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**IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP
Joint Group of Experts on the Scientific Aspects
of Marine Environmental Protection (GESAMP)**

Report of the twenty-fourth session of GESAMP

New York, 21-25 March 1994

GESAMP REPORTS AND STUDIES No. 53

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45	Global Strategies for Marine Environmental Protection	1991
	<i>Addendum 1: Can there be a common framework for managing radioactive and non-radioactive substances to protect the marine environment?</i>	1992
46	Carcinogens: Their Significance as Marine Pollutants	1991
47	Reducing Environmental Impacts of Coastal Aquaculture	1991
48	Global Change and the Air/Sea Exchange of Chemicals	1991
49	Report of the Twenty-second Session	1992
50	Impact of Oil and Related Chemicals and Wastes on the Marine Environment	1993
51	Report of the Twenty-third Session	1993
52	Anthropogenic Influences on Sediment Discharge to the Coastal Zone and Environmental Consequences	1993
53	Report of the Twenty-fourth Session	1994

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

REPORT OF THE TWENTY-FOURTH SESSION

New York, 21-25 March 1994

NOTES

- 1 GESAMP is an advisory body consisting of specialized experts nominated by the Sponsoring Agencies (IMO, FAO, Unesco-IOC, WMO, WHO, IAEA, UN, UNEP). Its principal task is to provide scientific advice concerning the prevention, reduction and control of the degradation of the marine environment to the Sponsoring Agencies.
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31	Report of the Seventeenth Session	1987
32	Land-Sea Boundary Flux of Contaminants: Contributions from Rivers	1987
33	Report of the Eighteenth Session	1988
34	Review of Potentially Harmful Substances. Nutrients	1990
35	The Evaluation of the Hazards of Harmful Substances Carried by Ships: Revision of GESAMP Reports and Studies No. 17	1990
36	Pollutant Modification of Atmospheric and Oceanic Processes and Climate: Some Aspects of the Problem	1989
37	Report of the Nineteenth Session	1989
38	Atmospheric Input of Trace Species to the World Ocean	1989
39	The State of the Marine Environment	1990
40	Long-Term Ecological Consequences of Low-Level Contamination of the Marine Environment	1989
41	Report of the Twentieth Session	1990
42	Review of Potentially Harmful Substances. Choosing Priority Organochlorines for Marine Hazard Assessment	1990
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44	Report of the Twenty-first Session	1991

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23	Interchange of Pollutants between the Atmosphere and the Oceans (second report)	1985	9	Future work programme	11
24	Thermal Discharges in the Marine Environment	1984	10	Matters of immediate or increasing concern with regard to the status of the marine environment	18
25	Report of the Fifteenth Session	1985	11	Other matters	20
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27	Report of the Sixteenth Session	1986	13	Election of Chairman and Vice-Chairman	20
28	Review of Potentially Harmful Substances. Arsenic, Mercury and Selenium	1986	14	Consideration and approval of the report twenty-fourth session	20
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2	Review of Harmful Substances	1976
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4	Report of the Eighth Session	1976
5	Principles for Developing Coastal Water Quality Criteria	1976
6	Impact of Oil on the Marine Environment	1977
7	Scientific Aspects of Pollution Arising from the Exploration and Exploitation of the Sea-bed	1977
8	Report of the Ninth Session	1977
9	Report of the Tenth Session	1978
10	Report of the Eleventh Session	1980
11	Marine Pollution Implications of Coastal Area Development	1980
12	Monitoring Biological Variables Related to Marine Pollution	1980
13	Interchange of Pollutants between the Atmosphere and the Oceans	1980
14	Report of the Twelfth Session	1981

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GESAMP XXIV

(21-25 March 1994)

1 INTRODUCTION

1.1 The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) held its twenty-fourth session at the Headquarters of the United Nations, under the chairmanship of Mr. J. Gray. Mr. O. Osibanjo was Vice-Chairman of the Group.

Opening of the session

1.2 Mr. J. P. Levy, Director of the Division for Ocean Affairs and Law of the Sea of the Office of Legal Affairs, welcomed the Group to the session on behalf of the Legal Counsel of the United Nations. In doing so, he expressed particular appreciation of the fact that the current session also marked the 25th anniversary of GESAMP. Mr. Levy emphasized that GESAMP is a very important component of UN system cooperation on marine and coastal area questions, and that the decision to revise its terms of reference in 1993 was done in recognition of the need for authoritative scientific advice over an increasingly wide range of complex issues.

1.3 Mr. Levy called the attention of the Group to the fact that the United Nations Convention on the Law of the Sea will enter into force on 16 November 1994 lending new impetus to the implementation of Chapter 17 of Agenda 21, which itself rests on the foundation provided by the Convention. He pointed particularly to the requirements in the Convention that marine environmental and resource management be scientifically based.

1.4 The Chairman thanked Mr. Levy on behalf of the participants for his good wishes for the success of the session.

Adoption of the agenda

1.5 The agenda for this 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 is shown in Annex III.

2 REPORT OF THE ADMINISTRATIVE SECRETARY

2.1 The Administrative Secretary of GESAMP introduced the Updated Memorandum on the Joint Group agreed by the Executive Heads of the Sponsoring Agencies extending the role of GESAMP "to cover all scientific aspects on the prevention, reduction and control of the degradation of the marine environment to sustain its life support systems, resources and amenities."

2.2 The Group also noted that the Intergovernmental Oceanographic Commission (IOC) of UNESCO has become a sponsoring agency of the Group.

2.3 The Updated Memorandum on GESAMP is shown in Annex IV.

3 ASSESSMENT OF THE CONDITION OF THE MARINE ENVIRONMENT

3.1 The IMO Technical Secretary of GESAMP recalled the origin of Working Group 36 and outlined the intersessional activities which had led to the preparation of draft "Guidelines for marine environmental assessments". The work had involved two sub-groups: one meeting in London (6-10 December 1993), under the chairmanship of Mr. R. Boelens, and the other in Bangkok (2-5 February 1994), under the chairmanship of Mr. P. Tortell. The draft guidelines were presented as document GESAMP XXIV/3.

3.2 The IMO Technical Secretary for GESAMP indicated that he considered the Working Group had completed its task and invited GESAMP to review the guidelines with a view to adoption.

3.3 The Co-Chairman of Working Group 36, Mr. R. Boelens, introduced the report emphasizing that the Working Group had concentrated on preparing a clear and concise statement of the purposes, scope and content of regional assessments and the process involved. Thus, the more technical aspects of the guidelines were presented as annexes, rather than in the main body of the text.

3.4 In the subsequent discussion, a number of constructive comments were made as to how the guidelines might be improved. It was agreed to add a short account of the scientific resources needed for the production of assessment reports, to review the contents of Annex 1 (with particular attention to the section on hydrographic properties), and to prepare a short Preface giving the background to the guidelines and inviting feedback on their utility and practicality.

3.5 The Co-Chairmen of the Working Group undertook to review the guidelines taking into account the comments received from GESAMP members. On this basis, GESAMP agreed that the guidelines should be published as GESAMP Reports and Studies No. 54.

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

4.1 The IMO Technical Secretary informed GESAMP that the twenty-ninth session of the Working Group on the Evaluation of the Hazards of Harmful Substances carried by Ships had been held during the intersessional period. The

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Technical Secretary then summarized the main achievements made by the Working Group as outlined in its session report (GESAMP XXIV/4).

4.2 The Chairman of the Working Group, Mr. P.G. Wells, emphasized that it had been the main task of his group to prepare hazard profiles for substances proposed for transport at sea, and to review existing hazard profiles in cases where new information had been made available. He then drew attention to the following issues considered by the Working Group.

4.3 The Working Group had considered information made available on copper and copper compounds, used as marine antifouling paints replacing organotin-based formulations. The Working Group, however, felt that there was still not sufficient data yet available to perform a comprehensive hazard assessment of copper-based antifouling paints in the marine environment. The Working Group agreed that this matter should stay under review. A number of studies concerning copper-based formulation for paints are being carried out in many countries and by many organizations, and Mr. Wells asked GESAMP members to provide any information on results and contacts in this field to the IMO Technical Secretary.

4.4 Draft guidelines for the measurement of odour detection thresholds in water have been developed by the Working Group with a view to identifying chemicals that are liable to taint seafood when spilled at sea. GESAMP confirmed that efforts be made to validate the draft guidelines and it requested the IMO Secretary to contact ASTM and chemical manufacturers' associations asking them for advice.

4.5 The Working Group has deleted "White Spirits" from its composite list of substances, noting that under this name a wide variety of different hydrocarbon mixtures of varying compositions and often tailored to customers' demands were transported in large quantities. Several mixtures had been tested and evaluated by the Working Group. However, the Working Group recognized that these were not representative for the many mixtures transported in bulk under this name. In this connection the Group was also advised that "White Spirits" were carried in oil tankers rather than in chemical tankers, and that no hazard evaluation was necessary for transportation and discharge requirements of "oils" (MARPOL 73/78, Annex I). GESAMP took note of the action taken by its Working Group, but asked the Working Group to review its position in light of "White Spirits" mixtures transported as packaged goods under conditions set out in the International Maritime Dangerous Goods Code.

4.6 The Group was informed of comments submitted by Greenpeace International to IMO criticizing the GESAMP hazard evaluation system, and in particular the biological testing protocols used by the GESAMP Working Group when evaluating the hazards of harmful substances carried by ships. The Working

Group had considered the comments, which were largely out of context and inaccurate, and prepared responses thereto. The Group requested the IMO Technical Secretary to pass on the Working Group's comments as set out in its report.

4.7 The Group endorsed the arrangements made for the review and update of GESAMP Reports and Studies No. 35, i.e., the description of the evaluation process and its scientific basis, and the results achieved, including testing guidance prepared by the Working Group.

4.8 With regard to the problems related to the finalization of the computerized data base, the Group appreciated the progress achieved so far and advised that this be made available as a CD-ROM disc.

4.9 The Group endorsed the report of the twenty-ninth session of its Working Group and, in particular, approved the hazard profiles that had been reviewed or established during the intersessional period.

4.10 A summary of the report of the twenty-ninth session of the Working Group, its terms of reference and members is shown in Annex V.

5 INDICATORS OF MARINE ECOSYSTEM HEALTH

5.1 The UNEP Technical Secretary of GESAMP reminded the participants that the Working Group on Indicators of Marine Ecosystem Health had been established on the initiative of experts of GESAMP at its twenty-second session (Vienna, March 1992). IMO, FAO, UNESCO, IAEA, UN and UNEP agreed to support the Working Group activities. UNEP has acted as lead agency. Mr. J. Gray had been nominated as Chairman of the Working Group.

5.2 A preliminary report had been submitted to the twenty-third session of GESAMP. The Group provided its comments and requested the Chairman to finalize the report and present it to the present session for approval.

5.3 Mr. Gray presented the report of the Working Group, prepared at its second meeting convened during the intersessional period. The summary of the report, the terms of reference of the Working Group and the list of participants are given in Annex VI. He emphasized the difficulties which his group had to overcome in preparing its report, especially with regard to the definition of such terms as "normal functioning of a system", "health", "ecosystem", "stress" and "disturbance".

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ended. A number of important issues were raised during discussion of the report, and these issues will be addressed during the intersessional period when a portion of the working group will develop a final draft of the report to be presented at GESAMP-XXV. Thirteen papers prepared for discussion at the workshop in Rhode island will be published as a book on the sea surface microlayer, after peer review.

TERMS OF REFERENCE

The Working Group No. 34 on the Sea-Surface Microlayer was established by GESAMP XXIII with the following terms of reference:

To prepare a report on current understanding of the physics, chemistry and biology of the sea-surface microlayer with particular reference to its role in global environmental changes and as a marine habitat, including:

- .1 a review of physical processes in the microlayer and their relation to changes in heat, momentum and mass exchange;
- .2 a critical assessment of interaction of the biology and chemistry (including radiochemistry) in the microlayer including reference to the effects on living marine resources;
- .3 a quantitative consideration of the effects of the sea-surface microlayer on air/sea exchange of gases;
- .4 an assessment of the effects of solar radiation and photochemical reactions on the chemistry and biology of the microlayer; and
- .5 an evaluation of existing and potential new techniques for investigating the surface layer of the ocean.

5.4 In the discussion following the presentation of the report, the Group raised a number of questions and issues which need to be resolved before the draft report can be approved for publication.

5.5 The Group appreciated the difficulties of defining "health" and "ecosystem", but it accepted the adoption of an operational definition of "ecosystem". It was agreed that the title of the final report should avoid the use of the term "health". The following title was adopted: "The measurement of biological responses to stress in the marine environment".

5.6 The Group further advocated the preparation of a clear and concise executive summary that provided a "road map" to the layout and contents of the document.

5.7 The Group agreed that the following actions should be accomplished before a decision on publication could be taken:

- All interested GESAMP members will send their comments on the report to the Chairman by the end of April;

- The Chairman will revise the report accordingly, prepare a detailed executive summary and send the report to all members of GESAMP, as well as to all sponsoring agencies;

- The decision on publication of the report will be taken by the Chairman of GESAMP on the basis of the reactions of GESAMP members and the sponsoring agencies.

6 ENVIRONMENTAL IMPACTS OF COASTAL AQUACULTURE

6.1 The FAO Technical Secretary of GESAMP Working Group 31 on Environmental Impacts of Coastal Aquaculture informed the Group on previous work carried out by this Working Group, in particular the preparation of GESAMP Reports and Studies No. 47 "Reducing the environmental impacts of coastal aquaculture". The Working Group met in Rome from 17-21 January 1994, to address the term of reference concerning the establishment of scientifically-based monitoring requirements and procedures for aquaculture pollutants leading to the assessment of the environmental capacity available for existing and planned coastal aquaculture sites. A summary of their interim report is given in Annex VII.

6.2 The Chairman of the Working Group, Mr. R. Gowen, introduced the draft report entitled "Monitoring the ecological effects of coastal aquaculture". He

pointed out that the report focusses on monitoring ecological effects of particulate and dissolved waste, and contains discussions of:

- the role of monitoring for the purposes of environmental protection within a management framework, as suggested in GESAMP Reports and Studies No. 45;
- selected interactions between coastal aquaculture and the natural environment;
- basic considerations (e.g. reference stations, statistical analysis, flexibility of monitoring intensity) in the design of monitoring programmes;
- parameters commonly used in monitoring programmes with consideration of their interpretative value;
- the design of hypothetical monitoring programmes;
- environmental capacity and biological standards.

6.3 Key points highlighted by the Chairman were: (a) it is impractical to define specific monitoring programmes because of the variety of aquaculture practices and the diversity of environments; and (b) there is a need to work towards the application of the concept of environmental capacity and the use of biologically-based environmental quality standards.

6.4 The Group appreciated the draft as presented, and commended the suggestion of a flexible approach to monitoring. Discussions by the Group focused on a variety of issues including the anticipated target audience, the relationship between monitoring and EIA requirements, enforcement problems, aquaculture site selection as a method of reducing the need for monitoring, and the concept of mixing zones. It was suggested that the number of scenarios should be increased to cover a wider range of aquaculture practices and should be carefully reviewed for technical consistency. It was further proposed that the report should contain a clear reference to GESAMP Reports and Studies No. 47, which describes the relevance of monitoring in relation to ecological effects of coastal aquaculture.

6.5 The FAO Technical Secretary informed the Group of comments on the report which had been received from a number of experts. In general, the response to the draft report was positive. There were suggestions to consider: all major types of coastal aquaculture; methods for prediction of impacts and hazard assessment; evaluation of monitoring programmes as carried out in tropical environments; general guidelines to help decision-making in relation to different environments and aquaculture practices.

5. Under topic 2, it is now recognized that few reliable data on the chemistry of the microlayer are available in off-shore regions. For dissolved trace metals no reliable data are available in these regions. While laboratory and some limited field data suggest that reproduction, growth and survival of neuston can be curtailed by exposure to contaminated microlayer material, considerably more in situ assessment is needed to ascertain the true impact, particularly in off-shore regions. It was pointed out that global warming could influence the distribution of neustonic organisms, as it would other organisms living in the surface ocean.

6. If natural organic films influence gas exchange, distribution changes of neuston could affect changes in the air-sea exchange of gases and other materials. Some evidence exists that some neustonic fish eggs and larvae as well as phytoneuston could be damaged by predicted increases in UVB radiation. If global changes occur, they are likely to be expressed as structural changes in the food web as sensitive species are replaced by more tolerant species, but long-term effects at the population level are quite uncertain.

7. Under topic 3 it was pointed out that the basic photochemical reactions and processes in the microlayer may not differ substantially from those in near-surface waters. Areas where microlayer photochemical processes may be important include photochemical reactions within hydrocarbon slicks, where toxic hydroperoxides can be formed from cycloalkanes in the slicks; the fate of certain atmospheric species following deposition in the ocean, for example, the photoreduction of atmospheric aerosol iron to the more soluble and readily useable Fe(II); and changes in physical properties of the microlayer due to phototransformation of its constituents. As an example of the latter case, the reflectance of the ocean surface could increase by 2-4% in the presence of an organic film, thus representing a significant decrease in short wave energy input to the ocean. Longwave radiation emission by the ocean could be affected by the microlayer if this has a different emissivity than water in the spectral region near 10 μ m.

8. Areas where microlayer photochemical processes are probably NOT generally important include photochemical reactions destroying surface-active species and altering surface wave damping and gas exchange; high levels of reactive photochemical intermediates presenting a "reaction barrier" to air-sea transport; photochemical reactions in the microlayer depleting or enhancing the concentrations of certain gases; chemically modifying air-sea exchanging compounds; reactive intermediate fluxes significantly affecting the transfer of reactive species; and photochemically-produced gases within the microlayer being important relative to the total flux of those gases from the water column.

9. As indicated in paragraph 1 above, the report presented at GESAMP-XXIV is interim in nature, since the draft was distributed only one week after the workshop

ANNEX VIII

SEA SURFACE MICROLAYER

Summary of the report of the Working Group on the Sea-Surface Microlayer
(Working Group No. 34)

1. The report presented to GESAMP-XXIV for discussion and comments is an interim report resulting from the meeting of Working Group 34 held from 20 to 24 February 1994 at the Alton Jones Campus of the University of Rhode Island, USA in the form of a workshop/working group meeting.

2. The report consists of a brief introductory chapter which outlines the major issues addressed by the Working Group. These issues were grouped into three topics: 1. - Physical processes in the microlayer and the air-sea exchange of trace gases; 2. - Biological effects of chemical and radiative change in the sea-surface; and 3. - Photochemistry in the sea-surface microlayer. The subsequent three chapters contain a detailed discussion of each of these issues.

3. Under topic 1, the Working Group pointed out that while the global coverage of surface active material on the ocean surface is still unknown, it is likely significant. The presence of a surfactant appears to produce an energy barrier to the formation of a wind-wave field, resulting in a lowered air-sea transfer velocity. This in turn will affect particularly the air-sea exchange of liquid-phase rate-controlled gases (e.g., those that are not highly soluble in the ocean, such as CO₂). Estimates indicate that increases in microlayer surfactant coverage in a region can either increase or decrease the estimated net flux of CO₂ into the ocean depending on whether Δp_{CO_2} is < or > zero.

4. Consideration of evaporative cooling of the ocean surface temperature would increase the modelled air-to-sea flux of CO₂ by about 0.6 GtC yr⁻¹ globally. Gas transfer is enhanced by bubbles, which are generated by waves. Changes in global wind fields could thus affect overall gas transfer. Reactions involving the enzyme carbonic anhydrase in the microlayer could enhance CO₂ exchange given that biological activity is higher there, although there have been no measurements of this enzyme in the microlayer. The effect of rain on air-sea gas exchange across the microlayer is believed to be minimal. New, non-intrusive optical techniques for studying the microlayer are being developed, including non-linear laser spectroscopy which may provide true remote sensing of sea surface chemistry in the future.

6.6 The FAO Technical Secretary proposed that Working Group 31 should finalize the draft report, including all the comments received, and undertake:

- an evaluation of the use of hazard assessment methods and impact prediction models within the context of the design and implementation of monitoring programmes for aquaculture;
- an evaluation of existing monitoring approaches and programmes, with particular emphasis on their applicability to major aquaculture practices in tropical and sub-tropical environments; and
- preparation, for inclusion in the report, of specific guidance on the various purposes, principles and applications of aquaculture-specific monitoring programmes, with particular attention to developing countries.

This task should be carried out during the forthcoming intersessional period. The Working Group would meet in October 1994 to finalize the report for presentation at GESAMP XXV. The Group endorsed this proposal.

6.7 With respect to the term of reference relating to chemical usage in coastal aquaculture, the Group agreed that a preliminary assessment should be undertaken. This should be done by correspondence among a small number of experts co-ordinated by the Technical Secretary, in consultation with the Chairman. For this purpose, relevant information available from industrialized countries would be used to assess problems associated with chemical usage in coastal aquaculture in developing countries. The first drafts for this preliminary review could be discussed briefly during the Working Group's meeting in October 1994, and would be presented to GESAMP XXV for discussion and consideration of possible future work.

6.8 With regard to the term of reference relating to the integration of aquaculture into coastal area management schemes it was recommended that the members of the Working Group continue to compile and review relevant information with particular emphasis on related experiences worldwide.

7 THE SEA-SURFACE MICROLAYER

7.1 The WMO Technical Secretary of GESAMP recalled that the problem of the sea-surface microlayer as a significant source of contaminant accumulation and its significance for biological processes and air-sea exchange was mentioned at the twenty-second session of GESAMP in 1992 as an issue of concern. In 1993, GESAMP XXIII established Working Group 34 on the Sea-Surface Microlayer to address the following issues, with particular reference to its role in global environmental change: physical processes in the microlayer and their relation to

changes in heat, momentum and mass exchange; biological effects of chemical change in the microlayer; effects of solar radiation and photochemical reactions on the chemistry and biology of the microlayer; and techniques for investigating the surface layer of the ocean. The meeting of the Working Group was held in the form of a workshop/working group meeting in Rhode Island, USA, from 20-24 February 1994. The meeting began with presentations of thirteen scientific papers prepared by the participants and continued at three theme groups and at plenary sessions of the Working Group where the interim report was prepared for discussion and comments by GESAMP XXIV. It was the intention of the Working Group to publish the proceedings of the workshop.

7.2 The Chairman of Working Group 34, Mr. R. Duce, introduced document GESAMP XXIV/7 as an interim report of the Working Group. It was acknowledged that this report contained too much scientific detail of a specialized nature to be suitable for publication as a GESAMP report, and that a further meeting of some of the Working Group members during the intersessional period was desired to allow editing of the document for presentation at GESAMP XXV in 1995. A summary of the interim report is given in Annex VIII.

7.3 A discussion of the interim report ensued. GESAMP commended the quality and value of the scientific detail in the interim report, particularly the section on photochemical processes. However, speakers were unanimous in their criticism of the section on the biological effects of chemical enrichment. Specifically, this section was considered to be lacking in clear, critical appraisal of the scientific evidence for the biological significance of microlayer enrichment of toxic materials. Specific, documented biological effects were not presented. Rather, the section was considered to depend too much on speculation. As a consequence, the report gave the impression that very significant effects might be expected, a view that is out of balance with the actual evidence discussed. It was further noted that a hazard assessment approach might be useful in rectifying this imbalance, although this may involve making some assumptions about exposure times for microlayer organisms.

7.4 The emphasis in the report on the vulnerability of larval-stage microlayer organisms to contamination was considered to be based largely on circumstantial evidence. Although important implications for fisheries were suggested in the report, the significance of these was considered very difficult to accept given the very great natural variability in the mortality of eggs and larvae.

7.5 Some speakers commented on a lack of discrimination in the report on the specifics of the microlayer in relation to the surface region in which neustonic organisms prevail. In response, Mr. K. Hunter, member of the Working Group, summarized the February workshop discussions on this point, noting that the concept of the microlayer, and therefore its physical dimensions, was not simple to

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meeting in January 1994. The WG would, however, continue to compile and review relevant information on other priority issues, in particular on above items 2. and 3. which would need to be discussed at that WG meeting.

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define in a manner that encompassed all relevant physical, chemical and biological processes. It was concluded that this important aspect needed to be brought out more clearly during the revision of the report.

7.6 A need to understand the absorbance properties of microlayer components was identified as critical in the report. However, it was pointed out that only the UV absorbing properties of surface film materials had been considered. Some discussion of the remainder of the electromagnetic spectrum was required. This discussion should consider not just the surface microlayer but a range of depths near the sea surface relevant to the neustonic community.

7.7 In addition, several other points were discussed. In particular, a need to take advantage of a wealth of fundamental knowledge arising from physical chemical studies of surface films and of mineral flotation processes in engineering was mentioned. It was also noted that bubbles in whitecaps comprised a surface area much larger than the geometric area of the air-sea interface, and they could be included in a broadened concept of the sea surface microlayer. In a similar vein, the importance of bubble flotation and aerosol formation processes to the horizontal dispersion of aquatic micro-organisms, and the electrification of the air-sea interface, were raised.

7.8 It was agreed that during the next intersessional period a core group of the Working Group should meet to complete and revise the report, taking into account the comments made by GESAMP, and to present the final report to GESAMP XXV in 1995. The members of GESAMP were requested to send additional comments, if any, to the Working Group Chairman by the end of May 1994.

8 OPPORTUNISTIC SETTLERS AND THE PROBLEM OF THE CTENOPHORE
MNEMIOPSIS LEIDYI IN THE BLACK SEA

8.1 The UNEP Technical Secretary of GESAMP reminded the participants that the Working Group on opportunistic settlers and the problem of the ctenophore *Mnemiopsis leidyi* in the Black Sea had been established by GESAMP at its last session at the request of UNEP. The main task of the Working Group was to advise Black Sea countries and UNEP on possible courses of actions to manage the problem of the massive population explosion of *Mnemiopsis leidyi* in the Black Sea. IMO, FAO and UNESCO had agreed to support activities of the Working Group. Mr. Y. Sorokin and Mr. P. Wells were requested to co-chair the Working Group. Its first meeting was convened in Geneva from 10 to 14 January 1994.

8.2 Introducing the first part of the report of the Working Group, Mr. Wells described the modification of the terms of reference suggested at that meeting.

The following modified terms of reference were presented for GESAMP consideration and approval:

- to assess the occurrence, distribution, reproductive biology and physiological features of the intruder ctenophore, its ability to compete for the food with pelagic fish, and control of its population by predators in its natural habitat;
- to assess the probable causes of the ctenophore outbreaks and their connection with other destabilizing factors and developments in the Black Sea region;
- to assess the impact of the ctenophore on pelagic and benthic communities and its consequence for fisheries;
- to develop a strategy, and to recommend measures, to overcome the ctenophore and similar invasions in other parts of the world, using the Black Sea region as an example.

8.3 He then presented a brief summary of the discussion on distribution, biology and ecology of *Mnemiopsis leidyi*, and on its occurrence in the Black Sea region. He pointed out various features of the ctenophores' biology that made it such a successful invading species.

8.4 Introducing the second part of the report, Mr. Sorokin presented the outcome of the discussion of problems related to alteration of the Black Sea ecosystem, impact of *Mnemiopsis leidyi* on Black and Azov Seas fisheries, monitoring and modeling the role of the ctenophore *Mnemiopsis leidyi* in the Black Sea region, and the strategy for the control of the invasion of *Mnemiopsis leidyi* in the Black Sea.

8.5 After the discussion of the problem presented by the Co-Chairmen and described in the report, the Group agreed with the suggested modification of the terms of reference, commented positively on the progress being made on the analysis of the problem, but concluded that any suggested strategies for control measures should be based on a sound scientific knowledge of the species biology and ecology. More knowledge on the species distribution and ecology was the recommended priority for research. A cautious approach was strongly advised about strategies involving the introduction of predatory species.

Careful selection of reference stations, statistically sound replication, and standardization of sampling and analytical procedures are important elements of programme design. As any monitoring should be matched to the size, type and location of a coastal aquaculture installation, it is not appropriate to recommend standard monitoring programmes. However a range of parameters commonly used in monitoring are discussed together with an evaluation of their value in interpreting changes resulting from discharges or losses to the receiving water body. To illustrate how particular monitoring programmes might be developed, four example scenarios are presented.

An approach to coastal development based on the concept of environmental capacity is recommended. Such an approach allows for a more equitable use of the coastal resource by a number of users. Establishing environmental quality standards for a whole water body avoids the problems associated with relying only upon operation-specific monitoring. At the present time this approach is rarely being used, and there are few scientifically based environmental quality standards with respect to the biological effects of waste from coastal aquaculture operations. The problems of defining environmental capacity of individual water bodies and of setting appropriate individual water body standards are ones which society has yet to tackle adequately. Meaningful progress in managing coastal development while protecting the natural environment can not be made until these issues are properly addressed.

TERMS OF REFERENCE OF THE WORKING GROUP:

The following tasks for the future work of WG 31 were recommended by the last GESAMP Session (XXIII):

1. the establishment of scientifically-based monitoring requirements and procedures for aquaculture pollutants leading to the assessment of the environmental capacity of existing and planned coastal aquaculture operations;
2. the preparation of review and guidance documentation for the safe use of chemicals in coastal aquaculture;
3. the review of concepts and experiences related to the integration of aquaculture into coastal area management schemes.

It was suggested that the WG first concentrate its efforts on the preparation of a report on the requirements and procedures for monitoring of coastal aquaculture pollutants. This report would be discussed and finalized during a WG

ANNEX VII

MONITORING THE ECOLOGICAL EFFECTS OF COASTAL AQUACULTURE

Summary Report of the Working Group on Environmental Impacts
of Coastal Aquaculture
(Working Group No. 31)

Monitoring is a critical element of the processes through which the impacts of coastal aquaculture on the marine environment can be kept minimal and within acceptable limits. This report discusses the framework under which monitoring should be carried out and recommends procedures through which appropriate monitoring of wastes from aquaculture can be planned, implemented and revised when needed. For the purposes of the report, monitoring to protect the natural environment is defined as "the regular collection, generally under a regulatory mandate, of biological, chemical and physical data, using predetermined procedures and sample locations, such that any ecological changes attributable to aquaculture can be quantified".

The development and operation of coastal aquaculture farms has been shown to have sometimes brought about undesirable ecological change including organic enrichment of aquatic ecosystems, destruction of habitat and interactions between farmed and wild organisms. To regulate such change, the formulation and implementation of a "management framework plan" is recommended to control development and evaluate potential ecological impacts before permission to develop is granted. Within such schemes, monitoring is implemented once the operation is under way, and can be regarded as a regulatory mechanism to 1) evaluate the judgements made in granting permission, 2) limit ecological damage should un-anticipated levels of impact occur, and 3) allow for further expansion or development should measured levels prove that observed ecological change is below unacceptable limits. Such overall planning has seldom taken place, and the result has usually been that monitoring programmes have been mis-directed or inadequate.

For monitoring to be a successful regulatory mechanism, a baseline survey should be undertaken prior to development of a proposed farm, and should be an element of the "impact management framework". The purpose of the baseline survey is to obtain data which can assist in formulating an appropriate monitoring programme, and to provide a set of references against which changes of the natural environment after the start of operations can be measured. In designing specific monitoring programmes consideration should be given to relating the scale of the programme to the size of the operation and to the sensitivity of the receiving water body, in order to keep the costs of the programme reasonable. In addition,

9 FUTURE WORK PROGRAMME

Oil in the Marine Environment

9.1 The IMO Technical Secretary introduced document GESAMP XXIV/9/1 addressing the concern of the IMO Marine Environment Protection Committee (MEPC) regarding the implications of new tanker design to the various oil release rates during accidents of different types. Two questions were presented to GESAMP by MEPC:

"1. If in a given period of time, a number of tanker accidents occur, which of the following two scenarios would result in the least ecological damage:

1.1 one tanker accident resulting in a relatively large spill at one location, or

1.2 several tanker accidents resulting in relatively small spills at different locations.

2. If in a given period of time, accidents occur in a given area, which of the following two scenarios would result in the least ecological damage:

2.1 have the entire quantity spilled at one instance, or

2.2 have the same quantity spilled by a number of smaller spills distributed over the time period."

9.2 The Group concluded that many factors influence the fate and effects of each spillage of oil, and that these factors (including weather, type of oil, location, and hydrographic features) are highly variable and unpredictable for each spill event. Most importantly, oil effects (both acute and chronic) are not directly related to the amount of oil spilled, particularly for wildlife species. Any attempts to answer these questions in their current form would lead to hypothetical and, very likely, misleading answers. Such an exercise would necessitate going through many dozens of spill scenarios and not provide useful answers to MEPC.

9.3 On the question of oil input into the marine environment, GESAMP, in its report "Impact of oil and related chemicals and wastes on the marine environment" (GESAMP Reports and Studies No. 50), provided estimates of oil amounts that enter the world's seas and oceans, as prepared by the U.S. National Academy of Sciences, which concluded that the amounts of oil entering the sea due to marine transportation activities had been reduced from 1.4 million tonnes in 1981 to 0.57 million tonnes in 1989. Oil input from all sources has during that period of time been reduced from 3.28 million tonnes in 1981 to 2.35 million tonnes in 1989.

9.4 At the thirty-fifth session of MEPC (7-11 March 1994), Friends of the Earth International pointed out that GESAMP, in the above-mentioned report, also quotes

other data from regional sources. When the estimates for the various regional sea areas are added, a different picture emerges: as much as 7.3 million tonnes of oil could be entering the seas annually.

9.5 The Group felt that the question of improving the accuracy of oil input figures from shipping could be addressed by a small task group or by correspondence, aided by the IMO Technical Secretary. The question of estimating oil inputs into the sea from all sources in all regional seas was a much larger question; the Group agreed that quoted values probably had very large but unknown errors and were likely to be very variable in time and space. At this point in time, it is only possible to re-check original published sources of the data, but not initiate a large and thorough new study.

Definition of marine pollution

9.6 The IMO Technical Secretary informed the Group of ongoing discussions related to a review of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention, 1972), in particular the inclusion in a revised text of a definition of marine pollution (GESAMP XXIV/9/2). The Group was invited to comment on the proposals currently under discussion, recalling that deficiencies in the GESAMP definition have been the subject of lengthy considerations at previous sessions of the Group.

9.7 The Group confirmed that a definition of pollution of the marine environment developed by the Scientific Group of the above Convention was technically correct; however, it advised that a definition which is selected for inclusion in any new or revised international agreement should conform to the definition contained in the United Nations Convention on the Law of the Sea, especially considering that this Convention will enter into force in 1994.

Task Force on integrated coastal management

9.8 The FAO Technical Secretary of GESAMP informed the Group of the need for scientific advice on how to practically implement Integrated Coastal Area Management (ICAM) programmes, particularly in developing countries, in order to ensure sustainable use of coastal resources (GESAMP XXIV/9). This was a priority concern expressed in Chapter 17, Oceans, of Agenda 21 of UNCED.

9.9 One member of the Group, Mr. S. Olsen, invited as an expert on this issue, explained that coastal management is a rapidly evolving field, and that this process will continue in the coming decades. The field has its origins in coastal zone management (CZM). CZM programmes were a response to the realization that sector by sector management in coastal areas too often produces costly development "mistakes" and social inequities. Coastal Zone Management

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programmes, by definition, therefore address at least two sectors and are directed at specific management issues. These programmes typically are concerned with the siting of facilities, the alteration of the natural features of the coastline and mediating among user groups.

9.10 Integrated Coastal Area Management (ICAM) programmes have evolved logically from Coastal Zone Management (CZM) but the context and focus are quite different. ICAM programmes have been shaped by the growing realization that in many regions, particularly in the tropics where the process of ecosystem change is most rapid, the development process is reducing the long term capacity of coastal ecosystems to produce renewable wealth and to support human societies at an adequate quality of life. ICAM programmes, unlike CZM programmes, therefore attempt to address the root causes of the issues posed by development and ecosystem change. The emphasis is not on selected technical "fixes" for specific management "problems", but rather to examine in an integrated manner all important issues posed by the relationship between human society and coastal ecosystems in specific places. Thus ICAM programmes are characterized by:

- the *transdisciplinary analysis* of the major social and environmental issues affecting a selected coastal area (often, as in CZM, arbitrarily defined) followed by a strategic selection of those issues that can be usefully tackled by the programme at that time;

- a *dynamic policy process* that is explicitly designed to learn and evolve rather than a more static process of selecting a few technical "fixes" or an ultimate plan;

- *concern for the equity issues* posed by how resources are allocated; and

- making progress towards the goal of *sustainable development* and therefore balancing between both conservation and development needs.

9.11 Mr. Olsen concluded that much time has been devoted to articulating the need for ICAM programmes, their scope, and the issues that they should address. This occurred most recently at the World Coast Conference that was held in the Netherlands in October of 1993. In his view, the top priority is to move forward towards effective action. In many instances, according to Mr. Olsen, the difficulty lies in lack of appreciation for the requirements of each step in the policy cycle, in the need to build constituencies for resource management initiatives and the importance of linking management policies and management instruments with the capabilities of the agencies concerned. It is important that the future work of GESAMP as it applies to the linkages between ICAM and the natural and social sciences, be cognisant of these realities and provide guidance that can be of

10 MATTERS OF IMMEDIATE OR INCREASING CONCERN WITH REGARD TO THE STATUS OF THE MARINE ENVIRONMENT

10.1 The Chairman asked GESAMP members to introduce issues which they considered worthy of special emphasis in the report of the Group.

Marine aggregate extraction and trawling

10.2 GESAMP noted with concern the increasing evidence of damage to marine habitats caused by fishing, both commercial and artisanal. Large infrequent storms can cause major disturbances to the seabed to which the marine ecosystem has become adapted. Trawling, using modern heavy gear towed by powerful ships, can have a disruptive effect similar to that of a storm. Modern trawling occurs more frequently in some areas than do major storms. A number of groups, e.g. ICES, are examining the effects of trawling to try to assess its impact on the benthic ecosystem.

10.3 Aggregate extraction for use in the construction industry and coastal protection also causes a major disruption to the seabed. How rapidly the seabed recovers and the dredged area is recolonized depends on the extent and frequency of the dredging in the particular marine region. In some Pacific islands the extraction may also weaken the natural coastal defenses. This practice also causes conflicts between users of the areas. For example, buried crabs may overwinter in the proposed extraction area and their disturbance could have a major impact on a local marine fishery.

10.4 Consideration should be given to the loss of habitat caused by the increasing disruption of the seabed by trawling and aggregate extraction.

Algal blooms

10.5 The Group reasserted its concerns over the impact of toxic algal blooms. During the past year, new concerns over, *inter alia*, levels of a ciguatoxin-like substances in spanish mackerel, and the potential relationship between chronic fatigue and ciguatera were identified.

Increased UVB radiation in Polar marine organisms

10.6 The Group noted the accruing data on the effects of UVB radiation on marine organisms. Should such effects lead to reductions in plankton abundances, then consequences may be observed on dependent organisms such as whale and sea-bird populations.

6 The report of the twenty-ninth meeting of the Working Group will be issued as a Circular of the IMO Sub-Committee on Bulk Chemicals (BCH/Circ.). This can be made available by IMO on request.

TERMS OF REFERENCE

To examine and evaluate available data and to provide such other advice as may be requested, particularly by IMO, for evaluating the environmental hazards of harmful substances carried by ships, in accordance with the rationale approved by GESAMP for this purpose.

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ANNEX V

EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS

Summary of the report of the twenty-ninth meeting of the Working Group
(Working Group 1)

1 The twenty-ninth session of the Working Group was held from 14 to 18 February 1994 under the chairmanship of Mr. P. G. Wells. The main work carried out during this session consisted of the review of existing hazard profiles in the light of new data made available to the Working Group, and the establishment of new profiles for substances that have recently been proposed for transport at sea either in the form of bulk liquid chemicals, bulk solids or as packaged goods.

2 In addition to the hazard evaluation of individual substances, the Working Group reviewed the following classes of compounds:

- Fluorides;
- Ethers;
- Barium salts;
- Lead salts; and
- Glycol ethers.

3 The Working Group continued its consideration of the impact on the marine environment of copper and copper compounds used in marine antifouling paints. The Working Group evaluated available information but concluded that sufficient scientifically sound data was not yet available to perform a comprehensive risk assessment, and it agreed that this matter should stay under review.

4 Draft "Guidelines for the Measurement of the Odour Detection Threshold of a Chemical Substance" were established by the Working Group with a view to facilitating the identification of substances that are liable to taint seafood when spilled at sea. The Working Group advised that these guidelines should be brought to the attention of chemical industry or standards associations requesting them to arrange validation trials.

5 The Working Group considered the need to review its previous publication: The Evaluation of the Hazards of Harmful Substances Carried by Ships (GESAMP Rep.Stud.No.35, IMO 1989). The Secretariat was requested to plan the next, thirtieth session of the Working Group in early 1995 as a "review and editorial" meeting.

Loss of nuclear-powered submarines

10.7 A number of such submarines have been lost over the last three decades. Some of them received wide publicity at the time of the accident that led to their loss (e.g., the "Thresher"), whereas others have not (e.g. the Soviet submarine lost off Bermuda). In addition to the nuclear reactors, several submarines carried nuclear missiles or torpedoes, and concern has been expressed about the contamination of the marine environment as these reactors and warheads corrode and release their radioactivity.

10.8 While these vessels and weapons pose no immediate threat to man or to the marine environment, consideration should be given to the long-term consequences.

Relating inputs to environment levels of contaminants

10.9 The Group noted that Governments are increasingly adopting pollution control measures which target the reduction of inputs of contaminants from all sources. This implicitly requires quantification of input loads as well as techniques to demonstrate that changes in input loads can be related to changes (temporal and spatial) in the levels of contaminants in environmental media.

10.10 The Group raised the question as to whether scientific capability was sufficient to make that relationship. Furthermore, concern was expressed as to the possibility that expenditures on monitoring would rise without producing the anticipated benefit. Several members of the Group undertook to prepare a paper discussing this issue and the implications for environmental management.

Disposal of radioactive wastes into Arctic Seas

10.11 At its last session, GESAMP noted the concerns being raised about the dumping of radioactive wastes at sea by the former Soviet Union. The IAEA informed GESAMP of the Arctic Seas Assessment Project (IASAP) to be carried out by the IAEA in 1993-1996. The objectives of the Project are to:

- assess the risks to human health and to the environment associated with the radioactive waste dumped in the Kara and Barents Seas, and
- examine possible remedial actions related to the dumped wastes and to advise on whether they are necessary and justified.

The Group had expressed its interest in being kept informed of the progress of the work. The IAEA Technical Secretary reported to GESAMP on the progress and future plans of the project.

11 OTHER MATTERS

The Group was informed that its sponsoring agencies have discussed the need for GESAMP to provide a mechanism by which it could respond more rapidly to urgent requests for advice from sponsoring agencies. The sponsoring agencies agreed that contact would be made through the Administrative Secretary who, in cooperation with the Chairman of GESAMP, would invite GESAMP experts to provide comments and suggestions in response to any request.

12 DATE AND PLACE OF THE NEXT SESSION

The Group noted that the twenty-fifth session of GESAMP would be hosted by the Food and Agriculture Organization of the United Nations in Rome, Italy, from 24-29 April 1995.

13 ELECTION OF CHAIRMAN AND VICE-CHAIRMAN

The Group unanimously elected Mr. O. Osibanjo as Chairman and Ms. H. Yap as Vice-Chairman for the next intersessional period and the twenty-fifth session of GESAMP.

14 CONSIDERATION AND APPROVAL OF THE REPORT OF THE TWENTY-FOURTH SESSION

14.1 The report of the twenty-fourth session of GESAMP was considered and approved by the Group on the last day of the session. It contains, in Annexes V to VII, summaries of reports prepared by Working Groups and other Sub-Groups. The summaries are included for information and were not considered by the Group with a view to approval.

14.2 The twenty-fourth session of GESAMP was closed by the Chairman of the Group at 1:15 p.m. on 25 March 1994.

Secretariat

11 IMO acts as the Administrative Secretariat for the Joint Group and assigns the Administrative Secretary. Each sponsoring organization assigns a Technical Secretary. The Administrative and Technical Secretaries form a joint secretariat. The Administrative Secretary maintains continuity and keeps the central archives relative to the work of the Joint Group. The Technical Secretary from the organization hosting a session acts in each case as the secretary for the session and takes responsibility for the preparation of the report of that session. The provisional agenda for each session is drawn up jointly by the sponsoring organizations under the initiative of the Administrative Secretary and after consultation with the Chairman, taking into account any suggestion received from any organization in the United Nations system which may be interested in taking part in the session.

Procedure of work

12 Detailed arrangements for the conduct of the business of the Joint Group and for its support (including inter-secretariat preparations, intersessional activities, sharing of responsibilities for documentations, costs of conduct of sessions, election of officers, routing of correspondence, etc.) are covered by guidelines based on this memorandum and drawn up jointly by the Secretaries.

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concerned with problems of marine environmental protection. Each sponsoring organization arranges for distribution of these reports according to its own needs.

5 Any recommendation by the Joint Group which pertains to or requires for its implementation concerted action by several of the sponsoring organizations may be referred to relevant ACC subsidiary bodies.

6 Proposals and recommendations relevant to the work of other organizations which are not among the sponsors of the Joint Group are, as appropriate, communicated to such organizations.

Membership

7 Each sponsoring organization nominates from one to four experts according to the needs. The Joint Group is composed of such nominees, the experts being appointed to act in their individual capacities. The multidisciplinary composition of the Joint Group is agreed among the sponsoring organizations. Some experts are nominated to serve for a period of up to four years to provide a continuing nucleus, while others can be appointed as occasion demands, having in mind the particular subjects to be considered at each session of the Joint Group.

Participation in sessions

8 Sessions are normally held annually and in rotation at the headquarters of the sponsoring organizations. In certain circumstances however the Joint Group may be convened elsewhere.

9 Organizations of the United Nations system which are not among the sponsors of the Joint Group may be represented at its sessions. Other organizations which are not members of the United Nations system may also be invited to send observers to sessions of the Group by agreement among the sponsoring organizations.

Financial arrangements for sessions

10 The sponsoring organizations share appropriately the costs of conference services and documentation pertaining to sessions of the Joint Group. Each sponsoring organization accepts responsibility for the expenses for participation in sessions by the experts it nominates and for maintaining contact with such experts.

ANNEX I

AGENDA

- 1 Adoption of the provisional agenda
- 2 Report of the Administrative Secretary
- 3 Assessment of the condition of the marine environment
- 4 Evaluation of the hazards of harmful substances carried by ships
- 5 Indicators of marine ecosystem health
- 6 Environmental impacts of coastal aquaculture
- 7 Sea-surface microlayer
- 8 Opportunistic settlers and the problem of ctenophore *Mnemiopsis leidyi* in the Black Sea
- 9 Future work programme
- 10 Matters of immediate concern with regard to the status of the marine environment
- 11 Other matters
- 12 Date and place of next session
- 13 Election of Chairman and Vice-Chairman
- 14 Consideration and approval of the report of the twenty-fourth session

ANNEX III

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