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The health of the oceans

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PREFACE

Although the idea of summarizing the state of marine pollution in the world oceans is probably much older than one might imagine, the specific idea of reviewing the health of the oceans seems to have first arisen in the report of the ACMRR/SCOAR/WMO Joint Working Party on Global Ocean Research (Ponza and Rome, 29 April – 7 May 1969).

This idea was taken up by the ACMRR/SCOR/ACOMR/GESAMP Joint Working Party on the Global Investigation of Pollution in the Marine Environment (San Marco di Castellabate and Rome, 11 – 18 October 1971).

The Action Plan adopted at the United Nations Conference on the Human Environment (Stockholm, 5 – 16 June 1972) recommended that GESAMP should assemble scientific data and provide advice on scientific aspects of marine pollution especially those of an interdisciplinary nature.

The IOC International Co-ordination Group for GIPME at its first session (London, 2 – 6 April 1973) recommended that the Secretary of IOC retain a consultant to bring together the available data into a report on the Health of the Oceans. Professor E. D. Goldberg* of the University of California at San Diego was asked to do this work, and his report was published by UNESCO in 1976.

The fifteenth session of the Inter-Secretariat Committee on Scientific Programmes Relating to Oceanography (ICSPRO), recommended "..... that GESAMP should be invited to advise agencies, and UNEP was asked to take the initiative, in consultation with other agencies, for the preparation of a detailed request to GESAMP for a critical examination of present and planned methods by which to generate a continuous authoritative review and assessment of the health of the oceans". The initiative requested of UNEP was taken at the meeting of the GESAMP Joint Secretariat (Geneva, 4 – 5 June 1977) when it was decided that the preparation of "periodic reviews of the state of the marine environment as regards marine pollution" should become one of the main terms of reference for GESAMP**.

The tenth session of GESAMP (Paris, 25 February – 1 March 1978) established the Working Group on a Review of the Health of the Oceans, with the objective of providing:

> "a periodically updated review of: the state of pollution of the world's oceans; the global mass balance of marine pollution; the trends of changes in ocean-related natural processes (e.g. climate) and living resources, amenities and other legitimate uses of the marine environment as well as on the land directly influenced by the oceans".

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* Goldberg, E. D. (1976). The Health of the Oceans. UNESCO, Paris.
** Pravdic, V. (1981). GESAMP, The First Dozen Years. UNEP, Geneva.

The Working Group was given the following terms of reference:

(i) to provide succinct periodic (3-4 years) critical reviews and scientific evaluation of the influence of pollutants on the marine environment;

(ii) to advise on the extent to which potentially harmful substances, processes or activities may affect the health of the oceans and the various uses of the marine environment;

(iii) to advise on areas requiring further examination either because of their relatively higher degree of contamination or lack of detailed accurate information.

All GESAMP co-sponsors (IMCO, FAO, UNESCO, WMO, WHO, IAEA, United Nations and UNEP) expressed their wish to co-operate and provide inputs to the work of the Group. UNESCO was asked to be the Lead Agency, providing administrative and technical support for the Group, with major financial support provided by UNEP. The composition of the Working Group was carefully selected by the co-sponsors of GESAMP and the Chairman of the Group, taking into account the necessity of covering most scientific disciplines as well as having experts from as many regions of the world as possible.

At the first meeting of the Working Group, held in Copenhagen (5 - 11 July 1979), the preliminary outline of the final report was discussed and agreed upon. The following subjects were selected for intersessional work by separate Task Groups: (a) Interface Flux Modelling; (b) Toxic Substances; (c) Biogeochemical Cycles, and (d) A Review of Geographical Areas.

The approach proposed by the Group was approved by GESAMP at its eleventh session (Dubrovnik, 25 - 29 February 1979).

The final draft report prepared by the Working Group was reviewed and revised by the twelfth session of GESAMP (Geneva, 22 - 28 October 1981), and the revised version was endorsed by the GESAMP experts and all the eight co-sponsors of GESAMP for publication as GESAMP's response to the recommendation of the 1972 Stockholm Conference on the Human Environment.

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EXECUTIVE SUMMARY

This presents the findings and conclusions of the Group, and in general is set out according to the terms of reference given in the preface.

1. Substances, activities, processes and effects

Man's activities contribute substantially to the fluxes of certain elements in the marine environment. For substances such as carbon dioxide, cadmium, arsenic, lead and mercury, fluxes of anthropogenic material approach or exceed the natural fluxes. Increased concentrations of lead, some radionuclides and carbon dioxide can be detected in the open ocean.

Many contaminants, particularly carbon dioxide and some metals, circulate widely in the atmosphere, and enter the oceans on a global scale primarily through the air-sea interface. Carbon dioxide is a significant environmental contaminant. Its principal direct impact is expected to be in the atmosphere and on the climate, and since this is being intensively investigated by several international expert bodies, carbon dioxide has not received detailed attention in this first report.

Trends in concentrations of some pollutants can be detected in the open ocean as illustrated by the presence of human-derived tritium at the Bahamas, of caesium-137 at the Arctic boundaries, and of increased levels of lead in open-ocean surface layers. Increased contamination in the form of tar-balls and oil-slicks, and, in some areas, elevated heavy metal levels are being seen along shipping routes, transportation by sea being a major use of the ocean. There is also the suggestion of decreased trends, for example in DDT and PCB concentrations, at higher latitudes of the northern hemisphere. On the other hand, there is the expectation, supported by some evidence, of increased concentrations of these compounds in the southern hemisphere and lower latitudes of the northern hemisphere.

The ocean surface microlayer controls the input of many gases and is a zone of high concentration of some substances, including heavy metals, organochlorines, and petroleum. No serious damage is known to have been done to this important interface by contaminants, although the potential exists for altering fluxes by the introduction of substances causing surface films. In this context, data from the Marine Pollution (Petroleum) Monitoring Pilot Project (MAPMOPP) of the Integrated Global Ocean Station System (IGOSS) indicate that of the area monitored, which included the major shipping lanes, between .05 and 0.1 per cent of the sea surface was covered by oil films at any given time.

Many substances eventually reach the sea floor. There they interact with the marine sediments and biota at the sediment-water interface. As yet, serious damage is known to have occurred only in very localized regions.

Some contaminants, such as radionuclides, halogenated hydrocarbons, and trace metals, can be detected at considerable distances from their sources, partly because of their world-wide transport by wind and ocean systems, and partly because sensitive methods are available for their detection. The controlled disposal of

low-level radioactive wastes in coastal and deep ocean waters is governed by the guidelines and protection limits for the general public recommended by the International Commission on Radiological Protection (ICRP). The dumping of packaged low-level wastes is governed by the London Dumping Convention and the guidelines and recommendations of the International Atomic Energy Agency (IAEA). Compliance with the spirit and intent of these regulations should ensure that the radiation exposure to human populations does not exceed internationally recognized standards.

There is no confirmed record of human illness having been caused by consumption of marine organisms due to their content of PCBs. However, the concentrations of PCB residues in some marine organisms exceed the level set by some national authorities in order to safeguard human health. On the ecological side, it is suspected that seals in some regions have suffered reproduction damage. The pathways and fate of DDT and other organochlorines are becoming reasonably well understood in the marine environment as are the toxic effects of their metabolites. DDT residues in seafood are not likely to place man at risk but fear of contamination from this and other sources could damage the marketability of seafood.

Pollution is generally most severe in semi-enclosed marginal seas and coastal waters bordering highly populated and industrialized zones. Such areas have substantial concentrations of contaminants from land-based sources. The environmental effects vary from one part of the coastal zone to another depending on the type and volume of the wastes, and the nature of coastal activities. Many pollutants introduced to the coastal zone remain there, at least temporarily.

Major chronic inshore marine pollution problems can often be attributed to the discharge of large volumes of wastes that have a local impact. These include materials which are partially biodegradable, such as raw sewage, sewage sludge, food and beverage processing wastes, pulp and paper mill effluents, woollen and cotton mill wastes, and sugar refinery effluents. Solid wastes such as mine tailings and dredge spoils are also in this category.

For sewage, problem areas are local rather than global, and coastal rather than oceanic. Sewage does present a direct risk of infections to humans on some beaches, especially during recreational seasons. Discharge on or near shellfish beds presents a greater risk to human health through the consumption of contaminated seafood.

Nutrient increase is often associated with sewage, and the impact of this has been perceptible in many coastal regions. The effects of nitrogenous wastes are usually most obvious, but phosphate may adversely alter the species composition of