p.</u> |
| 31. | Report of the seventeenth session, Rome, 30 March - 3 April 1987. (1987). <u>Rep. Stud. GESAMP, (31):36 p.</u> Available also in French, Spanish and Russian |
| 32. | Land-sea boundary flux of contaminants: contributions from rivers. (in press). <u>Rep.Stud. GESAMP, (32)</u> |

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Reports and Studies GESAMP

The following reports and studies have been published so far. They are available from any of the organizations sponsoring GESAMP.

1. Report of the seventh session, London, 24-30 April 1975. (1975). Rep.Stud.GESAMP, (1):pag.var. Available also in French, Spanish and Russian
2. Review of harmful substances. (1976). Rep.Stud.GESAMP, (2):80 p.
3. Scientific criteria for the selection of sites for dumping of wastes into the sea. (1975). Rep.Stud.GESAMP, (3):21 p. Available also in French, Spanish and Russian
4. Report of the eighth session, Rome, 21-27 April 1976. (1976). Rep.Stud.GESAMP, (4): pag.var. Available also in French and Russian
5. Principles for developing coastal water quality criteria. (1976). Rep.Stud.GESAMP, (5):23 p.
6. Impact of oil on the marine environment. (1977). Rep.Stud.GESAMP, (6):250 p.
7. Scientific aspects of pollution arising from the exploration and exploitation of the sea-bed. (1977). Rep.Stud.GESAMP, (7):37 p.
8. Report of the ninth session, New York, 7-11 March 1977. (1977). Rep.Stud.GESAMP, (8):53 p. Available also in French and Russian
9. Report of the tenth session, Paris, 29 May - 2 June 1978. (1978). Rep.Stud.GESAMP, (9):pag.var. Available also in French, Spanish and Russian
10. Report of the eleventh session, Dubrovnik, 25-29 February 1980. (1980). Rep.Stud.GESAMP, (10):pag.var. Available also in French and Spanish
11. Marine Pollution implications of coastal area development. (1980). Rep.Stud.GESAMP, (11):114 p.
12. Monitoring biological variables related to marine pollution. (1980). Rep.Stud.GESAMP, (12):22 p. Available also in Russian
13. Interchange of pollutants between the atmosphere and the oceans. (1980). Rep.Stud.GESAMP, (13):55 p.
14. Report of the twelfth session, Geneva, 22-29 October 1981. (1981). Rep.Stud.GESAMP, (14):pag.var. Available also in French and Russian
15. The review of the health of the oceans. (1982). Rep.Stud.GESAMP, (15):108 p.
16. Scientific criteria for the selection of waste disposal sites at sea. (1982). Rep.Stud.GESAMP, (16):60 p.

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1. OPENING OF THE SESSION

- 1.1 The Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) held its seventeenth session at the Headquarters of the Food and Agriculture Organization of the United Nations (FAO), Rome, from 30 March to 3 April 1987, under the chairmanship of Ms G.D. Howells. Mr H.L. Windom was Vice-chairman.
- 1.2 At the opening of the session, the Director of the Fishery Resources and Environment Division of FAO, Mr A. Lindquist, on behalf of the Director-General of FAO, welcomed the participants. Mr Lindquist noted that the interdisciplinary nature of GESAMP has made it an outstanding body within the United Nations system and that the ability of GESAMP to deal with marine pollution issues which are of direct interest and concern to the Member States of the Food and Agriculture Organization of the United Nations, as well as to the international community as a whole, had been of great value. Mr Lindquist further pointed out that a number of items to be considered by GESAMP at this meeting were of a rather difficult nature, but he hoped that these could be settled by consensus of the Group. In conclusion, Mr Lindquist wished GESAMP every success in its tasks.
- 1.3 The Chairman of GESAMP thanked Mr Lindquist on behalf of the participants for his good wishes for the success of the session, for hosting the meeting and for the provision of secretariat facilities.
- 1.4 Observers representing institutions and organizations interested in prevention and control of marine pollution, upon invitation by the Chairman, submitted brief statements on the scope and objectives of their bodies in relation to the interests of GESAMP.
- 1.5 The Agenda for the session, as adopted by the Group, is given in Annex I. The list of documents submitted to the session relating to particular items of the Agenda is given in Annex II. The list of participants is given in Annex III.

2. REVIEW OF POTENTIALLY HARMFUL SUBSTANCES (Working Group 13)

- 2.1 The WHO Technical Secretary briefly reviewed the recent developments within Working Group 13, which is carrying out its mandate through the sub-groups on organic and inorganic trace contaminants and on the effects of nutrients on the marine environment.

Sub-Group on Organic and Inorganic Trace Contaminants

- 2.2 During the last intersessional period the final document on organosilicons was issued (Reports and Studies No.29) and the review document on arsenic, mercury and selenium was edited and sent to press (Reports and Studies No.28). The activities of the sub-group concentrated on the review of carcinogenic substances, i.e. its Chairman and the Technical Secretaries of the sponsoring organizations explored alternatives for the continuation of the sub-group.
- 2.3 The Chairman of the Working Group, Mr L. Friberg, reported to GESAMP about his efforts with various national and regional agencies to obtain supplementary financial support for the in-depth evaluation of carcinogens in the marine environment. The topic had also been the subject of presentations and discussions at various international conferences, addressing questions such as the concentrations of carcinogens in seafood, their bioaccumulation and the amounts taken in through the seafood consumption route.
- 2.4 The quantification of the amounts of carcinogens consumed with seafood was debated, and risk assessment principles used by WHO were specified. It was stated that concentrations in marine biota are known for a variety of carcinogens and that it should be possible, by means of typical consumption patterns to calculate the average and maximum contribution of carcinogens to the human diet from this exposure route.
- 2.5 The Group then requested clarification from the sponsoring organizations as to the basis for their approaching GESAMP on the subject of carcinogens. It was explained that, in most of the international conventions on marine pollution control, carcinogens were listed as harmful substances. They were mostly included in the 'black list' of legal documents such as the Oslo Convention, the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources of the Barcelona Convention, and several other regional and inter-country

treaties. The UN agencies providing secretariat services to those legal instruments are mandated and obligated to specify the carcinogens in question and to furnish scientific proof as to their potential harm to marine ecosystems and to human health through their presence and accumulation in marine biota.

- 2.6 The Chairman of the Working Group drew attention to the recommendation made in the working paper presented to GESAMP XVI to which representatives of WHO, IMO, the International Agency for Research on Cancer (IARC) and the International Council for the Exploration of the Seas (ICES) had been party, i.e. that the organizations concerned consider, as a matter of urgency, the mobilization of the necessary support for the further development and acceleration of work on the impact of carcinogenic substances on marine organisms and implications concerning public health. The above recommendation was formulated as a need to carry out comprehensive reviews and evaluations of all aspects of the hazards of carcinogens in the marine environment. It was recognized that the work proposed will need to use a multi-disciplinary approach and involve specialists in several fields.
- 2.7 The Group suggested that this could be achieved by a substance-by-substance assessment of concentrations in the marine environment and associated effects and, in this context, it felt that the Group should react positively to the agencies' request.
- 2.8 It was proposed that, during the next intersessional period, the sub-group should concentrate on aspects of the introduction, occurrence and distribution of specific carcinogenic substances in the marine environment, particularly in edible organisms. This would include consideration of the chemical speciation and accumulation of these substances. It should seek advice from other appropriate international bodies such as ICES, as well as the support of national research institutions.
- 2.9 In the light of the changing focus of work of the sub-group it was considered appropriate to shift the responsibility of lead agency to Unesco in order to make full use of the existing marine science data base. Confirmation was given that WHO will continue to co-sponsor this work and will provide for the necessary support to the human health risk assessment, including the use of seafood consumption patterns. The other cooperating agencies (UNEP, IMO, FAO) will also continue to support this Working Group.

Sub-group on Nutrients

- 2.10 The progress report of the sub-group on nutrients under the Working Group on the Review of Potentially Harmful Substances was introduced by the Unesco Technical Secretary. He recalled that the sub-group was created at the Sixteenth Session of GESAMP, March 1986, to evaluate under the Terms of Reference for Working Group 13 the most common nutrients, working by correspondence, for the first intersessional period. In consultation between the Chairman of sub-group, Mr J.C. Portmann, and the sponsoring agencies, a workplan and a list of the potential topics to be covered by the work have been developed and a large number of scientists around the world invited to contribute on specific topics as well as on topics of their own choice. Positive responses have been obtained from about one third of those contacted, and about 10 contributions had been received in early 1987.
- 2.11 These contributions, together with the already existing material, cover a substantial part of the topics identified. In order to integrate the information, obtain coverage of the missing parts and compose a draft report, it is proposed that a meeting of the sub-group be arranged for mid-1987.
- 2.12 The Chairman of the sub-group reviewed the substance so far covered by the contributions received, suggesting good coverage but also gaps for several regions. It is expected that these will be covered by various means, including the use of the on-going regional reviews on the state of the marine environment.
- 2.13 Mr Portmann noted that the problem of eutrophication had been considered important at the last session of GESAMP and by the Working Group on the State of the Marine Environment (Working Group 26), and he suggested that the sub-group could consider aspects of this problem and feed its results to Working Group 26, provided a meeting of the sub-group could be arranged. A summary of the progress report is given in Annex IV.

- 6. Any data set for consideration will thus need to provide:
 - long-term records of the species, community or ecosystem;
 - coincident data on climatic or other natural factors;
 - coincident measurements of implied or identified pollutants,

as well as more general information, e.g. of exploitation or management changes, or of independent but significant changes in the locality, which could influence a population or community.

- 7. The following work plan is proposed, probably over a two-to-three year timescale.
 - (a) Identification of candidate data sets (for a range of species) to cover a range of conditions, both those thought to be pristine or 'unpolluted' and those shown to be polluted or contaminated by identified materials.
 - (b) Consideration of case histories of known pollution (and recovery) for a variety of classes of pollutants.
 - (c) Selection of potential pollutants and other perturbing factors for more detailed study.
 - (d) Review of information on physiological or biochemical mechanisms of action (and recovery) from both laboratory and field studies.
 - (e) Review of information on genetic or reproductive response to changes in population strength.
 - (f) Consideration of individual, population and community responses; lifetime doses.
 - (g) Consider what programme of monitoring would be needed to document effects at current or projected levels of contamination, the sampling and analytical tools required, the sensitivity of response, the timescale of response, the geographic extent, the associated data requirements (e.g. climatic data).
- 8. Species of both economic or conservation interest must be included; these will certainly be fish and shellfish, but marine mammals and birds and foodchain organisms should also be considered. Different habitats should also be reviewed although much more information is likely to be available for inshore and shelf areas than for open oceans. Special consideration might be given to known sensitive areas such as tropical and arctic seas and to enclosed seas.
- 9. The first meeting would give particular attention to items (a), (b), (c) and (g). Those members identified for the first meeting of the Working Group have been asked to prepare papers to initiate discussion on topics related to their interests and experience.

Terms of Reference of Working Group 27

- (i) To examine the evidence for the slow but long-term ecological changes which may be due to low persistent concentrations or slow build-up of contaminants in the marine environment, including changes in species composition and abundance, in physiological and reproductive and genetic functions affecting ecosystems at population level, in physical and chemical conditions of affected habitats, etc.;
- (ii) to examine the evidence for rehabilitation and recovery of altered (damaged) ecosystems and habitats, and to study and define the key elements and processes involved;
- (iii) to develop the concepts needed for understanding long-term ecosystem changes influenced by persistent low-level contaminations, and
- (iv) to identify gaps in knowledge where additional studies were needed.

Annex X

PROGRESS REPORT ON THE WORKING GROUP ON
LONG-TERM ECOLOGICAL CONSEQUENCES OF LOW-LEVEL CONTAMINATION
OF THE MARINE ENVIRONMENT
(Working Group 27)

1. In the intersessional period the Chairman of the Working Group had contacted a number of individuals and agencies to seek comments on the tasks envisaged in the Terms of Reference and to identify possible data sets for the Working Group's consideration. A substantial range of comments and suggestions had been received and these would be collated and summarized for the guidance of the Working Group at its first meeting. These comments had materially assisted the Chairman in developing the following strategy and workplan for the future meetings of the Working Group.
2. It was argued that the hypothesis to be tested is that persistent pollutants at low (non lethal) concentrations will have effects on populations and communities; that these effects will be evident and measurable both in individuals exposed in controlled tests and also in population or community changes. However, a "bottom line" approach might be to note the loss of a particular species from an area and to demonstrate that this loss is associated (i.e. statistically, contemporarily or geographically) with an identified and measured contaminant. Correlation, however, is insufficient alone, and unequivocal confirmation should be sought by experimental exposure of the target organism to appropriate concentrations of the toxic agent and by evidence of some detrimental change that could have a significant adverse effect on the well-being of a population or community. Independent evidence of damage at different locations, or at different times, or observations of damage following accidental release (at appropriate concentrations) could provide supporting, if circumstantial, evidence. Abatement of an identified discharge should be followed by reduction or reversal of the observed damage.
3. The detection of effects in the natural environment is difficult or even impossible if there is no established baseline encompassing the variability of natural populations and communities. This variability arises from a complexity of natural and other influences, not all of them identified. Extrinsic factors may induce long-term natural cycles in abundance of a species, and the interaction of several such factors and responses with different time scales may mean that the frequency is irregular and hard to predict. In addition, the probability of long-term natural cycles in populations (due to intrinsic biological phenomena) will mean that long-standing records of species or communities, both in terms of abundance and occurrence, are needed to establish whether a change has indeed occurred. The availability of such records, maintained over sufficient time and carried out with consistency throughout, is strictly limited. Any changes may be masked by the inherent variability of biological phenomena, and statistical techniques will probably be needed to verify a suspected trend and to establish its probability and significance. Statistical methods can also be used to define the number of observations that will be needed over specified sampling periods in order to establish a trend of specified magnitude.
4. Many natural factors, as well as a suite of potential pollutants, are known to influence populations or communities, especially climate-related factors and interspecific relationships. Fluctuations in populations, which can be attributed to these and other possibly natural causes, may be large in relation to the changes brought about by exposure to low levels of pollutants even over the long term. Further, the extent and variability of natural population changes is rarely well established. Commercially exploited species may provide the best data base, but in that case the effects of variable levels of exploitation and of management practices will have to be taken into account. Other regional or local changes of possible influence will have to be included.
5. A further problem is the interpretation of exposure to a number of pollutants simultaneously. In some cases, damage has been reasonably attributed to the additive effects of several pollutants (e.g. trace metals); in other cases synergistic or antagonistic effects may be observed (e.g. temperature stress and a toxic agent). Often the interpretation is purely empirical, however, and so difficult to apply in general terms. In some instances, synergistic or interactive effects are invoked without good evidence; conversely they have been ignored in other cases.

- 2.14 The Chairman noted that considerable progress had been made by working through correspondence only and that a draft report would be produced in time to be incorporated into the deliberations of Working Group 26, and invited comments from the Group.
 - 2.15 The question was raised whether factors concerning the physical conditions in the marine environment (e.g. stratification, turbulence, currents), river runoff, and other factors, such as availability of trace elements, influencing the productivity and occurrence of plankton blooms, would be considered. It was suggested that problems associated with aquaculture, giving rise to input of organic material and nutrients, should be considered also.
 - 2.16 It was mentioned that discharge of nutrients and organic material may be acceptable in certain conditions but unacceptable in other situations, and that an evaluation should be made of when and at what level of discharge an effect would be expected for given environmental conditions. Guidance would also be valuable on the levels of increase of inputs a given marine system could receive without unacceptable changes being induced. An evaluation should also be made of effects of changing the physical environment without changing rates of inflows, and examples of experiences in this respect were given.
 - 2.17 In certain areas of the Pacific, and possibly other places, small increases of nutrient levels may influence the primary productivity in the water column to such an extent that coral reefs are adversely affected, and the sub-group ought to give consideration to this problem.
 - 2.18 It was mentioned that several regional seas should be considered, e.g. the East Asian Seas, South Asian Seas and South Pacific, and that coordination with on-going activities should be secured, for instance in the Mediterranean. It was also suggested that effects of decreases of inputs of nutrients, an example being the reduced Nile flow, ought to be evaluated and that modelling could be a valuable tool.
 - 2.19 Mr Portmann responded that these comments and suggestions would be taken into account by the sub-group as far as possible and in accordance with the Terms of Reference, and he noted in particular that the eutrophication problem would be considered by the sub-group.
 - 2.20 The Chairman concluded that GESAMP would expect a well-advanced draft report at its next session and the sub-group should also feed its results to Working Group 26 as relevant.
3. EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS
(Working Group 1)
- 3.1 The IMO Technical Secretary informed the Group that the Working Group on Evaluation of the Hazards of Harmful Substances Carried by Ships had met twice during the intersessional period - in Delft, Netherlands (26 to 30 May 1986), and in London, United Kingdom (3 to 7 November 1986). The Working Group had made considerable efforts to complete the hazard evaluation of all those substances known to be carried in bulk, taking into account the date of implementation in April 1987 of Annex II to MARPOL 73/78 (Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk). The evaluation of substances carried in packaged form was the other major task, to be carried out as a priority in the near future, because this was of particular importance for the implementation of Annex III of MARPOL 73/78 (Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Forms). The Group also noted that requests continue for the hazard evaluation by GESAMP of new substances proposed for carriage by ships; this was likely to be a continuing task for GESAMP.
 - 3.2 The Chairman of the Working Group, Mr P.G. Jeffery, introduced the reports of the nineteenth and twentieth meeting of the Working Group. He highlighted some of the major activities, noting in particular that the guidelines for evaluating threshold values for fish tainting are near to completion and that these will be included in a revision of GESAMP Reports and Studies No.17, currently being carried out by the Working Group with a view to publication. This should be ready for consideration by the eighteenth session of GESAMP and will, in addition to the material contained in previous reports, include advice for toxicity and bioaccumulation testing, descriptions of relevant long-term health effects and all the hazard profiles prepared so far by GESAMP.

- 3.3 The Group welcomed the progress being made in the assessment of the potential of substances to taint seafood by placing measurement of such effects on a more objective and scientific basis. It urged the early publication of the GESAMP Guidelines for Evaluating Threshold Values for Fish Tainting as part of the current revision of GESAMP Reports and Studies No.17, taking into account that the very recently published 'Evaluation of Fish Tainting', prepared by the European Chemical Industry Ecology and Toxicology Centre (ECETOC Technical Report No.25), was based on the draft GESAMP Guidelines.
- 3.4 The Group took note of and endorsed the stand made in the report of the nineteenth session of the Working Group that the Working Group was not able to agree with the views of the chemical industry "that the differences between the marine toxicities of the relevant isomers were not great and that, therefore, it would be entirely reasonable for chemicals carried in bulk to assume the same hazard profile for each individual isomer or mixture of isomers to which the entry in the IMO Bulk Chemical Codes applies".
- 3.5 With regard to the evaluation of lubrication oil additives, the Group noted that two of the classes of additives containing zinc were assigned '+' by the Working Group (i.e. bioaccumulated to significant extent and known to produce a hazard to aquatic life or human health). Several members of the Group expressed their views that the substances concerned were likely to degrade slowly and were unlikely to bioaccumulate to a significant extent. The Working Group was requested to review the existing hazard profiles of zinc compounds.
- 3.6 The Group stressed the importance of considering breakpoints in homologous series of compounds that are of increasing toxicity and decreasing solubility in water. It urged the Working Group to continue such investigations.
- 3.7 The Group noted and appreciated the action taken by IMO in making provision for the improvement of the present filing and retrieval system of GESAMP hazard data. This matter had been of some concern for the Group for several years and it therefore endorsed the measures taken by IMO, emphasizing that the GESAMP hazard files contain the basic material and data necessary for the development by IMO of pollution categories of substances and of ship-type carriage requirements relevant to the effective implementation of IMO instruments.
- 3.8 The Group, after a number of comments and explanations given by the Chairman of the Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships, approved the reports of the nineteenth and twentieth sessions of the Working Group. In particular, the Group agreed to the future work plan of the Working Group as set out in its reports, and also adopted the hazard profiles set out in the annexes to the Working Group reports. A summary of the reports is given in Annex V.
- 3.9 The IMO Technical Secretary expressed his appreciation to Mr P.G. Jeffery, Chairman of the Working Group, who will retire from this office in the near future. The Group also thanked Mr Jeffery for his long service as member of GESAMP.

4. INTERCHANGE OF POLLUTANTS BETWEEN THE ATMOSPHERE AND THE OCEANS (Working Group 14)

- 4.1 The WMO Technical Secretary reminded the Group that, at the Sixteenth Session of GESAMP (1986), a draft report was submitted by the Working Group covering mainly the role of the global ocean in influencing the magnitude and variations of tropospheric carbon dioxide concentrations, which is vital for understanding and modelling any associated climatic changes and anomalies. Having made a number of comments, the sixteenth session of GESAMP endorsed the report in principle and recommended that the work on the report be continued during the intersessional period. Due to financial and organizational reasons, the Working Group had not been able to complete this task but intended to continue the work during the next intersessional period. GESAMP members will be requested to comment on the report before the eighteenth session.
- 4.2 It was reiterated that the Working Group would review also some UNEP Reference Methods for the Regional Seas Programme for the determination of contaminants in the marine atmosphere and their deposition.

- (c) the integrity of the role of the oceans in the energy balance of the earth;
- (iii) to base its draft on detailed technical annexes that will become part of the report.

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Annex IX

SUMMARY OF THE REPORT OF THE CORE GROUP OF THE WORKING GROUP ON THE STATE OF THE MARINE ENVIRONMENT (Working Group 26)

- 1. Following the endorsement of the outline of the Review at the sixteenth session of GESAMP in March 1986, the Core Group continued to identify individuals or groups of scientists to deal with sections of the review. In particular, the task teams were set up to produce reports on the regional sea areas.
2. A meeting was held in London in January 1987 which was attended by the Core Group and its experts, as well as the rapporteurs from each of the regional task teams which are operating as a parallel activity of the Working Group. This could be regarded as the first plenary session of the Working Group, and it provided an opportunity for most of those involved in the Review to consider each item of the outline, to ensure that all points were covered without significant overlap, to reconsider the details and arrangements of each section and to work out a provisional timetable.
3. A major achievement at the London meeting concerned the progress of the Regional Reports, which are seen as an important basic contribution to the Review, from which information for many sections will be drawn. Draft reports from all the regions were presented and subjected to detailed discussion. They provided, among other things, guidance which will enable the Working Group to focus on the most pressing pollution problems in each area and highlighted several topics which had not been previously considered. In general, these regional reports constitute a valuable contribution to the preparation of the Review. Arrangements were made to deal with a number of areas not covered by UNEP's Regional Seas Programme.
4. In addition, the London meeting made various changes in the outline. These included relatively minor alterations in the order of chapters or sections to rationalize the presentation, as well as the insertion of several new sections. Among the latter was a section on public health effects which will bring together the various aspects which bear on human pathology; a chapter on quality control of data with biological sector and a section on land-use practices which could have coastal impacts.
5. One aspect which it was felt required further elaboration was a consideration of the relative inputs of contaminants from rivers and the atmosphere to the sea. Although each of these areas was the concern of specific existing GESAMP Working Groups (14 and 22), there was a clear need for some members of each group to interact and produce a comparison. Arrangements for this were proposed.
6. Finally, a detailed work schedule was drawn up. This allowed for any comments from the Seventeenth Session of GESAMP to be relayed to those preparing sections of the Review, and set out the actions which would lead to a meeting of the Working Group in December 1987. Following that meeting, it was proposed to produce a first draft of the Review which would be presented for discussion to GESAMP at its eighteenth session in March 1988.

Terms of Reference of Working Group 26

- (i) To prepare, by the eighteenth session of GESAMP, a draft report consisting of a succinct critical review (up to 40 pages) of the state of the marine environment following as far as possible the pattern of UNSCEAR reports and making full use of the results and conclusions of other GESAMP working groups as well as of the data provided by relevant international and national programmes assessing the state of the oceans;
(ii) to examine and assess in the draft, global and regional trends, current and/or anticipated, arising from ongoing and planned human activities that, through changes of the oceans' chemical or physical state, may affect:
(a) the productivity of the oceans at all trophic levels;
(b) the quality of the ocean resources for human use;

- 4.3 Reference was made also to the meeting of the Core Group of the Working Group on the State of the Marine Environment (Working Group 26), held in London in January 1987, which stressed the need to organize a small expert meeting to compare riverine and atmospheric input of contaminants.
4.4 The Chairman of the Working Group, Mr R. Duce, briefly described the objective of the small ad hoc meeting of 5-6 experts from Working Group 14 and Working Group 22 (Land-sea Fluxes of Pollutants), which will take place during the intersessional period. The meeting will provide a brief written report for Working Group 26 (State of the Marine Environment) that will include the following:
(i) An evaluation of our current understanding of the rates of input of trace metals, synthetic organic compounds and nutrients due to riverine and atmospheric transport on a global scale and an indication, when possible, of how these have been changed, temporally and spatially, as a result of anthropogenic activities.
(ii) A comparison of these transport fluxes for a limited number of coastal regions or marginal or regional seas where information is available.
(iii) A comparison of the present level of understanding of these two flux pathways with regard to:
(a) existing data base,
(b) understanding the physical transport systems (i.e. hydrology, meteorology),
(c) ongoing research efforts.
(iv) A brief written report on the comparison described in (1), (2) and (3) for inclusion in the report of the GESAMP Working Group on the State of the Marine Environment (Working Group 26).
4.5 This meeting will also provide an opportunity to begin development of strategies for the generation of comprehensive estimates by the Working Group on the fluxes of contaminants and nutrients from the atmosphere to the ocean. The goal is to provide such estimates in a form which will allow direct comparison with the land-sea fluxes. Comprehensive estimates will be made for the global ocean and for certain specific regions. After the planned ad hoc meeting, the remainder of the intersessional period will be devoted to gathering appropriate data sets, identifying experts for the subsequent meeting of the Working Group and preparation of background papers for a later meeting to be held in 1988.
4.6 Comments were made relative to the inclusion of information on other (non-CO2) radiatively active trace gases in the report of the sixth session of the Working Group, which stressed the impact of contaminants on climate. These comments were noted and a section on these gases will be included in the final report to be presented to the eighteenth session of GESAMP.
4.7 After the discussion, the following revised terms of reference for the Working Group were adopted by the Group:
(i) To provide a continuing review of air-sea material exchange with emphasis on modification by contaminants of the atmosphere, sea-surface microlayer and ocean processes related to climate, the energy balance of the ocean and mechanisms of mass and energy transfer between the atmosphere and the oceans;
(ii) To review recommendations and/or manuals on the use of suitable standardized measurement techniques for the determination of pollutants in the marine atmosphere and their deposition, taking into account the need to minimize sampling and analytical artefacts;
(iii) To describe atmospheric transport processes into specific regions and to review the scientific literature, and to assess and compare the pathways and fluxes of important contaminants and nutrients into the global ocean and specific regions through the atmosphere with those through other media for which adequate information exists.

5. LAND-SEA BOUNDARY FLUX OF POLLUTANTS (Working Group 22)

- 5.1 The Agenda item was introduced by the Unesco Technical Secretary who referred to the draft final report of the Working Group, which was presented to the Group for possible adoption. The report had been circulated to all nominated experts in early March.
- 5.2 The Chairman of the Working Group, Mr H.L. Windom, reported that he and four other members of the Working Group met in Savannah in December 1986 to draft the report, which is based on a number of annexes prepared by correspondence. The draft report was completed and mailed to other Working Group members for comment.
- 5.3 The Chairman of the Working Group went on to review the report pointing out that the major part is constituted by seven appendices which give in detail the scientific basis for the discussions presented in the main body. The report discusses three categories of pollutants (nutrients, trace metals and synthetic organics) and provides examples of ways of, or information needed for, estimating gross riverine and net land-sea fluxes, taking into account the main processes controlling these.
- 5.4 In the subsequent discussion of the report, most members of GESAMP expressed their satisfaction with the report, pointing out that it should be published and given a wide circulation since it would be useful for several different communities and groups, including those working on the freshwater side.
- 5.5 A number of suggestions were made also as regards possible additions, changes of editorial and substantive nature, including:
- the requirement of considering specifically riverine inputs to the Arctic areas;
 - the need for comparisons between riverine and atmospheric inputs or fluxes which have been carried out in some regions, e.g. the Baltic;
 - the need to consider other pathways, e.g. glacial transport, including sediment mobilization, direct discharges and runoff, in more detail and to give estimates for comparison with the riverine inputs, it being recognized that the rivers are the major concern and that the direct runoff is even more difficult to estimate than the riverine input;
 - the possible need to discuss dredging and disposal of dredged material since the coastal systems are disturbed by the dredging, influencing the transfer characteristics;
 - the need to consider that in many areas the input occurs over brief periods, like events;
 - the need for a statement in the preface of the report that biological aspects had not been covered, since it had been impossible to evaluate the rate of (micro-) biological processes in sufficient detail; reference was made to a recent study by the SCOR Working Group on Coastal and Offshore Ecosystem Interactions;
 - the possible need to consider the transfer of particulate, suspended matter as a potential pollutant in certain special areas, e.g. coral reefs.
- 5.6 Specific points were also addressed, especially in relation to the influence of riverine inputs on conditions in the open ocean, the need to relate this to the time scales involved, and the importance of obtaining time series of data in this and other connexions, over several decades, using a common strategy to determine the riverine inputs. Another specific point raised concerned the relevance of extrapolating riverine inputs to a global scale from a few major systems, a question which had been evaluated by the Working Group.
- 5.7 It was suggested that some material in the appendices should be included in the main body of the report, especially Appendices 2, 3 and 4, and that this be considered in the further editing of the report.
- 5.8 It was also suggested that the title should be adjusted to reflect that the report covered essentially the riverine land-sea boundary flux and does not cover other fluxes in any detail, and that this should be explained in a preface with reference to the Terms of Reference of the Working Group.
- 5.9 The register of research groups involved in chemical studies of rivers and estuaries (Appendix 1 of the report) was considered useful, but it was suggested that the projects being carried out

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Annex VIII

SUMMARY OF THE REPORT OF THE WORKING GROUP ON COASTAL MODELLING (Working Group 25)

- 1. The second meeting of GESAMP Working Group 25 on Coastal Modelling was held in Sidney, B.C., Canada, on 4-10 September 1986 at the Institute of Ocean Science, under the Chairmanship of Mr J. Blanton. Although two members of the Working Group could not attend, the addition of two biological oceanographers helped to balance the expertise missing in the first meeting.
2. A review of the contents of the report and drafts brought to the meeting by the participants led to a revision of the contents and assignments for intersessional work. Along with assignments for writing specific sections, the Working Group members agreed to review models found in the open literature, to send a one-page description of the models to the IAEA Technical Secretary and to provide the Secretary with a copy of the reference for distribution as required.
3. Considerable effort was spent in more carefully defining what the Working Group was expected to do and in refining the conceptual model which includes processes in the water column, on the seabed and the sources and sinks involved.
4. The third meeting is planned to be held in Delft, The Netherlands, on 11-15 May 1987.
5. GESAMP was requested to review the conceptual model for contaminant transport, the types of oceanographic regimes chosen and the chapter on parameterization.

Terms of Reference of Working Group 25

- (i) To evaluate the state of the art of coastal (including continental shelf) modelling relevant to waste inputs by sea dumping or land-based discharges in such areas;
(ii) to determine what model parameters are site and source specific and what parameters are generic to different coastal situations and contaminants, and
(iii) to make recommendations as to the types of models appropriate for specific coastal situations.

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could perhaps be identified for the various groups, and reference was made in particular to the considerable work going on in the Mediterranean. It was realized that the register reflected the groups which the Working Group had been in contact with.

- 5.10 The recommendations in the report were discussed at some length; the Chairman of the Working Group explained that all were important and in particular stressed the need for a common strategy. It was suggested that the possibility of using river observations to obtain temporal trends over time scales of decades should be included as an additional recommendation.
5.11 The Group agreed on the recommendations subject to appropriate editing but suggested that perhaps they should be called conclusions rather than recommendations.
5.12 The Chairman of the Working Group responded to the comments made, stressing that the Terms of Reference had been addressed, that the riverine source had been selected as being of major concern and as providing a focus for the work, and that biological processes had not been considered, being a subject meriting separate treatment.
5.13 The Chairman of the Working Group confirmed that an explanation of the coverage of the report would be inserted in a preface, taking into account the comments made by the Group. He also stated that methodologies for studying riverine inputs were being prepared within the framework of cooperation between IOC and UNEP, on the basis of various practical experiences, including a workshop and an intercalibration exercise carried out in Thailand in April/May 1986; these contributions will be discussed at the forthcoming session of the IOC/UNEP Group of Experts on Methods, Standards and Intercalibration (GEMSI). It was emphasized that the methods developed should be used on a regional scale.
5.14 The Group endorsed the report and agreed that it should be published as GESAMP Reports and Studies No. 32, entitled 'Land-sea Boundary Flux of Contaminants: Contributions from Rivers'. The publication is expected within 6-8 months after editing by the Chairman of the Working Group (in cooperation with the Technical Secretary) on the basis of the comments made by the Group as well as those received from the members of the Working Group. A summary of the report, together with the contents table and a list of working group members, is given in Annex VI.
5.15 It was stressed by the Group and Technical Secretaries that the report should be widely circulated also to groups in the limnological community, and that information about the report should be prepared by the Chairman of the Working Group for publication in selected open literature, including abstracts in the Aquatic Sciences and Fisheries Abstracts (ASFA) and the Marine Science Newsletter.
5.16 Technical Secretaries informed the Group that the publication would be used in many of the on-going programmes and projects, regionally and globally.
5.17 The Chairman expressed the thanks of the Group and the co-sponsoring agencies to Mr Windom and all who had participated in the work.

6. INTEGRATED GLOBAL OCEAN MONITORING (Working Group 24)

- 6.1 The UNEP Technical Secretary informed the Group that the Working Group had held its second session in Moscow from 25 to 29 November 1986. Fourteen experts and two GESAMP Technical Secretaries (UNEP and WMO) participated in the meeting.
6.2 The Chairman of the Working Group, Ms A.V. Tsyban, provided a brief background concerning the activity of the Working Group and referred to the presentation of the report of the first session of the Working Group to the Sixth Session of the Scientific Committee for the Global Investigation of Pollution in the Marine Environment (GIPME) (Paris, September 1986).
6.3 Based on the information contained in the working papers prepared for the Working Group, on the comments offered by the sixteenth session of GESAMP and on the comments received from the Scientific Committee for GIPME, the Working Group re-examined the feasibility study on Integrated Global Ocean Monitoring (IGOM) and prepared a second report, which was reviewed by the Chairman of the Working Group. The Working Group concluded that the

concept of IGOM had been formulated and now required pilot scale implementation. The main contents of the report are summarized in Annex VII.

6.4 In the ensuing discussion, a number of comments and suggestions were made. Among these were the following:

- (a) The report on the feasibility of IGOM resulting from the second session of the Working Group is a considerable step forward in rationalization and conceptualization of IGOM.
- (b) The report does not give sufficient attention to priorities and the probable time scale.
- (c) The time frame suggested for the implementation of IGOM is over-optimistic and does not take sufficiently into account the availability of techniques and methods needed for the implementation of the proposed programme.
- (d) Other international programmes of regional and global scope of relevance to IGOM in addition to those listed in the Working Group report were noted; these include: WATOX (Western Atlantic Ocean Experiment); SEAREX (Sea-Air Exchange) Programme; AEROCE (Atmosphere-Ocean Chemistry Experiment) and IGAC (International Global Atmospheric Chemistry) Programme.
- (e) A meaningful monitoring of the atmospheric input of pollutants would require an almost continuous monitoring in view of the high temporal and spatial variability of this input.
- (f) The monitoring of fluxes through boundaries (e.g. air-sea, land-sea) may be of the highest importance, as it could provide the best information needed for the assessment of the fate and potential impact of contaminants.
- (g) More attention could have been given to fish diseases.
- (h) The question of the desirability of a comprehensive IGOM was raised by several members of the Group, but it was considered as irrelevant in the context of the Terms of Reference of the Working Group.
- (i) Some of the generalized statements made in the report of the Working Group would have to be supported and clarified by suitable examples and additional explanations.
- (j) The importance assigned to various pollutants/contaminants in the context of IGOM was considered as a subject requiring further clarification.

6.5 The Group accepted that some of the proposed components of IGOM could be implemented using currently available methods for sampling, sample processing and analysis. The 'mussel watch' type programmes and some other coastal monitoring programmes were considered as falling into this category. However, the Group felt in general that it may be premature to launch a large-scale global open ocean programme involving simultaneous monitoring of a large number of parameters, at least until such time when reliable observations and analytical methods yielding comparable results are available for most of these parameters.

6.6 The UNEP, WMO and Unesco Technical Secretaries indicated that their organizations are satisfied with the work accomplished by the Working Group and will take it into account in planning and implementing monitoring programmes sponsored or promoted by their organizations.

6.7 Taking into account the comments and suggestions reflected in the preceding paragraphs, the Group concluded it would not be proper to endorse the report by publishing it in the GESAMP Reports and Studies series. Nevertheless, the Group accepted the various reports of the Working Group as contributions to GESAMP's efforts to define, since 1973, the scientific principles and requirements for comprehensive monitoring of the state of the marine environment. However, the Group considered that the results of the work carried out by Working Groups 26 and 27 should be taken into account in any future conceptual and substantive development of IGOM.

6.8 An ensuing Intersecretariat Meeting confirmed that any sponsoring organization could, if it wished, publish the material from working groups. Consequently, a proposal was presented to

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6. The observations for IGOM proposed by the Working Group include chemical and biological measurements, air-sea fluxes of selected constituents, remote sensing of sea-surface characteristics and ancillary meteorological and oceanographic observations. Intercalibration among participating laboratories, particularly for chemical analysis and quality control of data, was regarded as of high priority. Emphasis should be placed on those constituents that have anthropogenic sources, recognizing that not all contaminants have adverse biological effects. While sampling and analytical techniques for open ocean studies appear to be adequate in most respects, refinements and improvements will be needed for sampling and analyses of low-level trace contaminants in water and atmosphere; GEMSI has expressed its readiness to develop and refine methods for open ocean studies, with respect to trace metals. Methods for reliable measurements of primary production in nanoplankton and picoplankton and determination of bacterial standing crop and biomass have yet to be developed.
7. Care must be observed in developing a sampling strategy. Before launching a monitoring programme, information will be essential on the spatial and temporal distribution of the measurements envisaged. This might be acquired through the assessment of existing literature and data banks, and by conducting a pilot phase of the monitoring programme and critically reviewing the preliminary data.
8. The Working Group noted that an IGOM programme cannot be considered in isolation from other current activities of a similar nature, even if such activities have somewhat different aims. Strong links should be established with the major programmes where activities of interest to IGOM are being pursued.
9. An IGOM programme can only be implemented with the voluntary participation of countries through their national institutions and with national funding. International financial resources would be needed, however, to ensure the coordination of the programme and the implementation of a number of common activities.
10. In conclusion, the Working Group stressed that an IGOM programme is both desirable and feasible and should include both an open ocean and a coastal component, which should complement each other, as well as other supporting elements.

Terms of Reference of Working Group 24

To examine the scientific basis, rationale, feasibility and the technical requirements for monitoring biological and chemical conditions and the ecological consequences of pollution, i.e. the scientific justification for an integrated global ocean (by which is meant all sea areas) monitoring study (IGOM) related to marine pollution and the ecological consequences thereof, taking account of what is already being done in these fields. In examining the scientific justification for IGOM the Working Group should consider:

- (a) The type of observations and measurements that could be included in IGOM i.e. the parameters which could be included and the areas in which they may be required;
- (b) the methodological feasibility of IGOM, i.e. the availability of adequate sampling and analytical techniques which can be expected to provide reliable data on a world-wide basis and to advise on the extent to which these can actually be applied and what, if any, further facilities may be required;
- (c) the type of observations/measurements which it is practicable to include in an IGOM programme;
- (d) the type of observations and sampling strategy which would be required, i.e. the frequency of sampling in both space and time and the distribution/location of sampling stations, and
- (e) the support needed to initiate and implement the IGOM study such as intercalibration, quality control of data, coordination, data processing and institutional arrangements, and what further facilities, if any, may be necessary.

the Group by the UNEP Technical Secretary to publish the reports of Working Group 24 in the series 'UNEP Regional Seas Reports and Studies', along with a description of the historical development of the concept of global ocean monitoring within GESAMP. The WMO Technical Secretary expressed the willingness of his organization to be associated with the publication of the document.

- 6.9 During the discussion, several experts reiterated their strong reservations with respect to the views expressed and the conclusions reached by Working Group 24. They reminded the Group that working papers on IGOM had been sent to the Chairman of the Working Group and that many of the ideas and views expressed in those working papers did not appear to have been adequately considered in the report of the Working Group. They requested that publication of the Working Group reports be prefaced by a disclaimer signifying that these reports were not endorsed by GESAMP for publication in the GESAMP Reports and Studies series, but rather should be regarded as reports to GESAMP.
- 6.10 The UNEP Technical Secretary responded by pointing out that not only would there be a disclaimer in the preface, but also the relevant comments on the various reports by GESAMP, as given in the reports of the sessions. On this understanding, the meeting finally agreed to support the proposal of the Secretariat.

7. COASTAL MODELLING (Working Group 25)

- 7.1 The report of the second meeting of the Working Group on Coastal Modelling, held in Sidney (B.C., Canada) from 4 to 10 September 1986, was presented by the Chairman of the Working Group, Mr J. Blanton. He noted that the outline for the report had been modified, as had the framework for the conceptual model. In addition, drafts of many chapters had been written, although not yet reviewed by the Working Group. A summary of the report of the Working Group is given in Annex VIII.
- 7.2 Several members commented on the conceptual model presented by the Working Group, including the interactions suggested. It was agreed that comments should be given in writing to the Chairman of the Working Group, who assured the Working Group that all comments would be duly taken into account. After further discussion of such points as how climatic conditions and stratification will be handled in the report. The Group expressed its satisfaction with the progress of the Working Group.
- 7.3 The third meeting of the Working Group will be held in Delft, The Netherlands, from 11 to 15 May 1987.

8. STATE OF THE MARINE ENVIRONMENT (Working Group 26)

- 8.1 The UNEP Technical Secretary for Working Group 26, Mr F. Sella, informed the Group that the Working Group's Core Group had met from 19 to 23 January in London (U.K.) at the Headquarters of the International Maritime Organization with the participation of seven members of the Core Group, of six experts and of ten rapporteurs of the task teams that were preparing regional reviews of the state of the marine environment.
- 8.2 The Core Group had considered a number of background documents provided by its members or by experts associated with its work. It also considered 12 draft regional reviews and other documents relating to regional conditions.
- 8.3 In the course of its deliberations, the Working Group had reviewed and extensively amended the outline of its planned Review on the State of the Marine Environment (hereinafter referred to as the global review), selected experts who could be assigned the task of writing the technical annexes to the Review and had proposed a timetable for its work in the interval between the current and the forthcoming session of GESAMP, it being understood that the Working Group would strive to complete its task by the nineteenth session of GESAMP.
- 8.4 The Chairman of Working Group 26, Mr A.D. McIntyre, underlined the invaluable contribution to the preparation of the global review that the regional task teams were making by assembling and reviewing data otherwise inaccessible to the Core Group. The documents prepared by, and the interventions of, the regional rapporteurs, he added, had also brought into

better focus a number of issues that the Core Group had at least in part neglected, and the existence and/or perception of which in regional, particularly tropical, areas demanded that they be highlighted in the global review.

- 8.5 In the course of its meeting, the Core Group had suggested a number of major changes of substance and emphasis and some additions to the outline of the global review which are reflected in the amended outline annexed to its report to GESAMP. Among the additions were section 3(d) and 4(c). The former would cover a number of land-use practices such as deforestation and reforestation, major irrigation schemes, the use of agrochemicals and other practices which, while clearly carried out in the hinterland, had or could have significant impacts on the oceans, as had been strongly emphasized by the regional rapporteurs. The other additional section would bring together the many aspects of changes in the sea composition that were likely to affect human health. The Chairman also mentioned that section 4 would include a brief discussion of the quality assurance requirements for biological effects. He also indicated how the tasks had been assigned to individual contributors, and mentioned that section 2(c) could be prepared by a small sub-group drawing on the work of Working Groups 14 and 22. The tasks of this ad hoc group are given in paragraph 4.4
- 8.6 In the course of the debate, a number of members of GESAMP and its secretariat sought clarification on various points of the outline and asked that the Core Group do not neglect such issues as bioaccumulation, the levels and effects of mercury and carcinogens, the fate of endangered species (e.g. turtles), the effects of stratospheric ozone depletion, and the state of the Antarctic seas and the threat to which they are exposed if the exploitation of the region's mineral resources were to be initiated.
- 8.7 One member drew attention to new data indicating that the oceans were a major source of reduced sulphur and ultimately of sulphate which served as cloud condensation nuclei in the atmosphere. Any change in ocean productivity, by altering the output of reduced sulphur, might therefore affect the cloud cover and through it the earth's albedo, thus contributing to climatic changes.
- 8.8 The IAEA Technical Secretary drew attention to the wealth of data available to her organization on radioactive contamination, including data on marine contamination, as a result of the Chernobyl accident. These data are currently being entered into a computerized data base and are being used by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) to assess the impact of the accident. Until all data are entered and checked for reliability, they are regarded as confidential. A detailed assessment of the effects of the accident on the oceans will improve understanding of global dispersion and atmosphere-to-ocean flux, but it may be difficult to incorporate this assessment in the time frame within which the Working Group was planning to operate.
- 8.9 The outline of the global review was endorsed by GESAMP, but members
- cautioned against the risk of the review attaining an unmanageable size;
 - pointed out the tightness of the schedule for its preparation;
 - underlined the need to indicate which measurements had a high signal-to-noise ratio for future trend detection.
 - emphasized the need for close coordination between the preparation of the regional reviews and the global one.
9. **LONG-TERM ECOLOGICAL CONSEQUENCES OF LOW-LEVEL CONTAMINATION OF THE MARINE ENVIRONMENT (Working Group 27)**
- 9.1 The FAC Technical Secretary introduced the report of intersessional work that had been done in setting up a new Working Group to examine evidence for long-term ecological changes which might be due to persistent exposure to low concentrations or slow bioaccumulation of contaminants in the marine environment. In the intersessional period there had been no meeting of the proposed working group, but progress had been made through correspondence in identifying possible material for review and in developing a strategy and work plan.
- 9.2 The first meeting of the Working Group was planned for 13-17 July 1987 at the Institute of Marine Environmental Research at Plymouth, United Kingdom. In order to ensure that the activities of IOC (GIPME and CEEP), as well as ICHS, be taken into account, Mr B. Hayne has been invited to join the Working Group as member.

Annex VII

SUMMARY OF THE REPORT OF THE WORKING GROUP ON
INTEGRATED GLOBAL OCEAN MONITORING
(Working Group 24)

1. The second meeting of the Working Group was held in Moscow, U.S.S.R., 25-29 November 1986, under the chairmanship of Ms A.V. Tsyban. Messrs F. Sella, representing UNEP, and A. Soudine of WMO acted as Technical Secretaries. Mr M. Waldichuk was the Rapporteur.
2. Continuing under the terms of reference established at the fourteenth session of GESAMP in Vienna, March 1984, the Working Group was made aware of the comments and suggestions made by the sixteenth session of GESAMP in London, March 1986, on the report of its first meeting held in Batumi, U.S.S.R., 2-5 December 1985. To meet one of the criticisms of that report, namely that many of the available documents describing programmes and approaches relevant to Integrated Global Ocean Monitoring (IGOM) were not taken into account, Mr L. Jettlic of UNEP prepared a working paper for the second meeting of the Working Group, 'Overview of global and regional monitoring programmes of interest to IGOM'. In representing IOC of UNESCO at the meeting, Mr S.W. Fowler presented a message from Mr G. Kullenberg, Senior Assistant Secretary of IOC, noting the work within the IOC GIPME programme, particularly that of its Group of Experts on Methods, Standards and Intercalibration (GEMSI) and the Group of Experts on Effects of Pollutants (GEEP), that would be relevant to IGOM.
3. The Working Group discussed at considerable length the definition, aim and tasks of IGOM. It agreed that IGOM should be an international multi-disciplinary programme for systematic surveillance and evaluation of those characteristics of the world ocean that may be altered as a consequence of human activity. Monitoring was defined as the systematic time sequence of observations of the marine environment conducted in order to detect changes, if any, from a given baseline, and to identify temporal and spatial trends. The overall aim of IGOM is to determine the extent to which the marine environment is impaired by certain human activities. To fulfil its role in carrying out systematic measurements in space and time, a series of tasks were outlined for IGOM. Among other things, these tasks would contribute to the understanding of the cause-effect relationships between levels of contaminants and observed ecological changes, to the recognition of hazardous conditions in the marine environment and to mapping of present and past levels and distribution of specific contaminants.
4. The scientific rationale and justification of IGOM were explored and debated by the Working Group. It was mentioned that at present, the processes essential for the maintenance of the 'health of the oceans' are poorly understood and the resilience of ecosystems to man-made perturbations is far from clear. Meanwhile, more than 30 000 chemical materials are being discharged to the world ocean. Contaminants are transferred by intensive currents over long distances to reach the open expanses of the ocean; persistent low-level contamination occurs in zones of convergence of different water masses; transfer of contaminants occurs from the surface to deeper layers of the ocean, and accumulation of contaminants takes place in particulate organic matter and marine organisms. Thus the ecological state of the world ocean may be affected by present-day discharges and exploitation of marine resources by man. After lengthy discussion the Working Group concluded that because of gaps in our knowledge about open ocean systems and the need for a baseline for future reference in identifying trends in concentrations of contaminants and changes in ecosystems, an integrated global ocean monitoring programme is justified and timely.
5. It was recognized by the Working Group that IGOM should consist of interlocking components and that monitoring activities should be supported by research. Basically, the Working Group considered that there should be two components of IGOM: (1) Global open ocean monitoring, and (2) Regional coastal programmes. Under (1), it was recommended that a pilot project should be initiated in oceanic areas, selected on the basis of knowledge on a range of hydrographic and ecological characteristics, as well as type, loading and location of sources of potential pollutants. Two candidate areas were proposed, based on the foregoing criteria: (a) the Kuroshio system and North Pacific gyre; and (b) the North Atlantic and the Sargasso Sea. With respect to (2), it was proposed that sites in each region should be chosen to include probable impacted areas and 'pristine' areas. Both estuarine and open coastline sites should be included. It was noted that many inshore and coastal areas are already monitored, and coordination with this activity will provide support for IGOM.

- (iv) to develop a report that can be used as input to total mass balance models and the next Review of the Health of the Oceans.

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9.3 The Working Group would also be able to keep in view the aims of Working Group 26 on the State of the Marine Environment through the Chairman's participation in both Groups. Although the final report of the new Working Group might not be completed until after that for Working Group 26, draft material could be available for consideration.

9.4 The Chairman of the Working Group, Ms G.D. Howells, summarized the steps taken during the intersessional period to identify members of the Working Group, to seek comments from wider groups of scientists and to identify possible data sets for review by the group in due course. A brief review of these activities is included in Annex X. As a result of intersessional discussion and correspondence, a strategy and work plan had been developed. The first meeting of the Working Group would be asked to select examples of time series data which might be used as evidence of trends in species occurrence, population strength or community structure which might be attributed to low concentrations of contaminants or to their bioaccumulation. Case histories of known pollution incidents and of recovery for a variety of pollutants could be illustrative of the timescale and geographic extent needed to reveal such changes against the background of biological variation. An appraisal of the adequacy of present methods would be included. A second meeting would be convened in 1988 to consider mechanisms of action at individual species, population and community levels, taking as examples those organisms or communities and those contaminants identified at the first meeting. Consideration of lifetime exposure and of genetic effects and their consequences on a population and community level would be included.

9.5 In the ensuing discussion, members of GESAMP and observers identified a number of possible sources of long time series data that could be considered by the Working Group. The need to take account of the ecological responses to long-term climatic cycles, of changes (including increases) in abundance of species and of the value of indicator species was identified. It was recognized that the task of the Working Group was very difficult and that the goals were possibly too ambitious. However, it was noted that a fall-back position might be to consider loss of individual species, attributable to a known contaminant, and from there to develop concepts needed to further the understanding of long-term ecosystem changes and to identify the information needed and the methods appropriate for the task.

9.6 After considering the approach proposed, and the comments and suggestions made in the discussion, the Group accepted the plan put forward.

10. FUTURE WORK PROGRAMME

Economic Aspects of Marine Pollution

10.1 The Group, recalling that the subject of economic aspects of marine pollution had been introduced at its sixteenth session, noted that a background paper on Relations Between Economic and Scientific Research had been prepared by the UN Technical Secretary. The UN Technical Secretary emphasized that the role of scientific input in environmental aspects of development planning was an important concern to his organization. He also pointed out that the original idea to establish a new working group on economic aspects of marine pollution has been held over at this time as economic issues would be considered by a sub-group of the Working Group on the State of the Marine Environment.

10.2 The Group was informed by one of its members of the increasing use of economic models in marine pollution control strategies and of recent results in the integration of science into economic models.

10.3 The Group noted the value to scientists of an increased understanding of current economic analyses and decision-making. It was stressed that the most important considerations for the Group would be the long-term effects rather than the acute short-term impacts, and the application of scientific/economic models to the evaluation of options in development planning. It was also recognized that planning decisions now being made on the basis of limited scientific information, such as dose-response relationships, would benefit from increased scientific input.

10.4 The Group supported the continued examination of economic issues through the inclusion of economic concepts within the work of the Working Group on the State of the Marine Environment and agreed to review the possible formation of a separate working group when

the results of the above-mentioned sub-group become available, if possible, at the eighteenth session of GESAMP.

- 10.5 Members of GESAMP were requested to submit comments and suggestions for terms of reference for a possible working group to the UN Technical Secretary.

Other Intersessional Work

- 10.6 Following the above decision, the Group noted that intersessional work would take place on the subjects listed below. The sponsoring organizations responsible for coordinating the intersessional work and the GESAMP members assigned to each working group are indicated. Additional GESAMP members and experts from outside GESAMP will be selected by the Chairmen of the working groups in consultation with the relevant organizations.

- (a) Evaluation of the Hazards of Harmful Substances Carried by Ships (Working Group No.1)

Lead agency: IMO
Cooperating agency: UNEP
Chairman: W. Ernst

- (b) Review of Potentially Harmful Substances (Working Group 1.3)

Lead agency: Unesco
Cooperating agencies: UNEP, FAO, WHO and IMO
Chairman: J.E. Portmann

- (c) Interchange of Pollutants between the Atmosphere and the Oceans (Working Group No.14)

Lead agency: WMO
Cooperating agencies: UNEP, Unesco
Chairman: R. Duce
Members: V.M. Koropalov
M. Waldichuk
H.L. Windom

- (d) Coastal Modelling (Working Group No.25)

Lead agency: IAEA
Cooperating agencies: UNEP, Unesco, IMO
Chairman: J. Blanton
Member: J.M. Bowers

- (e) State of the Marine Environment (Core Group of Working Group 26)

Lead agency: UNEP
Cooperating agencies: UN, FAO, Unesco, WHO, WMO, IMO, IAEA
Chairman: A.D. McIntyre
Members of the Core Group: J. Broadus
R. Duce
G.D. Howells
P. Tortell
H.L. Windom

- (f) Long-term Ecological Consequences of Low-level Contamination of the Marine Environment (Working Group 27)

Lead agency: FAO
Cooperating agencies: UNEP, Unesco, IMO
Chairman: G.D. Howells
Members: M. Bernhard
A. Kapuan
A.V. Tsyban

- 3.2 Processes Controlling Net Fluxes
3.3 Methods of Estimating Net fluxes

4. ESTIMATES OF NET LAND/SEA FLUXES

4.2 Nutrients

- 4.2.1 Introduction
- 4.2.2 Natural gross river fluxes
 - 4.2.2.1 Dissolved nitrogen
 - 4.2.2.2 Particulate nitrogen
 - 4.2.2.3 Dissolved phosphorus
 - 4.2.2.4 Particulate phosphorus
 - 4.2.2.5 Dissolved silicon
- 4.2.3 Anthropogenic fluxes
- 4.2.4 Net fluxes of nutrients to the open ocean

4.3 Trace Metals

- 4.3.1 Gross influxes
- 4.3.2 Net fluxes

4.4 Estimation of Net Fluxes of Synthetic Organics

- 4.4.1 Dissolved fraction
- 4.4.2 Particulate fraction

4.5 Direct Land-sea Fluxes

5. RECOMMENDATIONS

- 5.1 Development of Comprehensive Strategies for the Assessment of Cross River Transport of Contaminants
- 5.2 Cooperation Between Programmes
- 5.3 Regional Workshops and Intercalibration Exercises
- 5.4 Testing of Approaches to Determining Net Land-sea Fluxes

APPENDICES

- I. Register of Research Groups Conducting Chemical Studies of Rivers and Estuaries
- II. River and Estuarine Biogeochemistry of Nutrients
- III. River and Estuarine Trace Metal Geochemistry
- IV. River and Estuarine Biogeochemistry of Organic Materials
- V. Influence of River Hydrology on Material Transport
- VI. Estuarine and Shelf Sea Processes Affecting Net Land-sea Fluxes of Chemical Constituents
- VII. Techniques and Approaches to the Measurement of Gross Fluxes of Chemical Constituents in River Discharge

REFERENCES

WORKING GROUP MEMBERS, SECRETARIAT AND MEETINGS

ACKNOWLEDGEMENTS

Terms of Reference of Working Group 22

- (i) To review the scientific literature and assess the sources, pathways and fate of selected substances across the land-sea boundary to allow for a quantitative description of the flux of material to and through the marine environment;
- (ii) to describe the processes which control the fate of material being introduced into the estuarine and marine environment, with initial emphasis being given to the nearshore and exchanges with the open ocean;
- (iii) to consider and/or stimulate limited case studies to demonstrate the applicability and accuracy of the models generated;

Annex VI

SUMMARY OF THE REPORT OF THE WORKING GROUP ON
LAND-SEA BOUNDARY FLUX OF POLLUTANTS

(Working Group 22)

1. Five members of the Working Group met in Savannah, U.S.A., from 9 to 13 December 1986 to draft the final report of Working Group 22, using several papers prepared intersessionally by Working Group members.
2. The report discussed the land-sea flux of pollutants resulting from river transport. Three categories of substances are considered: nutrients, trace metals and synthetic organic compounds. Discussions in the report refer to gross and net river fluxes. The gross river flux is defined as the amount of the substance transported to the land-sea boundary and the net flux is the amount of the substance transported across the boundary. The report reviews the present knowledge of processes controlling gross fluxes and the estuarine and nearshore processes that influence the fate of substances as they are transported through land-sea boundary.
3. The main body of the report consists of five chapters.
4. Following a general introduction, chapter 2 introduces the concept of gross river flux of contaminants and defines the boundary at which such fluxes are measured. Influences on gross river fluxes due to biogeochemical processes and river hydrology are also discussed in this chapter. Finally, the state of the present understanding, on a global scale, of the gross riverine fluxes of materials is reviewed.
5. Chapter 3 introduces the concept of 'net fluxes' which represent the amount of a contaminant that reaches the sea after estuarine and nearshore processes have modified that quantity introduced to the marine environment as the gross river flux. The nature of these processes is then discussed, followed by a discussion of approaches to estimating net fluxes.
6. Given the discussions in the preceding chapters, estimates of gross river fluxes and net fluxes of the three classes of contaminants are presented in chapter 4.
7. The final chapter discusses four recommendations drawn from the report.
8. The list of contents of the document is as follows:

Land-sea boundary flux of contaminants:
Contributions from rivers

1. INTRODUCTION
2. GROSS RIVER FLUXES
 - 2.1 General
 - 2.2 Definition of Boundary for Estimating Gross River Fluxes
 - 2.3 Biogeochemical Influences on Riverine Transport
 - 2.3.1 Nutrients
 - 2.3.2 Trace metals
 - 2.3.3 Synthetic organics
 - 2.3.3.1 Analytical limitations
 - 2.3.3.2 Phase distribution of synthetic organics
 - 2.4 Influence of River Hydrology on Riverine Transport
 - 2.5 Needs for Improvement of Estimates of Regional and Global Gross River Fluxes
3. NET LAND-SEA FLUXES
 - 3.1 General
 - 3.1.1 Objectives of net-flux measurements
 - 3.1.2 Boundaries for net flux determination

11. DATE AND PLACE OF THE NEXT SESSION

- 11.1 The Group noted that the eighteenth session of GESAMP would be held at Unesco Headquarters, Paris, from 11 to 15 April 1988, commencing on Monday, 11 April, at 2 p.m. The Group urged the Technical Secretaries to distribute documents for consideration at the eighteenth session not later than 19 February 1988.

12. OTHER MATTERS

- 12.1 The members of the Group were invited to raise any points they may have under this agenda item. There was no request for consideration of additional items.

13. ELECTION OF CHAIRMAN AND VICE-CHAIRMAN FOR THE NEXT INTERSESSIONAL PERIOD AND FOR THE EIGHTEENTH SESSION

- 13.1 The Group unanimously re-elected Ms G.D. Howells as Chairman and Mr H.L. Windom as Vice-Chairman for the next intersessional period and for the eighteenth session of GESAMP.

14. CONSIDERATION AND APPROVAL OF THE REPORT OF THE SESSION

- 14.1 The report of the seventeenth session of GESAMP was considered and approved by the Group on the last day of the session. It contains in Annexes IV to X summaries of reports prepared by Working Groups. These summaries are included for information and were not considered by the Group with a view to approval. The Terms of Reference of Working Groups and lists of members are contained as well.

Annex I

AGENDA

- Opening of the session
1. Adoption of the Agenda
 2. Review of potentially harmful substances
 3. Evaluation of the hazards of harmful substances carried by ships
 4. Interchange of pollutants between the atmosphere and the oceans
 5. Land-sea boundary flux of pollutants
 6. Integrated global ocean monitoring
 7. Coastal modelling
 8. State of the marine environment
 9. Long-term ecological consequences of low-level contamination of the marine environment
 10. Future work programme
 11. Date and place of next session
 12. Other matters
 13. Election of Chairman and Vice-Chairman for the next intersessional period and for the eighteenth session
 14. Consideration and approval of the report of the session

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Annex V

SUMMARY OF THE REPORT OF THE WORKING GROUP ON
THE EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES
(Working Group 1)

1. The Working Group met under the chairmanship of Mr P.C. Jeffery at Delft, Netherlands, from 26 to 30 May 1986 and in London from 3 to 7 November 1986.
2. The Working Group reviewed quite a number of hazard profiles and also evaluated many new substances proposed by IMO for carriage in bulk. Lists of substances considered by the Working Group are shown in Annexes to the reports of its nineteenth and twentieth sessions.
3. Since January 1986 manufacturers of lubrication oil additives have carried out marine toxicity studies by testing a variety of additives. The Working Group rated compounds for which data had been submitted by the industry. For a number of compounds the Group was unable to establish hazard profiles because the Working Group felt that no precautions had been taken to ensure that the test organisms were exposed to saturated solutions in equilibrium with the dosed levels due to inadequate mixing.
4. The problems met in evaluating lube oil additives have also been compounded by the secrecy surrounding the composition of these materials, and the consequent paucity of data supplied which has prevented the Working Group from interpolating and extrapolating from background knowledge.
5. The Working Group noted with appreciation the efforts made by industry to provide complete data sets to be evaluated by the Working Group. Nevertheless, it was felt that, in particular for substances showing properties such as low solubility, high volatility and low density, guidance should be provided in relation to minimum requirements for aquatic toxicity testing, even though the previous view had been that it was not the task of the Working Group to establish standard test procedures. The Group prepared a list of such minimum requirements set out in Annex 4 to the report of its nineteenth session.
6. The Working Group agreed that its draft guidelines on fish tainting be revised in the light of the experience gained in their use during a number of years. The final guidelines will be included in the forthcoming revision of GESAMP Reports and Studies No.17. In the light of the results of tests carried out so far, the Working Group prepared an overview of those substances which had already been allocated a 'T' rating on the basis of the physical and biological properties of the substances concerned, comparing these with measured threshold values. It appeared that in earlier work the Working Group had assigned 'T' ratings to those compounds which tainted seafood at concentrations in the ambient water of 1 mg/l or less. The Group therefore considered this value as a preliminary criterion for allocating 'T' ratings, pending the availability of further testing results.
7. The Working Group identified items for priority consideration at its next meeting, which will be convened at Trondheim, Norway, from 18 to 22 May 1987 as follows: (i) Review and update of GESAMP Reports and Studies No.17; (ii) Evaluation of the hazards of substances carried as packaged goods, in particular pesticides, and (iii) Completion of the GESAMP Guidelines on Tainting.

Terms of Reference of Working Group 1

To enquire and evaluate available data and to provide such other advice as may be requested, particularly by IMO, for evaluating the environmental hazards of harmful substances carried by ships, in accordance with the rationale approved by GESAMP for this purpose (GESAMP IV/19/Suppl.1 as amended in Rep.Stud.GESAMP, (29)).

Annex II

LIST OF DOCUMENTS

| Agenda Item | Doc.No. | Author/source | Title |
|-------------|------------|--------------------------|--|
| 1 | XVII/1 | Administrative Secretary | Provisional Agenda |
| 2 | XVII/2 | Working Group Chairman | Review of Potentially Harmful Substances: Nutrients |
| 3 | XVII/3 | Working Group | The Evaluation of the Hazards of Harmful Substances Carried by Ships |
| 4 | XVII/4 | WMO | Revised Terms of Reference of the GESAMP Working Group on Interchange of Pollutants Between the Atmosphere and the Oceans |
| 5 | XVII/5 | Working Group | Land-sea Boundary Flux of Pollutants |
| 6 | XVII/6 | Working Group | Integrated Global Ocean Monitoring |
| 7 | XVII/7 | Working Group | Coastal Modelling |
| 8 | XVII/8 | Working Group Chairman | The State of the Marine Environment |
| 9 | XVII/9 | Working Group Chairman | Long-term Consequences of Low-level Contamination of the Marine Environment: Strategy and Workplan |
| 10 | XVII/10 | UN | Background Information and Draft Terms of Reference for a Working Group on the Relations of Economic and Scientific Research |
| | XVII/Inf.1 | Secretariat | GESAMP Members, Secretariat and Observers |
| | XVII/Inf.2 | Secretariat | List of Documents |

Annex III

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- (iv) Inputs: trends in input from land and via the atmosphere; trends in levels: in global terms (covered by earlier draft report to GESAMP) and in local and regional terms (for selected regions).
- (v) What is known in relation to the selected local/regional areas about dissolved oxygen levels, abnormal bloom incidences, species composition and the trends of these parameters; what is known about associated problems and their incidence; are the changes real, are they linked, entirely or partly, to changes in nutrient levels or are other causes involved?
- (vi) Regions to be covered for subjects (iv) and (v):
Baltic Sea including Kattegat
North Sea/Skagerrak
Mediterranean
Caribbean
Selected North American sites
South East Pacific
East Asian Seas
South Asian Seas
- (vii) Same as (iv) and (v) for open ocean and medium- to large-scale
- (viii) Human health problems, e.g. associated with plankton blooms
- (ix) Amenity problems
- (x) Conclusions

Terms of Reference of Working Group 13

- (i) To prepare short and referenced reviews on selected substances which include an assessment of the following factors:
 - (a) the total of particular substances which reach the marine environment (on a local, regional and global scale) with particular attention being given to the relative importance of land-based sources;
 - (b) the fate (transfer, distribution and transformation) of the substances in the marine environment;
 - (c) the effects of the substances on the marine environment and adjacent coastal areas, both direct and indirect, on living resources, human health and amenities.
- (ii) To produce a scientific evaluation of the harmful effects of substances released into the marine environment on living resources, human health, aesthetics and other legitimate uses of the marine environment and adjacent coastal areas.

*Unable to attend

Annex IV

PROGRESS REPORT
ON THE SUB-GROUP ON NUTRIENTS
OF THE WORKING GROUP ON THE REVIEW OF HARMFUL SUBSTANCES
(Working Group 13)

1. GESAMP, at its sixteenth session (London, 17-21 March 1986), decided to carry out an inter-session study, through a Sub-Group under the Working Group on a Review of Potentially Harmful Substances, with the aim of preparing an evaluation of potential pollution problems associated with inputs (increased or reduced) of nutrients to the marine environment. The Sub-Group should initially work by correspondence under the same Terms of Reference as the Working Group on the Review of Potentially Harmful Substances.
2. Mr J.C. Portmann accepted to chair the sub-group, while IOC of Unesco would act as technical secretariat. In consultation with representatives of FAO and UNEP, a workplan was developed. A list of topics for the content of a report was set up, potential contributors of review papers were identified and invitations extended.
3. From contributions received by February 1987 and other material available to IOC and the Chairman, it is apparent that increasing nutrient concentrations may not be confined solely to estuaries and river mouths but apparently have also been observed in certain coastal and shelf waters in the Baltic, North Sea and the Mediterranean and in coastal waters of North America and Japan. There is also evidence of changes in phytoplankton population structure and an apparent increase in plankton blooms either in terms of scale or duration or both with, in some instances, undesirable side effects such as toxicity or oxygen depletion as the blooms collapse and decay. Although there is considerable uncertainty about the comparability of analytical results over long time scales and, consequently, the extent to which apparent increases in nutrient levels in the marine environment are real, it is clear that inputs of nutrients from land-based sources have increased markedly in certain regions and these must have added to the nutrient pool.
4. The overall impression is that eutrophication is an issue which has not received the attention it deserves and could be a problem which threatens considerable areas of the world's shelf seas. Certainly the material gathered so far constitutes a proof of the insight of GESAMP XVI in agreeing to establish a working group to gather evidence on trends in nutrient concentration and plankton bloom events with a view to assessing the scale of the problem. The intended coverage of the review should provide answers to many of the current questions on issues such as trends in inputs, abnormal bloom occurrences, primary production and ecosystem changes.
5. Considerable use has already been made of the WHO Environmental Health Criteria report on Aquatic Biotoxins and of the results of the ICES Special Meeting on Exceptional Algal Blooms. Note will be taken of the outline of the Scientific Workshop on Eutrophication in the Mediterranean (2-6 March 1987) and of the Workshop on Study of Ocean Blooms and Red Tides to be held in Japan in the second half of 1987. The regional reports which are being prepared as part of the Review on the State of the Marine Environment will be scanned for relevant additional material. It is anticipated that the sub-group report will provide all the material on which to base a separate chapter on eutrophication problems in the Review on the State of the Marine Environment, if that is required.
6. Subjects expected to be covered are:
 - (i) Brief review of experiences in freshwater, including ground water; events, trends and effects in large lakes.
 - (ii) Definition and clarification of terms such as, for instance, blooms, exceptional blooms, eutrophication, hypenutritication, oligotrophic, etc., considered at a recent ICES meeting.
 - (iii) Forms of nitrogen, phosphorus and silicon - nutrients to be covered: description of their role in classical terms.

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