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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. 41

1990

REPORT OF THE TWENTIETH SESSION

Geneva, 7-11 May 1990



**WORLD METEOROLOGICAL ORGANIZATION**

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Reports and Studies No. 41

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

REPORT OF THE TWENTIETH SESSION

Geneva, 7-11 May 1990

WMO, 1990

## NOTES

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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 SEA WATER AND REDUCTION OF AMENITIES."

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Rep. & Stud. No.	Title	Date	Language
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1.	Report of the Seventh Session	1975	E,F,R,S
2.	Review of Harmful Substances	1976	E
3.	Scientific Criteria for the Selection of Sites for Dumping of Wastes into the Sea	1975	E,F,R,S
4.	Report of the Eighth Session	1976	E,F,R
5.	Principles for Developing Coastal Water Quality Criteria (Published also as UNEP Regional Seas Reports and Studies No. 42)	1976	E
6.	Impact of Oil on the Marine Environment	1977	E
7.	Scientific Aspects of Pollution Arising from the Exploration and Exploitation of the Sea-bed	1977	E
8.	Report of the Ninth Session	1977	E,F,R,S
9.	Report of the Tenth Session	1978	E,F,R,S
10.	Report of the Eleventh Session	1980	E,F,S
11.	Marine Pollution Implications of Coastal Area Development	1980	E
12.	Monitoring Biological Variables related to Marine Pollution	1980	E,R
13.	Interchange of Pollutants between the Atmosphere and the Oceans (First report)	1980	E
14.	Report of the Twelfth Session	1981	E,F,R
15.	The Review of the Health of the Oceans (Published also as UNEP Regional Seas Reports and Studies No. 16)	1982	E
16.	Scientific Criteria for the Selection of Waste Disposal Sites at Sea	1982	E
17.	The Evaluation of Hazards of Harmful Substances Carried by Ships	1982	E
18.	Report of the Thirteenth Session	1983	E,F,R,S
19.	An Oceanographic Model for the Dispersion of Wastes Disposed of in the Deep Sea	1983	E
20.	Marine Pollution Implications of Ocean Energy Development	1984	E
21.	Report of the Fourteenth Session	1984	E,F,R,S
22.	Review of Potentially Harmful Substances	1985	E
23.	Interchange of Pollutants Between the Atmosphere and Oceans (Second report)	1985	E
24.	Thermal Discharges in the Marine Environment	1984	E

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No.

Title

Date Language

25.	Report of the Fifteenth Session	1985	E,F,R,S
26.	Atmospheric Transport of Contaminants into the Mediterranean Region (Published also as UNEP Regional Seas Reports and Studies No. 68)	1985	E
27.	Report of the Sixteenth Session	1986	E,F,R,S
28.	Review of Potentially Harmful Substances. Arsenic, Mercury and Selenium (Published also as UNEP Regional Seas Reports and Studies No. 92)	1986	E
29.	Review of Potentially Harmful Substances. Organosilicon Compounds (Silanes and Siloxanes) (Printed in limited number by IMO and published also as UNEP Regional Seas Reports and Studies No. 78)	1986	E
30.	Environmental Capacity. An approach to Marine Pollution Prevention (Published also as UNEP Regional Seas Reports and Studies No. 80)	1986	E
31.	Report of the Seventeenth Session	1987	E,F,R,S
32.	Land-sea Boundary Flux of Contaminants: Contributions from Rivers	1987	E
33.	Report of the Eighteenth Session	1988	E,F,R,S
34.	Review of Potentially Harmful Substances. Nutrients	1990	E
35.	The Evaluation of the Hazards of Harmful Substances Carried by Ships: Revision of GESAMP Reports and Studies No. 17	1989	E
36.	Pollutant Modification of Atmospheric and Oceanic Processes and Climate: Some Aspects of the Problem (Printed in limited number by WMO and published also as UNEP Regional Seas Reports and Studies No. 117)	1989	E
37.	Report of the Nineteenth Session	1989	E, F, R
38.	Atmospheric Input of Trace Species to the World Ocean	1989	E
39.	The State of the Marine Environment (Published also as UNEP Regional Seas Reports and Studies No. 115)	1990	E
40.	Long-Term Consequences of Low-Level Marine Contamination	1989	E
41.	Report of the Twentieth Session	1990	E

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1. INTRODUCTION

- 1.1 The Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) held its twentieth session at WMO Headquarters, Geneva, from 7 to 11 May 1990, under the Chairmanship of Mr. H.L. Windom. Mr. D. Calamari was Vice-Chairman of the session.
- 1.2 Mr. R. Czelnai, Assistant Secretary-General of WMO, welcomed the participants on behalf of the Secretary-General of WMO. The WMO from the very beginning in 1969 supported the idea of this Joint Group composed of scientists acting in their individual capacities and the advice and recommendations of GESAMP have always been appreciated and taken into account by its constituent bodies, such as the World Meteorological Congress, Executive Council, Regional Associations and Technical Commissions. At present WMO is particularly interested in studying the changing composition of the atmosphere which may result in climate changes and have consequences for the marine environment. In conclusion Mr. Czelnai wished GESAMP every success in the performance of its tasks.
- 1.3 A list of participants is shown in Annex I and a list of documents in Annex II.

2. STATE OF THE MARINE ENVIRONMENT

The Group decided that each year it would issue a consensus on the state of the marine environment as follow-up to its "Report on the State of the Marine Environment", the Executive Summary of which is attached as Annex III. The text of the Statement is as follows:

STATE OF THE MARINE ENVIRONMENT: 1990

"GESAMP reaffirms the importance of the concerns listed in paragraph 17 of the Executive Summary of its Report on the State of the Marine Environment. It also highlights the fact that global climatic change may be the most important environmental issue facing humankind, and notes with concern the uncertainties surrounding the role of the oceans in the global carbon cycle. It recognizes that potential impacts resulting from global climatic changes are almost certain to accentuate current coastal zone management problems.

GESAMP stresses the fact that most of the current marine and ocean problems are concentrated in coastal zones. By the year 2000 the global population will exceed 6500 million people of whom over half will live in tropical developing countries and more than half will be living in the coastal zones of the world. It is likely therefore that without appropriate management measures these problems will become worse.

The apparent increase in harmful algal blooms, eutrophication and associated regional anoxia, and fish diseases are highlighted as causes for immediate concern, while causes for longer term concern centre on the potential impacts of climatic change on coastal environments and resources.



GESAMP recognizes that many of the mitigation measures necessary to address these problems involve management actions and decisions affecting areas at some distance from the marine environment. Control of eutrophication problems for example may involve changes in agricultural practices and riverine transport of contaminants, modification of sewage treatment and discharge.

GESAMP advocates an integrated approach to marine environmental management which should include consideration of different environmental sectors and incorporate economic, social, scientific and technological considerations to provide balanced decision-making in achieving sustainable development."

### 3. STRATEGIES FOR MARINE ENVIRONMENTAL PROTECTION AND MANAGEMENT

3.1 The Working Group report contains a number of scientific elements which were endorsed by GESAMP. It was stressed that environmental management strategies should include a hazard assessment exercise based on sources and loads of contamination, and data on toxicity to marine organisms, using QSAR predictions where specific information is not available. Should this assessment, based on conservative estimates, indicate a potential pollution problem, then new information may have to be sought to improve the accuracy of the predictions. This will assist in the formulation of effective regulatory action to reduce the pollutant load and to minimize harmful effects.

3.2 If the assessment predicts that environmental problems are unlikely to occur, then routine monitoring is undertaken, specifically in the environmental compartment subject to the greatest exposure, in order to show that the prediction is confirmed. The report describes the hazard prediction for chemical pollutants, it was however agreed that the same approach *mutatis mutandis* can be applied for other potential hazards, e.g. man-made physical change of the coastal environment.

3.3 Building on the results of the Working Group 28, as well as on ideas developed by Working Group 29, the Group undertook to formulate the underlying principles and elements for the protection and management of marine and coastal environment and their resources as a contribution of GESAMP towards the preparations for the 1992 United Nations Conference on Environment and Development. The text of the agreed principles and elements is given in Annex IV.

### 4. REVIEW OF POTENTIALLY HARMFUL SUBSTANCES

#### 4.1 Carcinogens

4.1.1 The Group received a draft report on various aspects of carcinogenic substances in marine biota, concerning both tumours in fish and cancer risk in humans due to seafood consumption. The Group concluded its deliberations on this topic by agreeing to the following summary statement:

- 4.1.2 There have been many suggestions that cancers in fish and other marine organisms are commonplace and are attributable to chemical pollution. There is also concern that as a number of known carcinogens are accumulated by marine organisms that are commercially exploited as human food, they may as a result present a risk to man.
- 4.1.3 A critical review of the European and North American literature concerning cancer in fish and shellfish shows that, although there are indeed many reports of "cancers" and "precancerous" lesions in fish and shellfish, there is considerable evidence to suggest that due to improper use of terminology, some of the reports are erroneous or misleading. There is some evidence, especially from North America, that polycyclic aromatic hydrocarbons and a few other hydrocarbons may cause liver cancer in fish. However, there is very little unambiguous evidence to suggest that other cancers in fish are associated with chemical contaminants. Although the adverse effect on individual fish is undisputed, the review identifies no substantial basis for concluding that the cancer problem in fish is serious enough to prejudice the survival of exposed populations of the species affected, even at the local level.
- 4.1.4 From a human health standpoint, the review of available data on concentrations of a few organic chemicals and elements linked with cancer and known to be accumulated by marine organisms is rather reassuring. It shows that for most substances for which an assessment was made (cadmium, mercury, lead, arsenic and the pesticides; aldrin, dieldrin, DDT, chlordane, heptachlor and hexachlorocyclohexane) the consumption of seafood is unlikely to pose undue cancer risks.
- 4.1.5 For a few substances (nickel, PCB's and nitrosamines) no conclusion could be reached. In certain instances, polycyclic aromatic hydrocarbons in seafood could present an increased cancer risk.
- 4.1.6 Therefore, there is a need for continued vigilance and control over the disposal of known carcinogens into the environment. More research is necessary to establish cause and effect relationships between carcinogens and marine species. Thus far it is assumed that only chemicals which induce cancer in terrestrial mammals are likely to be the causative agent of cancers in marine organisms. This may or may not be correct.
- 4.1.7 The review suggests that discharges of carcinogens into the marine environment should be kept as low as possible, taking into account technical and economic circumstances. The present risk is small but the potential one is real enough to predicate the restrictions currently applied to carcinogens in general and particularly to those specifically identified in this review as potential carcinogenic agents.

## 4.2 Organochlorine compounds

- 4.2.1 The subgroup on chlorinated hydrocarbons reported to the twentieth session of GESAMP. It was agreed that the organochlorine compounds represented a group of substances which had widely diverse toxic properties; therefore, there was a need at the outset to separate the group into several clearly defined sub-groups. It was clear that the higher molecular weight chlorinated aromatic compounds such as PCBs and PCDDs formed a separate subgroup for special attention. Similarly, the highly toxic and persistent chlorinated insecticides such as DDT, lindane and chlordane required separate consideration, as did the chlorinated herbicides. Considerable information including comprehensive reviews exist for these substances, which will facilitate the production of comprehensive hazard assessments.
- 4.2.2 The remaining organochlorine compounds were divided into low molecular weight compounds (less than 3 carbon atoms), aliphatic and aromatic compounds (up to 6 carbon atoms) and long-chain chlorinated paraffins. There were 720 compounds within these 3 groups which were shown by a survey of existing literature to be relevant to the marine environment. These substances were subjected to a preliminary hazard assessment, based on scientifically accepted criteria for toxicity, persistence and bioaccumulation, to identify those compounds which may present the greatest environmental hazard. Adjustments were made to allow for those substances produced in large quantities. This led to the identification of 77 compounds which represented the most hazardous organochlorine compounds in these 3 groups. For some of the other substances, the data made available were insufficient for an assessment and where necessary the gaps will need to be filled by the use of QSARs and comparison with similar compounds. It was agreed that this approach was a necessary step towards the production of specific hazard profiles for those organochlorine compounds of known or suspected environmental importance.
- 4.2.3 It was agreed that the problem of complex effluents containing chlorinated compounds, such as those arising from certain paper mills, could not be incorporated into this programme, which was directed towards single substances; the solution to this problem does not depend solely on the isolation and removal of specific compounds known to be harmful. The general theory of the toxicity of mixtures of substances has been recently reviewed and the results are applicable to commonly-known organochlorine compounds.
- 4.2.4 It was decided to publish findings of the sub-group as GESAMP Reports and Studies No. 42. The work will be continued through the Working Group on Potentially Harmful Substances. The Working Group will endeavour to prepare specific hazard profiles for individual substances or groups of substances which appear to be of priority concern, based on quantities used and access to the marine environment, and to assess the risks and fates of such substances in the marine environment.

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

4.3.1 The Group considered the draft on the review of "used lubricating oils". At this time, the draft review on used lubricating oils has concluded that:

- (a) used crankcase oils are a major source of PAHs (polycyclic aromatic hydrocarbons), lead, and various compounds from oil additives to coastal and marine environments. However, concerns about crankcase oil pollution relate principally to urban and industrialized harbors, and embayments, due to inputs from sewer outfalls.
- (b) crankcase oils probably have negligible acutely toxic (lethal) effects in the marine environment.
- (c) chronic sublethal effects in marine organisms that may be caused by elevated levels of PAHs and lead in the nearshore sediments of confined harbors or bays are of primary concern and interest.
- (d) there is sufficient evidence to be concerned about carcinogenesis occurring in marine animals exposed to combustion sources of PAHs, including those found in used engine oil.
- (e) there is some evidence that combustion sources of PAHs in sediments in the 3 to 5 ppm range can produce adverse effects, including carcinogenesis in certain benthic species.
- (f) concentrations of PAHs found in some frequently consumed edible species taken from areas having high levels of sediment contamination by combustion/used engine oil sources may result in a slight risk of human carcinogenesis.
- (g) there appears to be insufficient evidence to suggest that inputs of lead into the marine environment from used engine oil are of ecotoxicological importance. Any acute or chronic toxic effects would be expected to occur only in areas under extreme levels of lead contamination.
- (h) overall evaluation: Harbor and other sediments contaminated with relatively high (>3-5 ppm) levels of crankcase oil can be expected to be sublethally toxic to marine biota, especially among the benthos. Similarly, any edible species taken from such areas may impose a slight risk of human carcinogenesis. However, in both cases, it is important to stress that any adverse effects would be associated with localized areas of contamination.

4.3.2 The Group noted that the above conclusions should be considered tentative pending completion and peer review of the oil review.

- 4.3.3 GESAMP expressed its expectation to consider the final draft of the review at its next session. It agreed to change the title of the report to "Oil and individual hydrocarbons, including used lubricating oils, oil spill dispersants and chemicals used in offshore exploration and exploitation".

5. COASTAL MODELLING

The Group considered the draft report prepared by the Working Group on Coastal Modelling. It proposed several editorial changes and the addition of a decision flow chart for the construction of specific models. The draft report, as amended, was approved for publication under GESAMP Reports and Studies No. 43.

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

- 6.1 The Group noted that during the inter-sessional period approximately 200 substances which are carried by ships or are proposed for sea transport have been evaluated. The Group released the new hazard profiles for use by IMO for the development of the respective carriage and discharge requirements in accordance with MARPOL 73/78, Annexes II and III.
- 6.2 The Group agreed to the views expressed by its working group that there was no evidence of any human health problem arising from the arsenic content of consumed marine organisms. The Group further agreed that there was no evidence that zinc compounds are bioaccumulated with attendant risk to aquatic organisms or human health.
- 6.3 The Group noted that its Working Group upon request by IMO had considered the effects on the marine environment of discharges from sheep and cattle carriers. The Group concurred with the views of its Working Group that discharges from livestock carriers into the high sea and in areas 20 miles from the nearest land primarily add nutrients to the marine environment, but that, in the opinion of the Group, this input does not cause significant effects. The Group also agreed with the advice that the dumping overboard of dead livestock (slit to the extent that the thoracic and abdominal cavities are opened) should be carried out far away from fishing grounds.
7. COMPREHENSIVE FRAMEWORK FOR THE ASSESSMENT AND REGULATION OF WASTE DISPOSAL IN THE MARINE ENVIRONMENT
- 7.1 GESAMP reviewed the progress made by this Working Group which had been established at its XIXth Session. The basis of the review was a document prepared by a small group of experts in February 1990 (GESAMP XX/7). This document elaborated an approach to the task which contained the following steps:
- (i) A review of the basic principles for environmental protection as adopted by the United Nations Conference on the Human Environment, 1972;

- (ii) Analysis of international agreements and approaches on marine environmental protection that aim to fulfill all or part of these basic principles;
- (iii) Identification of any deficiencies in technical and scientific elements of these agreements and approaches; and
- (iv) Preparation of a report that discusses the outcome of the analysis and identifies opportunities for improving the assessment and regulation of waste disposal in the marine environment. The report should take account of the need for a comprehensive framework for the protection and management of the marine environment that incorporates scientifically-based procedures for the assessment and control of marine pollution.

7.2 The Group endorsed the approach proposed by the Working Group in general but recommended that it should not allocate a disproportionate amount of time to the analysis of individual agreements on, or approaches to, marine pollution prevention. Priority should be given to the elements of these instruments that incorporated scientific concepts and principles. The Group agreed that the Working Group should submit a substantially-completed draft report for consideration by GESAMP at its twenty-first session.

## 8. IMPACTS OF ANTHROPOGENICALLY MOBILIZED SEDIMENTS IN THE COASTAL ENVIRONMENT

The Group agreed with the general conclusions set out in the progress report of the Working Group as follows:

- (i) the surveys carried out by Drs. Milliman and Pernetta show that Southern Asia and Oceania contribute 70% of the world flux, although comprising only 15% of the land area; north eastern South America contributes 11%; the large Oceania input is due to the small river basins having little capacity to store sediment and thus small rivers in some limited size islands contribute as much sediment to the ocean as the Mississippi; the data base for Asia (except China) and South America is, however, very poor.
- (ii) erosion rates are changing continuously with Asian and Oceanian rivers discharging today five times the values before deforestation began and due to deforestation in Nepal the sediment load of the Ganges is much increased in recent years. Yet due to damming the Rhone carries only 5% of the load carried in the 19th century and the Indus now carries only 20% of the load before construction of barrages in the late 1940's.
- (iii) the amount of sediment actually reaching the ocean is in dispute. Some authorities believe that sediment settles rapidly and rarely reaches the continental shelf, whereas others maintain that material reaches the continental slope. It is probable that fluvial sediments reaching broad continental shelves remain trapped whereas on narrow shelves material can reach the deep sea.

- (iv) the areas most at risk to changes in sediment flux are the areas of high urban concentrations and large rivers (Indus, Ganges-Brahmaputra, Irrawady, Mekong, Pearl, Changjiang) which are also most sensitive to sea-level changes.
- (v) effects of the Aswan Dam have led to destruction of the coastal fishery, erosion rates of hundreds of metres per year and increased subsidence rates, which combined with rising sea level suggests that 25% of Egypt's land area could be inundated by 2100.
- (vi) effects of increased sediment discharge in destruction of coral reefs have been documented in the Philippines and Kenya with a subsequent reduction in tourism and fisheries yield.
- (vii) repeated floods in Bangladesh may lead to the building of dams and dikes which would result in destruction of the coastal mangroves on which 30% of the population survive and would alter sediment flux rates with as yet unknown consequences for the coastal areas. There are also strong pressures to increase dam and irrigation projects in Asia and yet the consequences of altered sediment flux are not considered.

## 9. FUTURE WORK PROGRAMME

### 9.1 Establishment of new working groups

#### 9.1.1 Environmental impacts of coastal aquaculture

Food production through aquaculture is rapidly increasing worldwide. Aquaculture development, and its sustainability, are however highly dependent on the environmental and socio-economic setting of each aquaculture enterprise. The expansion of coastal aquaculture could have severe consequences for the aquatic environment and for aquaculture itself due to water quality degradation and to contamination of the food produced. There is a vast potential for culture-based fisheries or open-water stocking of culture species especially in lagoons, enclosed bays and inland seas; the environmental impacts of such practices need to be addressed. Nevertheless, in many countries coastal aquaculture is contributing substantially to fish production and foreign-exchange earnings.

The Group decided to establish a Working Group on the Environmental Impacts of Coastal Aquaculture with the following terms of reference:

To prepare a 20-25 page document containing:

- (a) an analysis of impact of present coastal aquaculture practices on the marine and coastal environment as well as on human health; and
- (b) guidelines for environmentally sound management of coastal aquaculture.

### 9.1.2 Global change and the sea/air exchange of chemicals

One of the most urgent issues facing society over the next several decades is global environmental change, especially the change in composition of the atmosphere and related climate change resulting from the increasing atmospheric concentrations of greenhouse gases. Global climate change would cause the alteration of precipitation and wind flow regimes in some regions as well as atmospheric residence times of some species, thus changing the patterns of pollution transport and air/sea exchange. Other important global environmental changes include the increased production and emission to the atmosphere and the ocean of a variety of other harmful pollutants, the changing oxidizing capacity of the atmosphere and the ocean, and the present and future alteration of stratospheric ozone resulting in increased quantities of ultraviolet radiation reaching the earth's surface. The impact of global change on the coastal zone will be particularly important, putting increasing pressure on the part of the marine environment that is most biologically and economically productive.

The Group agreed to establish a Working Group on the Global Change and the Sea/Air Exchange of Chemicals and determined the following three main issues for the Working Group to deal with: exchange of nutrient nitrogen between the ocean and the atmosphere, global warming and sea/air exchange of gases and the changing oxidizing capacity of the atmosphere and the ocean.

The Working Group was requested to consider and evaluate the above issues at an expert meeting and to prepare a brief report by the next session of GESAMP in 1991.

### 9.2 Intersessional work

The Group noted that intersessional work is planned to be carried out on the following issues:

1. Evaluation of the hazards of harmful substances carried by ships (Working Group 1)

Lead agency: IMO; co-sponsor: UNEP

Chairman: W. Ernst; GESAMP member: P. Wells

A meeting of the Working Group will be convened in April 1991 to:

- evaluate substances listed in the International Maritime Dangerous Goods (IMDG) Code, in particular class 3 (flammables);
- evaluate solid bulk cargoes transported by ships;
- evaluate hazards to the marine environment caused by copper compounds used in anti-fouling paints;
- review bioaccumulation and tainting ratings of the existing hazard profiles.



## 2. Review of potentially harmful substances (Working Group 13):

Lead agency: Unesco; co-sponsors: UNEP, FAO, WHO, IMO

Chairman: L. Landner

### 2.1 mutagenic substances (sub-group 1)

Lead agency: Unesco; co-sponsors: UNEP, WHO, FAO, IMO

Chairman: F. Wuergler

Preparation of an extended review paper by the chairman to be evaluated by the members of the sub-group and completed by correspondence. Concerning teratogenic substances, D. Calamari will provide information on feasibility of GESAMP evaluation and report to the WMO Technical Secretary.

### 2.2 chlorinated hydrocarbons (sub-group 2)

Lead agency: FAO; co-sponsors: UNEP, Unesco

Chairman: R. Lloyd; GESAMP member: D. Calamari

In case requests for reviews of specific organochlorine compounds are received in time from any of the co-sponsors, a meeting of this subgroup will be held in autumn 1990.

### 2.3 oil and other hydrocarbons, including used lubricating oils, oil spill dispersants and chemicals used in offshore exploration and exploitation (sub-group 3)

Lead agency: IMO; co-sponsors: UNEP, FAO, Unesco

Chairman: P. Wells

A meeting of the sub-group will be convened in January 1991 to finalize the review paper for consideration by GESAMP at its next session.

## 3. Comprehensive framework for the assessment and regulation of waste disposal in the marine environment (Working Group 29)

Lead agency: IMO; co-sponsors: UN, UNEP, Unesco; IAEA

Chairman: R. Boelens; GESAMP members: J.M. Bewers, R. Lloyd,  
P. Tortell and P. Wells

One meeting of the Working Group will be convened in late 1990 to evaluate the effectiveness, applicability and scientific viability of the current marine environmental protection framework. This will include:

- an analysis of the strategies and elements of existing international agreements and national approaches; and
- an examination of the extent to which the measures adopted for coastal and marine environmental protection comply with the provisions of relevant international agreements, and an estimation of additional expenditures necessary to overcome any deficits, including political and social implications.