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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. 49

1992

**Report of the
Twenty-second Session
Vienna, 9–13 March 1992**



INTERNATIONAL ATOMIC ENERGY AGENCY

Doc 7-6

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

REPORT OF THE TWENTY-SECOND SESSION

Vienna, 9-13 March 1992

IAEA 1992

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) RESULTING 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 SEAWATER AND REDUCTION OF AMENITIES."

* * *

For bibliographic purposes, this document should be cited as:

GESAMP - IMO/FAO/Unesco/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP): Report of the Twenty-second Session. Vienna 9-13 March 1992. Rep. Stud. GESAMP No. 49, 66pp.

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GESAMP XXII
(9-13 March 1992)

1 INTRODUCTION

1.1 The Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) held its twenty-second session at the Headquarters of the International Atomic Energy Agency (IAEA), Vienna from 9 to 13 March 1992, under the chairmanship of Mr. D. Calamari. Mr. J. Gray was Vice-Chairman of the session.

Opening of the session

1.2 Mr. Jia-Luo Zhu, Director of the IAEA Division of Nuclear Fuel Cycle and Waste Management, on behalf of the Director General of the IAEA, welcomed the Group to this session. Mr. Zhu emphasized the importance of GESAMP as a multidisciplinary advisory body which brought a wide range of expertise to bear on problems put forward by the sponsoring agencies in relation to particular aspects of marine pollution. The IAEA has benefitted from the work of GESAMP over the years in particular with regard to issues related to the sea disposal of radioactive wastes. Mr. Zhu noted further the concern of the international community related to potential global environmental effects of human activities on this planet. He appreciated that GESAMP has taken action in providing an input to the forthcoming United Nations Conference on Environment and Development (UNCED) to be held in Brazil in 1992. Finally, Mr. Zhu wished the Group every success in this session.

1.3 The Chairman thanked Mr. Zhu on behalf of the participants for his good wishes for the success of this session.

1.4 The Chairman informed the Group that Mr. Michael Waldichuk (Canada) who had attended altogether fourteen sessions of the Group and was a Chairman of three GESAMP sessions, as well as of many GESAMP Working Groups, had died unexpectedly during the intersessional period. Mr. Waldichuk was recognized as one of the founding fathers of GESAMP and the Group considered his work and his impact on the development of GESAMP to be highly significant. The Group noted his passing away with deep regret.

Adoption of the agenda

1.5 The agenda for the session as adopted by the Group is reproduced in Annex I. The list of documents considered at the session is given in Annex II. The list of participants, shown in Annex III, includes a representative from Greenpeace International who was invited to discuss certain issues under items 2 and 3 of the agenda.

2 STATE OF THE MARINE ENVIRONMENT

2.1 Review of GESAMP Reports and Studies No. 39

2.1.1 The Group was informed of a request from IMO to respond to a critique submitted by Greenpeace to the Fourteenth Consultative Meeting of Contracting Parties to the London Dumping Convention (25-29 November 1991) (GESAMP XXII/2).

2.1.2 The Group noted that the Intersecretariat had agreed to invite two representatives from Greenpeace to attend the session when the comments of Greenpeace were discussed under this agenda item. Mr. Peter Taylor from Greenpeace was present.

2.1.3 The Chairman asked the Ex-Chairman (H. Windom), who had been involved in the preparation of the report on the State of the Marine Environment to describe the procedures used for the preparation of the report.

2.1.4 Work on the report had commenced in 1985. It is based on the reports of a number of GESAMP Working Groups as well as those of 12 review groups set up by UNEP, FAO and IOC on a regional basis, and also on the input from the GESAMP membership and that from invited experts from outside GESAMP. Members of GESAMP felt that the conclusions of the report are still valid. It was acknowledged that the report may eventually require updating and for this purpose a mechanism would have to be developed.

2.1.5 The Chairman informed Mr. Taylor that a response to the Consultative Meeting of Contracting Parties to the London Dumping Convention had been prepared as follows:

"GESAMP'S RESPONSE TO CONTRACTING PARTIES TO THE LONDON DUMPING CONVENTION REGARDING THE GREENPEACE CRITICISM OF GESAMP REPORTS AND STUDIES NO. 39 ON 'THE STATE OF THE MARINE ENVIRONMENT'"

GESAMP has considered the comments made by Greenpeace on GESAMP Reports and Studies No. 39 "The State of the Marine Environment", as requested by the IMO Technical Secretary on behalf of the Contracting Parties to the London Dumping Convention (LDC). These comments clearly indicate that Greenpeace has reservations about the basis for the conclusions drawn by GESAMP in this report. GESAMP nevertheless reassures the Contracting Parties to the LDC that, contrary to the views expressed by Greenpeace, the wide consultative process adopted in the preparation of this report lends authority to its conclusions. Accordingly, GESAMP believes that the document constitutes the most authoritative evaluation of conditions in the marine environment in recent years.

GESAMP would like to clarify the following points:

Ranking of Marine Environmental Problems

GESAMP's ranking, on a global basis, of marine environmental problems has been questioned by Greenpeace. The ranking was based on a wealth of scientific evidence contained in the 12 UNEP/IOC/FAO Regional Reviews, several recent GESAMP Reports and Studies, and the expertise of those involved in the review who were drawn from diverse disciplines. Greenpeace has not ranked problems and not offered perspective on the seriousness of the issues it raises.

Distinction between coastal and oceanic environments

Greenpeace's position that a distinction between coastal and oceanic waters was unscientific, is incorrect. GESAMP used a definition of coastal waters wherein the offshore coastal zone boundary is at the shelf break. Coastal waters have physical, chemical and biological properties that are distinctly different from those of oceanic waters. Recognizing such differences does not suggest that exchanges across coastal-oceanic boundaries are unimportant.

Cleanliness of the open ocean

GESAMP's statement that "open oceans are relatively clean compared to coastal waters" does not imply that the open oceans are

uncontaminated. GESAMP sees nothing in the Greenpeace comments which would contradict this view.

Impacts of settlements in the coastal zones

GESAMP stands by its conclusion that increased population densities and urban development of the coastal zone are primary causes of anthropogenic impacts on the marine environment. The problems caused by sewage, especially in the absence of sound management practices, illustrate this situation.

Acceptability of contamination

GESAMP accepts that it is important to distinguish between the assessment and the acceptability of environmental changes caused by substances and wastes. GESAMP indeed made judgements on scientific grounds but does not presume that these will always be acceptable on political, social and economic grounds (i.e. to society as a whole).

Notwithstanding the above remarks, GESAMP welcomes constructive comments on any of its reports, from Greenpeace or any other organization, as a means of improving both the scientific basis of these documents and their value to the international community."

2.1.6 The representative from Greenpeace made several suggestions on how a future review of the state of the marine environment should be carried out.

2.1.7 The Group noted the proposals and thanked Mr. Taylor for his constructive suggestions.

2.2 Emerging issues of concern

2.2.1 The Chairman asked members of the Group to introduce issues which had come to their notice in the last twelve months and which they considered worth the attention of the Group. Major topics raised by members of the Group were as follows:

- .1 The state of the Black Sea. Recently published data and information made available to the Group suggested that the Black Sea was in a much worse state than previously estimated. GESAMP expressed its deep concern about the deterioration of the environmental quality of the Black Sea that has occurred during the past few decades.
- .2 PCBs in cod liver in the Barents Sea. New data show levels of PCBs which are as high as those found in the North Sea. This raised questions concerning the sources involved, and as to whether the problem was a general one for areas in high latitudes.
- .3 Surface microlayer. Concerns have been expressed about the surface microlayer as a significant source of contaminant accumulation. In discussion, GESAMP raised questions as to the conditions under which the layer occurs and is modified, and on its significance for biological process and air/sea exchanges.
- .4 Algal toxins. Reference was made to sea bird mortality due to an algal toxin present in fish on the US West Coast. Related items discussed were the causes of changes in toxicity of algal species and the physical factors controlling the distribution of toxic algal blooms.

- .5 Low levels of organochlorines in marine mammals and birds. The continued uncertainty of the link between low levels of organochlorines was noted and mortality and pathology in marine mammals and birds were discussed.

2.2.2 GESAMP agreed to keep these items under consideration for possible inclusion in a future revision of the "State of the Marine Environment" report.

2.2.3 A member of the Group agreed to prepare intersessionally a short review on the significance of the surface microlayer for consideration by GESAMP XXIII.

3 COMPREHENSIVE FRAMEWORK FOR THE ASSESSMENT AND REGULATION OF WASTE DISPOSAL IN THE MARINE ENVIRONMENT

3.1 Review of GESAMP Reports and Studies No. 45

3.1.1 The IMO Technical Secretary introduced document GESAMP XXII/3 containing comments from Greenpeace on Reports and Studies No. 45 (1991) entitled "Global Strategies for Marine Environmental Protection". He explained that IMO had been requested by the Consultative Meeting of the Contracting Parties to the London Dumping Convention to relay the comments to GESAMP and to invite the Group to respond.

3.1.2 The Chairman welcomed the attendance of Mr. P. Taylor, a representative of Greenpeace, as an observer for this sub-agenda item.

3.1.3 The Chairman then informed Mr. Taylor that GESAMP had discussed the comments from Greenpeace in detail and had formulated its response as follows:

"GESAMP'S RESPONSE TO THE CONSULTATIVE MEETING OF CONTRACTING PARTIES TO THE LONDON DUMPING CONVENTION REGARDING THE GREENPEACE CRITICISM OF GESAMP REPORTS AND STUDIES NO. 45 'GLOBAL STRATEGIES FOR MARINE ENVIRONMENTAL PROTECTION'

The critique by Greenpeace contests many of the arguments and points of view that GESAMP has used to justify its proposal for a new and improved framework for marine environmental protection and management. Greenpeace questions GESAMP's motives in promoting a more structured approach to pollution control that would take full advantage of scientific knowledge and capabilities. GESAMP feels that this reflects a misunderstanding of the underlying purpose of the document.

GESAMP's consideration of strategic approaches to marine pollution control is predicated on the global state of the marine environment as described in the preceding GESAMP Reports and Studies No. 39 and other supporting scientific documents. In essence, there is clear evidence that certain sectors of the marine environment are seriously and adversely impacted by human activities and that remedial action is urgently required. GESAMP does not believe that this situation is due to a failure of science; rather, it is attributable to a failure to apply the best available knowledge and capabilities, both scientific and non-scientific, to environmental management.

Accordingly, the approach taken by GESAMP was to examine the many and various elements of environmental management. The next step was to search for linkages that would allow these elements to be combined into a common and comprehensive framework that would be globally applicable and consistent with the concept of sustainable development.

The framework developed by GESAMP is intentionally broad in scope. It contains elements that are inherently scientific and other elements that lie predominantly in economic, social and political spheres to which science merely acts in an advisory capacity. Assessments of risk and harm, and the acceptability of environmental change, are made at the political level. Such decisions will be strongly influenced by economic, social and political perspectives. However, scientific input is also legitimate and necessary. GESAMP believes that the absence of a comprehensive framework, identifying the essential elements of environmental management and protection, contributes to the continuing degradation of the oceans.

In summary, GESAMP Reports and Studies No. 45 seeks to stimulate debate on the opportunities for resolving environmental and development conflicts at national, regional and global levels. GESAMP welcomes responses and contributions that will lead to the development of the ideas contained in this report."

3.1.4 The above statement would be the basis of the response to the Consultative Meeting of the Contracting Parties to the London Dumping Convention and would be transmitted by IMO.

3.1.5 Mr. Taylor thanked the Group for having given him the opportunity to introduce Greenpeace comments. Mr. Taylor made a number of additional comments on Reports and Studies No. 45 to which the Group responded. The Group invited Greenpeace to produce its own version of global strategies for marine environmental protection and to publish this, as it feels appropriate.

3.2 Can there be a common framework for managing radioactive and non-radioactive substances to protect the marine environment?

3.2.1 The Group considered a study prepared by the GESAMP Working Group at a meeting held at IMO Headquarters, London, from 2 to 6 September 1991 under the Chairmanship of Mr. R. Boelens. The study (GESAMP XXII/3/1) was prepared in response to a question raised by the Inter-Governmental Panel of Experts on Radioactive Waste Disposal at Sea (IGPRAD) established under the London Dumping Convention, as follows:

"Examine the parallels between the regulatory approaches to, and environmental assessments of, the dumping at sea of both radioactive and non-radioactive wastes to identify opportunities for developing a common, comprehensive and holistic framework for the regulation of dumping at sea of all wastes".

3.2.2 The study prepared by the Working Group summarizes GESAMP Reports and Studies No. 45, reviews the principles and mechanisms designed to protect human health and the environment from excessive exposures to radioactive materials, and demonstrates the compatibility of the approaches currently used.

3.2.3 The Group discussed the study in detail and proposed a number of amendments which were included in the study (GESAMP XXII/3/1/Rev.1). After further discussion of the revised document during which some editorial changes were proposed, the Group adopted the study for publication as GESAMP Reports and Studies No. 45, Addendum 1. A summary is given in Annex IV.

4 REVIEW OF POTENTIALLY HARMFUL SUBSTANCES

4.1 Mutagenic and teratogenic substances

4.1.1 From a human health point of view, mutagenic and teratogenic substances may contribute to cancer induction and conversely carcinogenic substances are usually genotoxic. A brief review of the literature indicates that potentially mutagenic and teratogenic substances in the marine environment of major concern to human health are metals (e.g. Pb, Hg, Cd), organochlorine compounds (e.g. DDT, hexachlorocyclohexanes, PCBs), PAHs and components of oil.

4.1.2 An assessment of the carcinogenic risk to humans of most of these chemicals via exposure from seafood has been carried out in GESAMP Reports and Studies No. 46 "Review of potentially harmful substances: carcinogens". An additional GESAMP report "Review of potentially harmful substances: oil, and other hydrocarbons including used lubricating oils, oil spill dispersants and chemicals used in offshore exploration and exploitation" (in press) contains a detailed health risk assessment of oil and related products.

4.1.3 Based on these assessments, GESAMP concluded that a detailed review of potentially mutagenic and teratogenic substances is not warranted at this time.

4.1.4 There is limited information on mutagens and mutagenic effects in the marine environment. The probability is that these substances and effects may be relatively widespread. Nevertheless, the evidence available at present suggests that any harmful consequences on marine organisms are restricted in scale and significance. More research and study will be required to establish exactly how limited or serious the problems are, or might become. Until such information is available GESAMP urges caution, as with carcinogens, in relation to the release of known or suspected mutagens into the marine environment.

4.2 Organochlorine compounds

4.2.1 The FAO Technical Secretary informed the Group that no meeting was held by the sub-group on organochlorine compounds because no requests had been received from the Agencies to deal with specific hazard profiles.

4.2.2 The Chairman of the sub-group, Mr. R. Lloyd introduced document GESAMP XXII/4.3. He reported that general enquiries and a brief review of the literature indicated that there was indeed little information on the discharge of organochlorine substances, other than the persistent pesticides and PCBs to coastal waters. Studies were largely confined to analyses of concentrations of substances in the water (dissolved and/or total); there were no comprehensive data on loads, degradation and distribution between water, sediment and biota.

4.2.3 However, these studies showed that measurable amounts of the following substances can be found in certain estuaries and coastal waters:

Chloroform; 1,1,2-Trichloroethane; 1,1,2-Trichloroethylene;
1,1,2,2-Tetrachloroethylene; Chlorobenzene; Dichloroethane;
Dichloroethylene; Trichlorophenol.

4.2.4 The chairman of the sub-group proposed that GESAMP could review relevant information on these compounds within a QSAR (Quantitative Structure-Activity Relationship) framework. This would be a natural extension of the initial study published as GESAMP Reports and Studies No. 42., and a prediction of the likely distribution of these substances in the water, sediment and marine biota may encourage scientists to make the corresponding field measurements and assessments.

4.2.5 It was noted that a report is being prepared by the Mediterranean Action Plan on semivolatile organochlorinated hydrocarbons. That study proved the suitability of predictive models in the hazard assessment process for organochlorine compounds, and went some way towards satisfying the requests of GESAMP for verification of the applicability of predictive models. Also, progress was being made elsewhere in using QSARs to set water quality standards for homologous groups of compounds.

4.2.6 Taking into account also that to date no requests for specific hazard profiles have been received from the Agencies, the Group decided that there was no further need for work by the sub-group on organochlorine compounds.

4.3 Oil, and other hydrocarbons including used lubricating oils, oil spill dispersants and chemicals used in offshore exploration and exploitation.

Impact of oil and related chemicals and wastes on the marine environment.

4.3.1 The Technical Secretary of the International Maritime Organization introduced for consideration the draft final report prepared by the GESAMP sub-group on Oil, with the view to approval for publication in the Reports and Studies Series. The Chairman, Mr. P.G. Wells, gave a summary of the reviews considered, the major parts of the report that had received new attention, and the main points in the executive summary. He acknowledged the hard work of his Group during the last meeting from November 8 to 12 where the report was corrected, based on the technical reviews solicited during Summer 1991.

4.3.2 Comments and suggestions made by the GESAMP members based largely on the executive summary included the following:

- .1 it should be explained why tropical coastal ecosystems are particularly vulnerable and sensitive to oiling;
- .2 sections on the recovery of oiled seagrasses should be modified;
- .3 the problem of crankcase oil in coastal waters in developing countries should receive more emphasis;
- .4 the executive summary should be edited for clarity and emphasis of the main messages;
- .5 some numbers describing inputs should be revised to reflect the correct precision, and the ranges should be given;
- .6 the Gulf War spill should be mentioned with input figures;
- .7 health assessment for lead should be revised using more recent information (i.e. GESAMP Reports and Studies No. 46);
- .8 the usefulness, as currently understood, of bioremediation agents should be highlighted;
- .9 general terms such as "small" or "many" should be quantified wherever possible, in the executive summary;
- .10 the change in transportation routes since the last report should be described if data are available;
- .11 the need for more information regarding land-based sources of oils should be highlighted;

4.3.3 The Chairman of the sub-group undertook to include the proposed amendments in the final report.

4.3.4 The Group agreed that the report be adopted for publication in the Report and Study Series as No. 50. The contents of the report are reflected in Annex V.

5 IMPACTS OF ANTHROPOGENICALLY MOBILIZED SEDIMENTS IN THE COASTAL ENVIRONMENT

5.1 In the absence of the Technical Secretary from UNESCO, the Chairman of the Working Group Mr. J. Gray, presented the report. In outlining the history of the Working Group, the Chairman conveyed the view that the Working Group had not been adequately funded to complete its task. Both the Chairman of the Working Group and the Group itself felt that the coverage of the report was uneven and did not reflect a truly expert review of the subject.

5.2 In discussion, GESAMP confirmed its opinion that the impacts of anthropogenically derived sediments on marine ecosystems was a serious and important problem and that a report was needed. However, and as indicated in the report to date, this subject should be considered on a more holistic non-sectoral basis. This issue was particularly important if the ultimate aim is to provide a sound scientific basis for coastal zone management.

5.3 As the Working Group reported, increased inputs of sediments to coastal areas may result in deleterious effects such as harm to living resources, hindrance to marine activities and reduction of amenities. The report also indicated that deleterious effects may result from decreased sediment inputs to coastal areas.

5.4 In view of the Working Group's findings, and the further sessional discussion of this topic by GESAMP Experts, it was recommended that this Working Group should continue its efforts but that its terms of reference (see report of the nineteenth session, item 8(c)) should be modified to reflect the need for a more holistic river-basin scale evaluation of the problem with the aim of providing a more appropriate scientific framework for managing the impacts of changing sediment inputs to coastal zones. The new terms of reference represent a refinement of the nine items previously listed, based on experience gained in preparing the draft report (GESAMP XXII/5). These are as follows:

- .1 Review and quantify where possible the effects of land-based human activities on sediment transport rates and volumes in relation to watershed characteristics;
- .2 Review on a regional basis the known and potential impacts of changes in sediment flux to coastal and near-shore waters on coastal environments, resources, amenities and human use; and
- .3 Develop conceptual models that would provide a better understanding of the time scales which connect watershed activities and coastal impacts in different watershed types and regions.

6. EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS

6.1 The IMO Technical Secretary gave a short outline of the achievements of the Working Group on the "Evaluation of the Hazards of Harmful Substances Carried by Ships", and the use of the results of the work by IMO bodies.

6.2 The Chairman, Mr. P.G. Wells, gave a brief summary of the work accomplished at the 26th session of the Working Group (London, 8-12 April 1991), covering intersessional work, correspondence with the chemical industry, evaluation of the various categories of substances, review of hazard profiles of several specific groups of chemicals, consideration of copper and copper compounds, consideration of floating chemicals, marine toxicity testing schemes, data computerization and specific issues on lube-oil additives, the carriage of petroleum solvents and coal tar fractions.

6.3 A number of comments were received from the GESAMP members, including:

- .1 the request that current application of the definition of column A ratings be carefully compared to previous studies and that the bioaccumulation ratings be re-examined;
- .2 observations of considerable differences of values reflecting toxicity to fish versus crustaceans are common; high toxicities measured in tests may also be due to artifacts in the exposure conditions;
- .3 consideration should be given in the future to a subdivision of Category 4, Column B, where LC50's are below 1 mg/l.

6.4 The Group also expressed concern about the large number of petrochemicals discharged and carried under conditions of MARPOL 73/78, Annex I rather than under Annex II of the Convention.

6.5 The Chairman undertook to transmit the above suggestions and comments to the Working Group for consideration at the next meeting.

6.6 The contents of the report of the Working Group are listed in Annex VI.

7. ENVIRONMENTAL IMPACTS OF COASTAL AQUACULTURE

7.1 The FAO Technical Secretary recalled that at the twenty-first session of GESAMP, the Chairman of the Working Group, Mr. Chua Thia-Eng had been requested to prepare a scoping document on the feasibility of undertaking work on the following subject areas:

- .1 the preparation of a comprehensive review on viral, bacterial and parasitic human diseases associated with coastal aquaculture operations covering potential health risks, prophylactic measures and hygienic surveillance schemes;
- .2 the establishment of monitoring procedures for aquaculture-specific pollutants leading to the assessment of the environmental capacity of aquaculture operations;
- .3 the formulation of guidelines for the safe use of chemicals in coastal aquaculture based on drug-specific information, including mode of use, drug withdrawal times and environmental fate; and
- .4 the formulation of a preliminary aquaculture-specific contingency plan for red tide outbreaks.

7.2 The Chairman of the Working Group, introduced a document (GESAMP XXII/7), which he had prepared to identify critical areas in present and future coastal aquaculture activities that require interventions to reduce impacts on the environment and on human health. He reported that there had been very little response from experts and agencies contacted for contributions to the paper, and that he was not very optimistic on what could

be achieved in the future by correspondence, taking into account that due to financial constraints, it was unlikely that the Working Group could meet during the forthcoming intersessional period. Furthermore, a number of international bodies are currently working on a number of related subjects, e.g. FAO/WHO on the Codex Alimentarius, ICES (International Council for the Exploration of the Sea), ICLARM (International Center for Living Aquatic Resources Management), NACA (Network of Aquaculture Centers in Asia). A number of relevant meetings have been convened recently on the above and related issues.

7.3 The Group pointed out that it is important and a matter of urgency to regulate the use of chemicals and drugs in coastal aquaculture in developing countries where most coastal aquaculture practices occur. However, it was recognized that even in developed nations, compiling information on the use of such substances turned out to be difficult, and progress in this direction has been slow.

7.4 Mr. Chua proposed to either disband the Working Group or to keep it in abeyance for one year to await the outcome of the work of the other groups. A subject which however could be tackled without waiting for the results from the other groups, would be the compilation of practical guidelines for environmentally sound management of aquaculture in developing countries. Such guidelines would be very useful and timely.

7.5 In view of the considerable importance of aquaculture in the coastal regions of developing countries, and the concomitant potential for environmental damage being caused by such activity, the Group recommended that the Working Group should remain in existence for a further year with the following limited terms of reference:

- .1 the Working Group should consider the preparation of general guidelines for aquaculture development within the overall framework of Integrated Coastal Zone Management; these should include in particular the need to avoid human and environmental health risks arising from the use of chemicals; and
- .2 to this end, the Chairman of the Working Group should maintain contact with other regional groups and organizations such as ICES, NACA, IOC, FAO, WHO and review the relevant literature which is being produced in order to assess its relevance to the problems and needs of developing countries and to report progress to the next Session of GESAMP.

7.6 The conclusions of the scoping document are recorded in Annex VII.

8 BIOLOGICAL INDICATORS OF MARINE ECOSYSTEM 'HEALTH'

8.1 Increasingly national, regional and international bodies require assessment of the state of the marine environment within their jurisdiction. Yet there are few accepted indicators that are available to make such assessments at the level of ecosystems.

8.2 Given GESAMP's role in the periodic assessment of the state of the marine environment, and the scientific assessment on man's impact on the marine environment, it is important that GESAMP define environmental criteria that can be used to indicate 'health' of marine ecosystems. Ecosystems incorporate physical, chemical and biological properties which operate as an integrated whole. It is recognized that physical and chemical indicators alone may not detect changes in ecosystems caused by natural or anthropogenic

factors. Therefore, the focus of this group will be biological responses that are detectable in relation to environmental change, emphasizing their potential and limitations.

8.3 Accordingly, it is proposed that a working group be established which should:

- .1 identify characteristics of components of marine ecosystems that can generally be used to indicate the normal functioning of those ecosystems;
- .2 consider the origin and value, for these purposes, of terms such as stress, population, community and ecosystem with specific reference to space and time scales and energy flow in the marine environment;
- .3 review the methods used to detect stress on marine populations, communities and ecosystems and assess their value and limitations;
- .4 review the methods used to detect stress on individual marine organisms in a field situation and assess their value and limitations; and
- .5 identify, on the basis of the above, suites of indicators of the state of marine ecosystems that can be used to assess the impact of anthropogenically induced change of the marine environment.

9 REPORT ON GESAMP CONTRIBUTION TO UNCED

In response to a request made by the UNCED Secretariat at the twenty-first session for GESAMP to assist the preparatory process for the UN Conference on Environment and Development, an ad hoc group, comprising the Chairman, three members of GESAMP and two Technical Secretaries, met at Halifax, Canada, from 11-13 May 1991, to draft a "Response to Specific Questions Posed by the UNCED Working Group on Oceans". That draft was finalized by the Chairman on the basis of written comments submitted by the GESAMP membership. This contribution was subsequently submitted to Governments as UNCED Research Paper No.11, "Some Reflections on Scientific Research on Marine Issues" (English only). It is annexed to the present report (Annex VIII), in view of its considerable importance for the future direction of the work of GESAMP and for the marine scientific community at large.

10 FUTURE WORK PROGRAMME

10.1 Interpretation of the terms 'bioaccumulation', 'toxicity' and 'persistence'

10.1.1 Some members of the Group proposed that authoritative advice from GESAMP could assist in clarifying the meaning and applications of terms used for the hazard classification of substances contained in lists of international regulatory instruments. Terms such as toxicity, bioaccumulation and persistence have in some cases been interpreted very loosely and the relationship between the respective properties in hazard assessments have in many cases not been taken into account. It was therefore necessary to review the scientific basis of these properties.

10.1.2 Several members however emphasized that there was sufficient scientific literature available which provided the necessary information. Others pointed out that current methods for quantifying persistence were not satisfactory.

10.1.3 The Chairman of the Working Group on the "Evaluation of the Hazards of Harmful Substances Carried by Ships", Mr. P.G. Wells, noted that his Working Group will make an attempt to quantify the term 'toxicity' for the purposes of his Group.

10.1.4 The Group deferred action on the above proposal until the study prepared by the above Working Group was available.

10.2 Impact of maritime activities in shelf areas

10.2.1 The IMO Technical Secretary informed the Group that a scope document had been prepared by IMO for consideration by GESAMP with a view to establishing a new Working Group. During the preparation of the document it had been recognized that the wide range of maritime issues concerned were strongly linked with managerial issues of coastal zone planning.

10.2.2 The paper accordingly requested a comprehensive review of coastal activities with a view to assisting those responsible for coastal and marine environment protection. It had also been recognized that such work was beyond the current terms of reference of GESAMP. Consequently, it had been decided not to present the scope document to GESAMP XXII.

10.2.3 Several members noted that the work outlined in the original IMO proposal made at GESAMP XXI was also related to the work of the Working Group on "Impacts of Anthropogenically Mobilized Sediments in the Coastal Environment" (see section 5) and that the outcome of that Group should be awaited before action on the above be considered.

10.2.4 The IMO Technical Secretary informed the Group that his Organization would make an attempt to develop a new set of terms of reference for the work needed from the perspective of IMO; however this might be difficult without including managerial aspects of coastal protection and development.

10.3 The future of GESAMP

10.3.1 Given the particular importance of GESAMP's "State of the Marine Environment" report, and the on-going need for periodic assessments of the state of the marine environment and trends thereon (as recognized in UNCED doc. A/CONF.151/PC/100/Add. 21, para. 118(d)), the Group agreed to discuss at the next session, the timing, duration, processes involved, information and data needs for the next such report. Members were asked to submit their views in writing to the Chairman in advance of the next session.

10.3.2 The Group noted that in discussions on a variety of different subjects, e.g. aquaculture, sedimentation, and marine 'health' indicators, questions were raised repeatedly as to their intimate relationship with environmental protection and management generally and with integrated coastal zone management specifically. The Group also remarked on a clear trend in requests from agencies for advice from GESAMP on management-related scientific issues. Finally, the Group affirmed the continuing importance, regardless of context, of the independence of the expertise required to serve a joint advisory mechanism.

10.3.3 The Group recognized that the future role of GESAMP will have to be redefined in the light of the outcome of the United Nations Conference on Environment and Development, within an inter-agency consultation involving all sponsoring organizations of GESAMP as well as other organizations which might wish to participate in a future new GESAMP mechanism.