

UNITED NATIONS  
NEW YORK

FOOD AND  
AGRICULTURE  
ORGANIZATION  
OF THE UNITED  
NATIONS  
ROME

UNITED NATIONS  
EDUCATIONAL,  
SCIENTIFIC AND  
CULTURAL  
ORGANIZATION  
PARIS

WORLD HEALTH  
ORGANIZATION  
GENEVA

WORLD  
METEOROLOGICAL  
ORGANIZATION  
GENEVA

INTER-  
GOVERNMENTAL  
MARITIME  
CONSULTATIVE  
ORGANIZATION  
LONDON

INTERNATIONAL  
ATOMIC ENERGY  
AGENCY  
VIENNA



---

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

---

# **REPORTS AND STUDIES**

---

**Nº, 8**

1977

REPORT OF THE NINTH SESSION  
NEW YORK, 7-11 March 1977



**UNITED NATIONS**

IMCO/FAO/UNESCO/WMO/WHO/IAEA/UN Joint Group of Experts  
on the Scientific Aspects of Marine Pollution (GESAMP)

REPORT OF THE NINTH SESSION  
New York, 7-11 March 1977

UNITED NATIONS  
New York, 1977

## NOTES

1. GESAMP is an advisory body consisting of specialized experts nominated by the Sponsoring Agencies (IMCO, FAO, UNESCO, WMO, WHO, IAEA, UN). Its principal task is to provide scientific advice on marine pollution problems to the Sponsoring Agencies and to the Intergovernmental Oceanographic Commission (IOC).
2. This Report is available in English, French, Russian and Spanish from any of the Sponsoring Agencies.
3. The Report contains views expressed by experts acting in their individual capacities which may not necessarily correspond with the views of the Sponsoring Agencies.
4. Permission may be granted by any one of the Sponsoring Agencies for the Report to be wholly or partly reproduced in publications, provided that the source of the extract and the condition mentioned in 3 above are indicated.

For bibliographic purposes, this document may be cited as:

IMCO/FAO/UNESCO/WMO/WHO/IAEA/UN Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP).

Report of the ninth session held at United Nations Headquarters, New York, 7-11 March 1977. Rep.Stud. GESAMP (8)

# CONTENTS

	<u>Page</u>
I. OPENING OF THE MEETING . . . . .	1
II. EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS .	2
III. REVIEW OF HARMFUL SUBSTANCES IN THE MARINE ENVIRONMENT . . . . .	4
IV. SCIENTIFIC ASPECTS OF DEVELOPING CRITERIA FOR DETERMINING THE HARMLESSNESS OF MATERIALS LISTED IN ANNEX I OF THE LONDON DUMPING CONVENTION . . . . .	5
V. INTERCHANGE OF POLLUTANTS BETWEEN THE ATMOSPHERE AND THE OCEANS .	7
VI. MARINE POLLUTION IMPLICATIONS OF SEA-BED EXPLORATION AND COASTAL AREA DEVELOPMENT . . . . .	8
VII. SCIENTIFIC ASPECTS OF THE REMOVAL OF HARMFUL SUBSTANCES FROM WASTE WATER . . . . .	10
VIII. REPORT FROM THE FIRST MEETING OF THE WORKING GROUP ON BIOLOGICAL EFFECTS OF THERMAL DISCHARGES IN THE MARINE ENVIRONMENT . . . . .	12
IX. MONITORING BIOLOGICAL PARAMETERS OF MARINE POLLUTION . . . . .	14
X. FUTURE WORK PROGRAMME AND METHOD OF WORK . . . . .	16
XI. DATE AND PLACE OF THE NEXT SESSION . . . . .	18
XII. OTHER BUSINESS . . . . .	18
XIII. ELECTION OF CHAIRMAN AND VICE-CHAIRMAN FOR THE NEXT INTERSESSIONAL PERIOD AND FOR THE TENTH SESSION . . . . .	21
XIV. CONSIDERATION AND APPROVAL OF THE REPORT . . . . .	21

## ANNEXES

I. Agenda . . . . .	22
II. List of documents . . . . .	23
III. List of participants . . . . .	25
IV. Updating the review of harmful substances: critical criteria for evaluation of hazardous materials . . . . .	29
V. Members of the Working Group on the Evaluation of the Hazards of Harmful Substances . . . . .	31
VI. The pollution implications of sea-bed exploitation and coastal area development . . . . .	32

## I. OPENING OF THE MEETING

1. The Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) held its ninth session at United Nations Headquarters, New York, from 7-11 March 1977. The Chairman of GESAMP, Dr. G. Kullenberg, opened the session.
2. Mr. Vladimir Baum, Director of the Centre for Natural Resources, Energy and Transport of the United Nations Department of Economic and Social Affairs, welcomed the experts, the representatives of the sponsoring agencies and the observers from other organizations attending the session as a scientific advisory body in relation to many key issues in the United Nations Conference on the Law of the Sea and other major activities in which marine pollution is an important aspect. In a further opening address, Mr. Robert G. Muller, Director and Deputy to the Under-Secretary-General of the Office for Inter-Agency Affairs and Co-ordination, stressed the need for cohesion and co-ordination in the activities of all the various organizations of the United Nations system. He pointed to GESAMP as a good example of such co-ordination among its seven sponsoring organizations in the field of marine pollution.
3. The agenda for the session, as adopted by the Group, is shown in annex I and a list of documents considered by the Group under each agenda item is shown in annex II. This list includes information papers submitted by the sponsoring agencies summarizing their respective recent activities in the field of marine pollution.
4. A list of participants, comprising the experts, observers from interested organizations and representatives of the sponsoring agencies is shown in annex III. The Group noted with regret that Dr. Machta, Dr. Mosaev, Dr. Downing, Dr. Fukai, Dr. Smagin and Dr. Vigliani, who had been nominated as experts by their sponsoring agencies, could not attend the session.

## II. EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS

5. The Group noted a report on the Evaluation of the Hazards of Harmful Substances Carried by Ships (GESAMP IX/2) submitted by IMCO and introduced by the IMCO Technical Secretary. This included a summary of the outcome of the first session of the IMCO Sub-Committee on Bulk Chemicals (17-21 May 1976). In particular the Group noted that the tasks to be performed by the Sub-Committee under this item of its work programme should include the following:

- (a) Identifying substances being carried in bulk by sea which require evaluation;
- (b) Obtaining available information and data from Governments for evaluating the substances in accordance with the rationale (GESAMP IV/19/Supp.1);
- (c) Referring the substances and the available data to GESAMP for advice;
- (d) Utilizing, as appropriate, the hazard profiles established by GESAMP for individual substances;
- (e) Categorizing the substances in accordance with the criteria set out in appendix I to annex II of the 1973 Marine Pollution Convention;
- (f) Considering the substances for possible inclusion in the list annexed to the 1969 Intervention Protocol;
- (g) Making recommendations to the Marine Environment Protection Committee with a view to the adoption of appropriate amendments to the lists in appendices II and III of annex II of the 1973 Convention and to the list annexed to the Protocol.

The Group further noted that its task was to establish the hazard profiles for substances referred to it under (c) above and requested the Working Group to continue its work in close liaison with the IMCO Sub-Committee.

6. The Group was further informed of the outcome of the second session of the Sub-Committee (17-24 January 1977), particularly with respect to the arrangements made in order to obtain data for numerous substances for which product information was required by the GESAMP Working Group. In view of the large number of substances which have yet to be evaluated, the Group expressed the hope that Governments would take appropriate measures to make more resources available in order to carry out the tests and experiments which will be required to produce the necessary information and data.

7. The Group considered and approved the reports of the fourth and fifth sessions of the Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships, held at IMCO Headquarters, London, from 12 to 14 July 1976 and 22 to 24 November 1976 respectively, which were introduced by the Chairman, Dr. P. G. Jeffery.

8. In his introduction, Dr. Jeffery drew attention to the need for some revision in the membership of the Working Group. This particularly concerned the field of human toxicology because of difficulties experienced in obtaining the services of appropriate experts. The Group invited members to consider this problem and to inform the Chairman of the Working Group of any human toxicologists who might be available to participate in this work.

9. Some experts suggested that there may be a need to revise the methodology used in the rationale (GESAMP/IV/19/Supp.1), particularly with regard to assessment of the bioaccumulation hazard. Furthermore, the term "bioaccumulation" should be more specifically defined. It was pointed out that certain practical problems could arise if the methodology of the rationale was revised at the present time. Nevertheless, if such a revision is found to be necessary, a proposal could be made to the Marine Environment Protection Committee of IMCO indicating, if possible, what effect the proposed changes would have on the hazard ratings of substances. The Group requested the Working Group to take note of the above comments in relation to its future work.

10. Some experts drew attention to the advantages of storing hazard profiles and data relating to hazard evaluation in a computer as a means of facilitating the retrieval of such information and the co-relation and comparison of data and evaluations for various substances. They suggested that IMCO should make an effort to institute such a system as soon as possible, in view of the continuously increasing number of substances evaluated.

### III. REVIEW OF HARMFUL SUBSTANCES IN THE MARINE ENVIRONMENT

11. The Chairman of the Working Group, Dr. Ketchum, introduced the preliminary report (GESAMP IX/3) which resulted from one intersessional meeting at Woods Hole, Massachusetts, on 3-4 March 1977. A list of substances prepared by the WHO Scientific Group on Environmental Criteria was also included as an annex to the report.

12. The Working Group presented an outline of criteria for evaluation of hazardous materials (annex IV to this report) and suggested that the updating of the "Review of harmful substances ..." (GESAMP Reports and Studies, No. 2) could be accomplished by developing these criteria.

13. The method of work was discussed extensively and it was agreed that the priority task would not be a thorough revision of the existing "Review of harmful substances ..." but the preparation of a new document using an approach based upon consideration of a small number of selected substances. This would allow an assessment to be made as to whether criteria were generally applicable for the evaluation of hazardous materials.

14. It was agreed that the intersessional working group would be formed with experts in human health aspects and harm to living resources as well as other relevant aspects. Responsibility for the substantial aspects of the work programme would be undertaken by WHO and FAO. It was understood that the decision regarding the designation of a lead agency would be reached at the forthcoming intersecretariat meeting.



IV. SCIENTIFIC ASPECTS OF DEVELOPING CRITERIA FOR DETERMINING  
THE HARMLESSNESS OF MATERIALS LISTED IN ANNEX I OF THE  
LONDON DUMPING CONVENTION

15. The Group took note of a request (GESAMP IX/4) made by the First Consultative Meeting of Contracting Parties to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London, 20-24 September 1976), for advice concerning the development of criteria for determining the harmlessness of substances listed in paragraphs 1 to 7 of annex I of the Convention. The enquiry specifically referred to the provisions of paragraph 2 of annex I and requested GESAMP to study the scientific aspects of the problem and to submit its findings in time for the Second Consultative Meeting, to be held from 26-30 September 1977.

16. With a view to facilitating the task, the Technical Secretary of IMCO has referred the enquiry to the GESAMP Working Group on Evaluation of the Hazards of Harmful Substances Carried by Ships for preliminary consideration at its fifth session (22-24 November 1976). The Group noted and concurred with the view expressed by the Working Group that the problem does not arise with mercury, mercury compounds, cadmium, cadmium compounds, persistent plastics and other persistent synthetic materials (for example, netting and ropes) or high-level radio-active waste, but related only to organohalogen compounds, oils and materials produced for biological and chemical warfare.

17. In this connexion, the Group noted a report (GESAMP IX/4/Add.1) prepared by the IMCO Technical Secretary at the request of the Working Group, containing a summary of the work done in a similar context under the Oslo Commission with respect to article 5 and annex I of the Oslo Dumping Convention, which provide a comparable exemption for organohalogen compounds and organosilicon compounds.

18. After preliminary discussion of this topic in plenary, an ad hoc working group was formed to consider the matter in more detail and to formulate a framework that could be used for further work.

19. Subject to certain amendments, the Group generally agreed with the report of the ad hoc working group (GESAMP IX/4/W.P.1) and it was noted that, while there are many similarities between the London and Oslo Conventions, especially in the list of prohibited substances contained in annex I of each Convention, there seemed to be enough differences to warrant further consideration of the need for a fresh approach for determining the "harmlessness" of materials contained in annex I of the London Convention. At the same time the Group noted that it is the general policy of the Consultative Meeting that the implementation of the London Convention should be in harmony, as far as possible, with the implementation of regional instruments such as the Oslo Convention.

20. Several experts were of the opinion that the use of the term "harmlessness" in relation to annex I substances could be misleading. It was pointed out that the term was used in annex I only to refer to the processes rendering substances harmless.

21. The Group agreed that since this topic had been referred to it by IMCO, the Working Group on Evaluation of the Hazards of Harmful Substances Carried by Ships should be asked to undertake the work.

22. The Group requested the Chairman of the Working Group, in consultation with the Secretary of the Consultative Meeting and the IMCO Technical Secretary, to determine what additional expertise may be required in the Working Group for consideration of this question and to make arrangements accordingly.

23. The Group also requested the IMCO Technical Secretary, if appropriate, to inform the Second Consultative Meeting of the progress made by the Working Group on the understanding that its findings will be subject to approval by GESAMP at its tenth session, and to submit to the Consultative Meeting a comprehensive summary of the work carried out under the aegis of the Oslo Commission relating to this subject.

## V. INTERCHANGE OF POLLUTANTS BETWEEN THE ATMOSPHERE AND THE OCEANS

24. An informal meeting of GESAMP members of the Working Group on the Interchange of Pollutants between the Atmosphere and the Oceans was convened during the session on 8-9 March 1977 under the chairmanship of Dr. W. D. Garrett.

25. The meeting reviewed working papers which were prepared during the intersessional period. These papers were developed using an outline designed by the Working Group Chairman and covered the interchange of petroleum hydrocarbons, CO<sub>2</sub>, SO<sub>2</sub>, arsenic, cadmium, gaseous chlorine, zinc, copper, mercury and halogenated hydrocarbons. In addition, it was agreed that future work would include these substances and selected radio-nuclides and additional heavy metals and pathogenic organisms. It was also noted that mechanisms exist (e.g., bubble bursting and spray formation) whereby harmful substances may be transported from off-shore dump sites and other coastal areas onto land via the atmosphere, and the Working Group proposed to deal with these matters.

26. In general, the Working Group will primarily consider substances introduced by man's activities. Naturally introduced substances will be studied when they influence interchange processes, e.g., the role of organic sea surface films as an accumulation site for lipophilic substances. In this regard, it was noted that the Working Group on Ocean Atmosphere Materials Exchange (OAMEX), recently formed by the Scientific Committee on Oceanic Research (SCOR), will have broader terms of reference than the GESAMP Working Group. One of the group members, Dr. R. Chesselet, is also chairman of OAMEX, thereby providing a valuable liaison between the SCOR and the GESAMP groups. Through this arrangement, the overlap of activities performed by the two working groups could be held to a minimum.

27. It was stressed that pathways and interchange mechanisms are important items to be studied for each substance. This interchange study will also identify the harmful aspects of the substances, some of which may modify weather and climate and/or alter the properties of the air-sea interface.

28. The items under the terms of reference with priorities as specified in paragraph 38 of the report of the eighth session of GESAMP were assigned to the individual members of the Working Group. The Group recognized that a study of the interchange of pollutants between the atmosphere and the oceans is an important task and urged the Working Group to increase its efforts during the next intersessional period and to produce an interim report for the next session of GESAMP.

## VI. MARINE POLLUTION IMPLICATIONS OF SEA-BED EXPLORATION AND COASTAL AREA DEVELOPMENT

29. The Chairman of the Working Group, Dr. Cole, introduced the report which he characterized as an interim report resulting from one intersessional meeting, held at IMCO headquarters in London from 10-14 January 1977. The two different tasks described in the terms of reference of the Working Group which were given at the eighth session of GESAMP were reviewed.

30. The first was the examination of certain aspects of sea-bed exploitation not sufficiently covered by the previous Working Group on Scientific Aspects of Pollution Arising from the Exploration and Exploitation of the Sea-bed, which had completed its work at the eighth session. These priority items were:

(a) Marine pollution arising from exploitation of off-shore tin;

(b) Further study of dredging, including dredging for minerals and for maintenance of channels, but excluding the disposal of dredge spoils.

31. The second covered the formulation of guidelines for the assessment of the marine pollution implications of specific coastal area developments, particularly for the purpose of providing assistance to developing countries.

### Off-shore tin mining

32. The Group was advised that the sections of the report concerning off-shore tin exploitation and dredging should be considered for publication as part of the final report of the previous Working Group (GESAMP Reports and Studies, No. 7).

33. After a discussion of the tin mining operation, which emphasized the physical nature of the process and the lack of chemical beneficiation or refining, the Group approved this section of the report for inclusion in the publication, with certain amendments, in particular the following:

#### Page 3, paragraph 12, line 3

Add Certain tin compounds can be biologically alkylated in the marine environment, and the compounds produced are known to be highly toxic. Analytical methods for their estimation at very low concentration have not yet been fully developed. There is, however, no evidence to suggest that such substances are produced in the off-shore mining of tin.

The procedures for separation and enrichment of the tin mineral, cassiterite, are entirely mechanical. No chemical agents are added during the process.

### Dredging

34. The dredging section was also discussed and certain amendments were accepted. Note was taken of the serious problems which may arise in the disposal of dredge spoil, but these were excluded from the terms of reference. This section was also approved for publication with GESAMP Reports and Studies, No. 7.

### Guidelines for the assessment of the pollution implications of coastal area development

35. The guidelines section of the report, which was of an interim character, elicited considerable discussion, and written suggestions for the improvement of certain paragraphs of the preliminary report (paras. 20-104) have been received and others have been promised. They will be fully considered at the next meeting of the Working Group.

36. The Group commended the broad range of concerns included in the present report. The Group considered it necessary to examine the observations and measurements required for assessing the pollution implications of specific examples of coastal area development, such as deep-water ports and dredging in contaminated areas. In addition, it was suggested that citations be included with regard to specific points in the report as well as a general list of references. The Group agreed that the work on the preparation of guidelines for assessment of the pollution implications of coastal area development be continued during the coming intersessional period.

## VII. SCIENTIFIC ASPECTS OF THE REMOVAL OF HARMFUL SUBSTANCES FROM WASTE WATER

37. Following the discussions held in the plenary on an introductory paper by the WHO Technical Secretary (GESAMP IX/7), concerning the scientific aspects of the removal of harmful substances from waste water, an ad hoc working group was formed under the chairmanship of Dr. Thompson to review the draft proposal prepared by WHO for the ninth session of GESAMP, taking into account the outcome of these discussions.

38. Attention was drawn to "Management of Waste Disposal" (GESAMP IV/19/annex VI) and also to a letter from Dr. Slaczka of UNESCO (GESAMP IX/12/1) dealing with the concept of "self-purification" of the marine environment. Also it was noted that article IX of the London Dumping Convention deals with means of treatment.

39. The discussion of the ad hoc working group may be summarized as follows:

(a) A review is needed of present-day technology of waste treatment in relation to the efficiency of both conventional and non-conventional processes. This review should utilize a "total system" approach;

(b) Evaluation of relevant aspects of the environmental impact of waste treatment are needed, e.g., sludge removal and disposal, nutrient discharges to confined water bodies, the potential environmental recycling of substances such as Hg, the relative contribution of other sources of pollutants such as rivers;

(c) Reviews of waste treatment by GESAMP should be limited to their scientific aspects and should avoid, as far as possible, going into design, construction or economic aspects and should be limited to selected harmful substances causing major concern;

(d) Any review should be done with an awareness of regional waste treatment efforts such as currently under way in the Mediterranean and new national legislation governing requirements for effluent qualities and marine environmental qualities in dumping controls;

(e) The review should consider new methods for evaluating efficiencies of waste treatment by using indices which are related to significant marine effects of broad geographical distribution including long-term effects.

40. The Group agreed to set up a Working Group on the Scientific Aspects of Removal of Harmful Substances from Waste Water, with the following terms of reference:

(a) To prepare a limited updating of the paper "Management of Waste Disposal" (GESAMP IV/19/annex VI) and a limited bibliography on conventional waste water treatment for inclusion in this report;

(b) To examine the efficiency of removal of Cd, Hg and PCBs in the processes available for the treatment of municipal and industrial waste water when the effluent is to be discharged into the coastal waters;

(c) To identify parameters relating to ecological effects of pollutants by which treatment efficiency could be evaluated.

41. The Group recommended that WHO take the initiative in conducting the activity on the lines indicated above, subject to the availability of funds and following normal procedures adopted for the establishment of working groups. The FAO Technical Secretary expressed the wish of his organization to be associated with the work. The Group recommended that Dr. Thompson should act as Chairman of the Working Group, which would also include Prof. Mendia, Dr. Kamath, Dr. Jernelöv as well as any other member selected by WHO in consultation with FAO and the Working Group Chairman.

VIII. REPORT FROM THE FIRST MEETING OF THE WORKING GROUP ON  
BIOLOGICAL EFFECTS OF THERMAL DISCHARGES IN THE  
MARINE ENVIRONMENT

42. The members of the Working Group on Biological Effects of Thermal Discharges in the Marine Environment met on 5 March 1977 at United Nations Headquarters in New York under the chairmanship of Dr. Berge to prepare a draft working plan for submission to the ninth session of GESAMP (GESAMP IX/8).

43. The Working Group considered its terms of reference (GESAMP VIII/11, para. 67) and understood that the tasks should be to:

- (a) Identify and evaluate available literature;
- (b) Summarize and highlight significant aspects of the thermal discharge problems, especially in the context of the effect on living resources;
- (c) Facilitate the development of guidelines for site selection for thermal discharges.

These tasks were recognized as valuable in providing the basis for two levels of decisions. First, the Working Group would provide the most significant criteria for initial site selection for thermal discharges. Secondly, the Working Group would provide advice on research objectives which must be achieved for a scientific evaluation of the impact of an initially selected site.

44. It was considered that GESAMP expertise on the effects and impact of substances in the marine environment should be utilized in relation to the scientific inquiry into the impact of thermal discharges. Examples would be the potential synergistic effects in limited areas of thermal discharges in combination with other pollutants which have been studied by GESAMP, for example, "Impact of oil in the marine environment", (GESAMP Reports and Studies, No. 6), "Principles for developing coastal water quality criteria" (GESAMP Reports and Studies, No. 5), "Hazard evaluation of noxious substances transported by ships" and "Review of harmful substances" (GESAMP Reports and Studies, No. 2), and "Scientific criteria for the selection of sites for dumping of wastes into the sea" (GESAMP Reports and Studies, No. 3). Special emphasis should be placed on the interaction of thermal discharges on the turnover of bioaccumulative substances in the aquatic system.

45. The Group approved the plan, in principle, and agreed with the Working Group that action be delayed until the UNESCO International Hydrological Programme (IHP) report be made available. In this context, the UNESCO Technical Secretary was asked to provide the Working Group with early copies of the final version of the IHP Report. In the discussion it was decided that the Working Group should retain the original terms of reference, but that in its consideration it should include synergistic effects of entrainment, of the shutting-down of power plants, of screen impingement and effects of biocides, as well as of heat induced changes in physical and chemical parameters of sea water.



46. It was understood with regret that Dr. Berge would be unable to continue to serve on the Working Group, and Dr. Pravdic was appointed Chairman. The membership of the Working Group (Drs. Thompson and Pravdic) was broadened by inclusion of the following members of GESAMP: Dr. Jernelov; Dr. Kamath; and Mr. Gerard. It was recognized that it was the task of the Chairman of the Working Group, in consultation with the FAO Technical Secretary, to nominate outside experts. The Group pointed to the value of a joint IHP-GESAMP member, and to the necessity to consider membership based on different regional experience and on the value of interdisciplinary representation.

## IX. MONITORING BIOLOGICAL PARAMETERS OF MARINE POLLUTION

47. The UNESCO Technical Secretary recalled that UNESCO had announced its interest in the subject at the eighth session of GESAMP at which time UNESCO had expressed its intention to submit proposals to the ninth session of GESAMP for establishing a working group to re-examine the feasibility of monitoring biological parameters of marine pollution. The background information for this proposal was prepared by Dr. Bengtsson at the request of UNESCO and was submitted for consideration by the Group (GESAMP IX/9).

48. In presenting that document, Dr. Bengtsson stressed that he had considered the subject of biological monitoring of marine pollution in a general way in order to make a statement on the importance of the problem and to review the state of the art of biological monitoring. In proposing wide terms of reference for the Working Group, Dr. Bengtsson asked the Group to consider how it could contribute most usefully to this complex and difficult problem.

49. During the discussions that followed, some doubts were expressed about the proposals as presented. It was considered that the terms of reference were so wide that the objectives for the proposed working group were unclear, and that further attention should be given to defining more precisely the role of biological monitoring. It was suggested that biological monitoring should not be considered in isolation but that attention should be given to associating a simple form of it with existing regional and global monitoring programmes. The suitability of techniques currently employed in other disciplines, such as medicine, pharmacology or fisheries sciences, should also be actively investigated. Several experts expressed their doubts about the feasibility of carrying out any meaningful biological monitoring at this time, pointing out the logistical and technical problems of sampling and the difficulties in ascribing significance or causation to observed changes in biological variables. Although considerable difficulties in undertaking this type of work existed, it was generally felt that there was a great need for assessing the biological effects of marine pollution and that GESAMP should attempt to give guidance on the most appropriate procedures for assessment.

50. The attention of the Group was drawn to similar studies being undertaken by other bodies such as the International Council for the Exploration of the Sea (ICES). The ICES Working Group on Pollution Baseline and Monitoring Studies in the Oslo Commission and International Commission for the Northwest Atlantic Fisheries (ICNAF) areas has established a subgroup to study the feasibility of effects monitoring in the marine environment. The conclusions and recommendations reached to date by the subgroup have been endorsed by the ICES Working Group and are to be published shortly. Regional monitoring programmes were already under way. They included a number of simple biological parameters of effects. The Group was concerned that the proposed working group would duplicate work already being done.

51. Consequently, an ad hoc group was established to consider the comments of the Group, with particular regard to clarifying the intentions of monitoring biological

variables and to advise whether, at this time, GESAMP could make a significant contribution to the problem by the establishment of a working group.

52. The ad hoc group considered that there was a need for monitoring the biological effects of marine pollution and that GESAMP could play a useful role by establishing principles and drawing up guidelines for the practical implementation of these principles.

53. The ad hoc group recommended that the proposed working group on the monitoring of biological variables related to marine pollution should be set up, and it submitted terms of reference for consideration by the Group.

54. Following further discussions in plenary, the Group endorsed the formation of the working group with, in order of priority, the following terms of reference:

(a) To formulate a rationale for monitoring biological variables taking into account existing and planned regional and global monitoring programmes, paying particular attention to those which include monitoring of biological variables;

(b) To determine the scientific requirements for monitoring relevant biological variables;

(c) To assess the feasibility of establishing practical procedures for the monitoring of biological variables related to marine pollution.

55. The Group agreed that this Working Group should consist of Dr. K. Wilson (Chairman), Dr. B. Bengtsson, Dr. R. Chesselet and Dr. G. Kullenberg, as well as additional members, as required, from outside GESAMP, to be appointed by the Chairman in consultation with the Technical Secretaries of UNESCO and other interested sponsoring agencies. The Group asked the Working Group to submit an interim report to the next session of GESAMP.

## X. FUTURE WORK PROGRAMME AND METHOD OF WORK

56. The Group noted that intersessional work would continue or be initiated by working groups on the following subjects; the sponsoring agencies indicated in parentheses are the "lead" agencies responsible for organizing the intersessional work:

(a) Evaluation of the hazards of harmful substances carried by ships, which should also include consideration of the scientific aspects of developing criteria for determining "harmlessness" of materials contained in annex I of the London Dumping Convention (IMCO);

(b) Review of harmful substances (United Nations/WHO/FAO; lead agency to be determined at intersecretariat meeting);

(c) Interchange of pollutants between the atmosphere and the ocean (WMO);

(d) Marine pollution implications of sea-bed exploitation and coastal area development (United Nations);

(e) Scientific aspects of the removal of harmful substances from waste water (WHO in co-operation with FAO);

(f) Biological effects of thermal discharges on the marine environment (FAO);

(g) Monitoring of biological variables related to marine pollution (UNESCO).

57. The Group noted that there had been difficulties in carrying out intersessional work for the present session due to a lack of financial resources and expressed the hope that the situation would be improved during the forthcoming intersessional period so as to enable the working groups to make satisfactory progress. In this connexion, the Group appreciated the support provided by UNEP and took note of the statement by the observer from UNEP that that programme should not be considered as a funding agency for the work developed through or by GESAMP but rather as a collaborating partner ready to use its funds for the support of those GESAMP activities which are in the field of UNEP's interest and priorities. UNEP will, therefore, consider being associated with each of the working groups for which financial assistance will be provided.

58. The Group considered a note prepared by the Chairman (GESAMP IX/10) reviewing its objectives, functions and working procedures and presenting certain views and suggestions on the method of work. The main purpose of this exercise was to have a free and informal exchange of views among experts on possible ways and means of improving the efficiency and quality of GESAMP's work.

59. The main points raised during the discussion included the following:

(a) It is desirable for the experts nominated by the agencies to cover as many disciplines and as wide a geographical representation as possible;

(b) It is important to maintain continuity by retaining the services of a sufficient number of experts for a reasonable number of sessions;

(c) It would be helpful if the sponsoring agency seeking advice from GESAMP could put the question as clearly and specifically as possible;

(d) Whereas GESAMP would be a suitable forum to deal with questions of an interdisciplinary nature, questions involving single disciplines might be better dealt with by the relevant agencies themselves;

(e) The present system of employing intersessional working groups on specific tasks should, in general, continue, including the preparation of papers for discussion on specific items by individual experts;

(f) The main responsibility for organizing intersessional work should rest with the Technical Secretary of the "lead" agency rather than the experts concerned;

(g) Working group meetings should be held well ahead of GESAMP sessions to allow sufficient time for circulation and study of their reports by GESAMP members prior to the session and should not be held immediately before a session except in special circumstances;

(h) Agencies should consider ways and means for improving documentation storage, publicity and information services relating to GESAMP work;

(i) Since GESAMP operates under the terms of its Updated Memorandum, the Group felt that experts nominated by the agencies should be given a copy of the Updated Memorandum and Guidelines at the time of their nomination to GESAMP;

(j) In the course of their work, working groups may seek expert advice and review from sources outside GESAMP when appropriate.

60. The group felt that the above exchange of views was very useful and agreed that the Administrative and Technical Secretaries, as well as experts, should take them into account in organizing the future work of GESAMP.

## XI. DATE AND PLACE OF THE NEXT SESSION

61. The Group was informed that UNESCO will act as host agency for the tenth session of GESAMP, which is expected to be held in Paris in March/April 1978. The exact dates of the session will be determined later.

## XII. OTHER BUSINESS

### Enquiry from the Legal Committee of IMCO concerning the possible extension of the 1969 Civil Liability Convention

62. The Group took note of an enquiry (GESAMP IX/12) addressed by the Legal Committee of IMCO to member States and various IMCO technical bodies as well as to GESAMP, seeking information and views regarding the possible extension of the International Convention on Civil Liability for Oil Pollution Damage, 1969, to cover oils not presently included in the Convention and substances other than oil.

63. Having considered the questionnaire attached to the enquiry, the Group noted that, under its present terms of reference, it could only consider matters requiring scientific evaluation or judgement in the field of marine pollution as defined in its Updated Memorandum. In this context, the work carried out on evaluation of the hazards of harmful substances carried by ships and on the impact of oil in the marine environment would be particularly relevant. The Group, therefore, requested the IMCO Technical Secretary to bring the following reports and studies to the attention of the Legal Committee:

(a) Report of an Ad Hoc Panel of IMCO and GESAMP Experts to Review the Environmental Hazards of Noxious Substances other than Oil Transported by Ships (GESAMP IV/19/Supp. 1);

(b) A comprehensive list (to be prepared by IMCO) of all the substances evaluated to date, and their respective hazard profiles;

(c) Report on the Impact of Oil on the Marine Environment (GESAMP Reports and Studies, No. 6).

64. With regard to the questionnaire, the Group noted and concurred with the views expressed by the Working Group on Evaluation of the Hazards of Harmful Substances Carried by Ships, particularly with regard to their uncertainty as to the meaning of the word "toxicity" in question 1.5. This raised some doubt as to how the term "marine pollution" is defined for the purposes of the Legal Committee's work on this subject. It was suggested that with a view to assisting the Committee in this respect, the GESAMP definition and the rationale established by GESAMP might be brought to the attention of the Committee.

Technical assistance in relation to the  
London Dumping Convention

65. The Group was informed that, in implementation of article IX (c) of the London Dumping Convention concerning the promotion of technical assistance on "the disposal and treatment of waste and other measures to prevent or mitigate pollution caused by dumping", a manual or guidelines might be prepared for guidance to developing countries and that this task might be undertaken by GESAMP. The Group, noting that this subject was closely related to agenda item 7 dealing with scientific aspects of the removal of harmful substances from waste water, agreed that the Working Group on that subject should also take into account the relevant provisions of the London Dumping Convention when considering the matter (see para. 38 above).

66. The Group was further informed that other technical assistance activities in the implementation of the London Dumping Convention would include the compilation of:

(a) A list of experts who might be available to provide technical assistance to parties which request it; and

(b) A bibliography of reports, publications and other documents containing data and information relating to pollution by dumping.

67. In order to assist the IMCO secretariat in these matters, the Group invited its members to provide the IMCO secretariat with any appropriate references and names and addresses of possible experts for this purpose.

Review of existing manuals on marine  
pollution methodology

68. The UNESCO Technical Secretary drew the attention of the Group to the resolution adopted by the first session of the Working Committee for the Global Investigation of Pollution in the Marine Environment (GIPME). That resolution invited GESAMP to review existing manuals on marine pollution methodology published by United Nations agencies and some other international organizations, with a view to identifying any conflict between such manuals.

69. The Group, while agreeing in principle on the desirability of avoiding incompatibility which might exist in various methodologies adopted in existing manuals, felt that this task was not, strictly speaking, of an interdisciplinary nature but would involve detailed examination of different methodologies by experts actually engaged in work in this field.

70. After discussion, the Group concluded that GESAMP might not be a suitable body for this task and suggested that the Working Committee for GIPME consider the possibility of establishing a special task team to undertake this work.

71. It was pointed out that, in any event, it would be necessary to prepare a list of manuals to be reviewed and to obtain the consent by the Agency or the organization which produced the relevant manuals before they were included in such a list.

"Self-purification" of the marine environment

72. The UNESCO Technical Secretary suggested that GESAMP should consider the possibility of establishing a new working group on "self-purification" of the marine environment. In this context the term "self-purification" should be understood to mean all physical, chemical and biological processes occurring in the marine environment that convert harmful substances in the sea into harmless compounds or that diminish their concentration below the dangerous levels. He informed the Group that UNESCO would, during the intersessional period, prepare a background paper and draft terms of reference of the working group for consideration at the next session, if the Group agreed to the establishment of such a working group.

73. The Group felt that, although "self-purification" was an important subject, the task involved would cover a wide range of problems dealt with by the Group under various agenda items and it might not be practicable or productive to establish a separate working group for this purpose. It was pointed out in this connexion that the term "self-purification" might not be appropriate and some more suitable term should be used.

74. The Group noted that the International Hydrological Programme (IHP) was considering this subject mainly in the context of inland and fresh-water pollution, and requested the UNESCO Technical Secretary to make available to GESAMP the progress of IHP work in this field.

75. The Group considered that the achievement of the objective in UNESCO's suggestion would be facilitated if the Working Group on the Scientific Aspects of Removal of Harmful Substances from Waste Water and the Working Group on the Review of Harmful Substances would take this subject into account. The Group, therefore, requested the UNESCO Technical Secretary to bring the information on this subject to the attention of those Working Groups, as well as to the next session of GESAMP. Both Working Groups are requested to consider these matters and make recommendations as to whether a new working group should be formed.



**XIII. ELECTION OF CHAIRMAN AND VICE-CHAIRMAN FOR THE NEXT  
INTERSESSIONAL PERIOD AND FOR THE TENTH SESSION**

76. The Group unanimously re-elected Dr. G. Kullenberg Chairman and Dr. C. H. Thompson Vice-Chairman for the next intersessional period and for the tenth session of GESAMP.

**XIV. CONSIDERATION AND APPROVAL OF THE REPORT**

77. This report of the ninth session of GESAMP (GESAMP IX/14) was considered and approved by the Group on the last day of the session.

## Annex I

### AGENDA FOR THE NINTH SESSION OF GESAMP

#### Opening of the meeting

1. Adoption of the agenda
2. Evaluation of the hazards of harmful substances carried by ships
3. Updating of the Review of Harmful Substances in the Marine Environment
4. Scientific aspects of developing criteria for determining the harmlessness of materials contained in annex I of the London Dumping Convention
5. Interchange of pollutants between the atmosphere and the oceans
6. Marine pollution implications of sea-bed exploitation and coastal area development
7. Scientific aspects of removal of harmful substances from waste water
8. Biological effects of thermal discharges in the marine environment
9. Monitoring biological parameters of marine pollution
10. Future work programme and method of work
11. Date and place of next session
12. Other business
13. Election of Chairman and Vice-Chairman for the next intersessional period and for the tenth session
14. Consideration and approval of the report of the session

## Annex II

### LIST OF DOCUMENTS

No.	Agenda item	Author	Title
GESAMP IX/1	1	-	Agenda for the ninth session
GESAMP IX/2	2	IMCO	Evaluation of the hazards of harmful substances carried by ships
GESAMP IX/3	3	United Nations/WHO	Preliminary report of the working working group on the review of harmful substances in the marine environment
GESAMP IX/4	4	IMCO	Scientific aspects of developing criteria for determining the harmlessness of materials contained in annex I of the London Dumping Convention
GESAMP IX/4/Add.1		IMCO Technical Secretary	Summary of the work done by the Oslo Commission on the subject of agenda item 4
GESAMP IX/4/W.P.1		<u>Ad hoc</u> Working Group	Scientific aspects of developing criteria for determining the harmlessness of materials contained in annex I of the London Dumping Convention
GESAMP IX/5	5	<u>Ad hoc</u> Working Group	Interchange of pollutants between the atmosphere and the oceans
GESAMP IX/6	6	Working Group	Marine pollution implications of sea-bed exploitation and coastal area development. First report of the Working Group
GESAMP IX/7	7	WHO	Proposals for the formation of a working group on the scientific aspects of removal of harmful substances from waste water
GESAMP IX/8	8	Working Group	Biological effects of thermal discharges in the marine environment
GESAMP IX/9	9	UNESCO	Proposal for a working group on the monitoring of biological parameters of marine pollution
GESAMP IX/9/W.P.1		<u>Ad hoc</u> Working Group	Monitoring biological parameters of marine pollution

# LIST OF DOCUMENTS (continued)

No.	Agenda item	Author	Title
GESAMP IX/10	10	GESAMP Chairman	Background note on the future work programme and method of work
GESAMP IX/12	12	IMCO	Request by the IMCO Legal Committee for information and views in connexion with civil liability for pollution damage from substances other than oil as defined in the 1969 Oil Liability Convention
GESAMP IX/12/1	12	UNESCO	Future work programme
GESAMP IX/Inf.1		IMCO	Recent activities of IMCO in the field of marine pollution
GESAMP IX/Inf.2		FAO	Summary report of activities of FAO in the field of marine pollution
GESAMP IX/Inf.2/1		FAO/UNEP	Joint FAO (GFCM)/UNEP co-ordinated project on pollution in the Mediterranean. Report No. 1
GESAMP IX/Inf.3		UNESCO/IOC	Report on the work of UNESCO and its IOC in relation to marine pollution since the seventh session of GESAMP
GESAMP IX/Inf.3/Add.1		UNESCO/IOC	Information on the work of IODE
GESAMP IX/Inf.4		WMO	Summary report of activities of WMO in the field of marine pollution
GESAMP IX/Inf.5		WHO	Recent activities in the field of marine pollution and relevant subjects by WHO
GESAMP IX/Inf.6		IAEA	Report of the IAEA on its activities related to marine pollution
GESAMP IX/Inf.7		United Nations	Recent activities of the United Nations in marine affairs
GESAMP IX/Inf.8		IMCO	Consequence of oil pollution

Annex III

LIST OF PARTICIPANTS

Members of GESAMP

Dr. Bengt-Erik Bengtsson  
National Swedish Environment  
Protection Board  
Brackish Water Toxicology Laboratory  
Studsvik  
S-611 01 Nyköping, Sweden

Dr. G. Berge  
Institute of Marine Research  
Nordnesparken 2  
Bergen, Norway

Dr. R. Chesselet  
Centre des Faibles Radioactivités (CFR)  
Centre Nationale de la Recherche  
Scientifique (CNRS)  
Gif-sur-Yvette 91190  
France

Dr. H. A. Cole  
Forde House, Moor Lane  
Hardington Mandeville  
Yeovil BA22 9NW  
England

Dr. W. D. Garrett  
Naval Research Laboratory  
Ocean Sciences Division  
Washington, D.C. 20375  
United States of America

Dr. R. D. Gerard  
Senior Research Associate  
Lamont-Doherty Geological  
Observatory of Columbia University  
Palisades, New York 10964  
United States of America

Dr. P. G. Jeffery  
Department of Industry  
Warren Spring Laboratory  
Gunnels Wood Road  
Stevenage, Herts.  
England

Dr. A. B. Jernelöv  
Research Institute for Air  
and Water Pollution  
Stockholm, Sweden

Dr. P. R. Kamath  
Environmental Studies Section  
Health Physics Division  
Bhabha Atomic Research Centre  
Bombay 400 085, India

Dr. B. H. Ketchum  
Woods Hole Oceanographic Institution  
Woods Hole, Massachusetts 02543  
United States of America

Dr. G. Kullenberg (Chairman)  
Institute of Physical Oceanography  
University of Copenhagen  
Haraldsgade 6  
2200 Copenhagen, Denmark

Professor A. La Fontaine  
Institute of Hygiene  
and Epidemiology  
14, rue Juliette Wytsman  
1050 Bruxelles, Belgium

Professor L. Mendia  
Institute of Water Supply and  
Waste Disposal  
Faculty of Engineering  
University of Naples  
Piazzale Tecchio  
80125 Naples, Italy

Dr. V. Pravdic  
Center for Marine Research  
"Rudjer Bosković" Institute  
POB 1016  
41001 Zagreb, Yugoslavia

LIST OF PARTICIPANTS (continued)

Dr. C. H. Thompson  
Director, Office of Hazardous  
Materials Operations (MTH-1)  
US Department of Transportation  
Washington, D.C. 20590  
United States of America

Dr. M. Waldichuk  
Department of the Environment  
Fisheries and Marine Service  
Pacific Environment Institute  
4160 Marine Drive  
West Vancouver, B.C., Canada

Dr. K. W. Wilson  
Ministry of Agriculture,  
Fisheries and Food  
Fisheries Laboratory  
Remembrance Avenue  
Burnham-on-Crouch  
Essex CMO 8HA, England

Staff and representatives of the United Nations and  
specialized agencies

Inter-Governmental Maritime Consultative Organization (IMCO)

Mr. Y. Sasamura (Administrative Secretary of GESAMP)  
Director  
Marine Environment Division  
Inter-Governmental Maritime Consultative Organization  
101-104 Piccadilly  
London, W1V OAE, England

Mr. S. L. D. Young (Technical Secretary of GESAMP)  
Deputy Director  
Marine Environment Division  
Inter-Governmental Maritime Consultative Organization  
101-104 Piccadilly  
London W1V OAE, England

Food and Agriculture Organization of the United Nations (FAO)

Dr. G. Tomczak (Technical Secretary of GESAMP)  
Fishery Resources and Environment Division  
Food and Agriculture Organization  
Via delle Terme de Caracalla  
00100 Rome, Italy

United Nations Educational, Scientific and Cultural Organization (UNESCO)

Dr. W. Slaczka (Technical Secretary of GESAMP)  
United Nations Educational, Scientific and Cultural Organization  
7, Place de Fontenoy  
Paris, France

World Meteorological Organization (WMO)

Dr. I. Zrajevskij (Technical Secretary of GESAMP)  
World Meteorological Organization  
Case Postale No. 5  
1211 Geneva 27, Switzerland

World Health Organization (WHO)

Dr. R. Pavanello (Technical Secretary of GESAMP)  
Chief Sanitary Engineer  
Division of Environmental Health  
World Health Organization  
Avenue Appia  
1211 Geneva 27, Switzerland

International Atomic Energy Agency (IAEA)

Dr. C. L. Osterberg (Technical Secretary of GESAMP)  
International Atomic Energy Agency  
International Laboratory of Marine Radioactivity  
Musée Océanographique  
Monaco, Principauté de Monaco

United Nations

Dr. L. Neuman (Technical Secretary of GESAMP)  
Office for Ocean Economics and Technology  
Department of Economic and Social Affairs  
United Nations  
New York, NY 10017  
United States of America

Observers from international organizations

United Nations Environmental Programme (UNEP)

Dr. S. Keckes  
Geneva Liaison Office  
United Nations Environmental Programme  
Palais de Nations  
CH-1211, Geneva 10  
Switzerland

Intergovernmental Oceanographic Commission (IOC)

Dr. V. Zitko  
Biological Station  
Fisheries Board of Canada  
Department of Environment  
Fisheries Service  
St. Andrews, New Brunswick, Canada

International Council for the Exploration of the Sea (ICES)

Dr. G. Berge  
Institute of Marine Research  
Nordnesparken 2  
Bergen, Norway

European Inland Fisheries Advisory Commission (EIFAC)

Dr. P. G. Jeffery  
Deputy Director (Resources)  
Department of Trade  
Warren Spring Lab.  
Gunnels Wood Road  
Stevenage, Herts.  
England



#### Annex IV

### UPDATING THE REVIEW OF HARMFUL SUBSTANCES: CRITICAL CRITERIA FOR EVALUATION OF HAZARDOUS MATERIALS

#### I. Selection of substances

- A. Abundance (natural and additions by man's activities)
- B. Wastage - to environment
- C. Persistence in sea water and sediments
- D. Transformations in sea water, organisms and sediments
- E. Route to sea
- F. Toxicity
  - 1. To marine organisms - plants, animals
  - 2. To man or other mammals

#### II. Fate in marine environment

- A. Transfer to atmosphere
- B. Transfer to sediments
  - 1. Effects on benthic organisms
- C. Decay to innocuous substances
- D. Half-life in organism
- E. Dilution (site specific)
- F. Transport (site specific)

#### III. Evaluation of effects

- A. Local concentrations at source
- B. Ambient (SW) concentration, if any
- C. Type of effects
  - 1. Acute
  - 2. Sub-acute
  - 3. Chronic
    - a. Mutagenic
    - b. Teratogenic
    - c. Carcinogenic
  - 4. Interactions
    - a. Additive

- b. Synergistic
- c. Antagonistic

- D. Bioaccumulation
- E. Bioconcentration

IV. Mode of action on humans

- A. Contact sports
- B. Reduction of amenities
- C. Consumption of sea food and desalinated water
- D. Via atmosphere
- E. Destruction of human resources
- F. Through animal fodder and foods

V. Groups of humans exposed

- A. Occupation groups
- B. Critical groups (pregnant women, children)
- C. Critical pathways

VI. Anticipate unknown problems

- A. By-products of manufacturing processes (e.g., Kepone)
- B. New man-made organics, biotoxins

Annex V

MEMBERS OF THE WORKING GROUP ON THE EVALUATION OF THE HAZARDS  
OF HARMFUL SUBSTANCES

Dr. P. G. Jeffery (Chairman)  
Deputy Director (Resources)  
Warren Spring Laboratory  
P.O. Box 20  
Stevenage, Herts.  
England

Dr. J. E. Portmann  
Fisheries Laboratory  
Remembrance Avenue  
Burnham-on-Crouch  
Essex, England

Dr. C. H. Thompson  
Chief, Regulations Division  
Office of Hazardous Materials  
Operations MTH 20  
Department of Transportation  
Washington, D.C. 20590  
United States of America

Professor E. C. Vigliani  
Clinica del Lavoro  
Via San Barnaba 8  
Milan 20122, Italy

Dr. B-E. Bengtsson  
Brackish Water Toxicology Laboratory  
Swedish Environment Protection Board  
Studsvik S-611 01  
Nykoping, Sweden

Mr. L. Fyn  
Institute of Marine Research  
P.O. Box 2906  
5011 Bergen, Norway

Dr. D. M. M. Adema  
Central Laboratory TNO  
P.O. Box 217  
Delft  
Netherlands

Professor R. Truhaut  
Chaire de Toxicologie et d'Hygiène  
industrielle  
Faculté de Pharmacie  
Université de Paris  
Ave. de l'Observatoire  
Paris VI, France

IMCO Technical Secretary  
Mr. S. L. D. Young  
Marine Environment Division  
Inter-Governmental Maritime  
Consultative Organization  
101-104 Piccadilly  
London W1V OAE, England

## Annex VI

### THE POLLUTION IMPLICATIONS OF SEA-BED EXPLOITATION AND COASTAL AREA DEVELOPMENT

#### Contents

1. INTRODUCTION
2. TERMS OF REFERENCE
3. OFF-SHORE TIN DREDGING
4. DREDGING
5. FORMULATION OF GUIDELINES FOR THE ASSESSMENT OF THE POLLUTION IMPLICATIONS OF COASTAL AREA DEVELOPMENT
  - 5.1 INTRODUCTION
  - 5.2 ENVIRONMENTAL DATA REQUIREMENTS
    - 5.2.1 Oceanography and weather
    - 5.2.2 Sea-bed conditions
    - 5.2.3 Estuaries
    - 5.2.4 Living resources
    - 5.2.5 Existing discharges of sewage
    - 5.2.6 Existing discharges of industrial effluents
7. FUTURE PROGRAMME

#### List of members of the Working Group on the Pollution Implications of Sea-bed Exploitation and Coastal Area Development

##### GESAMP experts

Dr. H. A. Cole (Chairman)  
Forde House, Moor Lane  
Hardington Mandeville  
Yeovil BA22 9NW  
England

Dr. G. Kullenberg  
Institute of Physical Oceanography  
University of Copenhagen  
Haraldsgade 6  
2200 Copenhagen  
Denmark

Mr. R. D. Gerard  
Senior Research Associate  
Lamont-Doherty Geological Observatory  
of Columbia University  
Palisades, N.Y. 10964  
United States of America

Prof. L. Mendia  
Institute of Water Supply and Waste  
Disposal  
Faculty of Engineering,  
University of Naples  
Piazzale Tecchio  
80125, Naples  
Italy

Dr. M. Waldichuk  
Department of the Environment  
Fisheries and Marine Service  
Pacific Environment Institute  
4160 Marine Drive  
West Vancouver, B.C.  
Canada

Additional experts

Mr. M. J. Cruickshank  
United States Geological Survey  
Reston, Va.  
United States of America

Mr. B. Smale-Adams  
Rio Tinto Finance and Exploration, Ltd.  
London  
England

Mr. H. R. Oakley  
J. D. and D. M. Watson, Civil Engineers  
London  
England

United Nations Technical Secretary

Dr. L. D. Neuman  
Ocean Economics and Technology Office  
Department of Economic and Social Affairs  
United Nations  
New York  
United States of America