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SUMMARY OF THE REVISED FRAMEWORK FOR SCIENTIFIC ACTIVITIES WITHIN THE IOC OCEAN SCIENCE RELATING TO GLOBAL INVESTIGATIONS OF POLLUTION IN THE MARINE ENVIRONMENT (GIPME)

This document was prepared by the Chairman of GIPME, Dr. J.M. Bewers, to provide information on progress in the restructuring of the GIPME Programme in pursuant to IOC Assembly Resolution XIX-4.

The Executive council is invited to consider the information presented and provide guidance on further work by IOC.

BACKGROUND

1. For the past 20 years, the Global Investigation of Marine Pollution in the Marine Environment (GIPME) Programme has been working on issues of marine contamination and pollution. Through method development programmes, workshops and intercomparison exercises, techniques have been developed to assess contaminant concentrations in several marine matrices and the effects of contaminants on marine organisms. GIPME is co-sponsored by the Intergovernmental Oceanographic Commission (IOC), the United Nations Environment Programme (UNEP) and the International Maritime Organization (IMO).

2. The foundation for GIPME was established in IOC Technical Series No 14 entitled *'A Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment and Baseline Study Guidelines'* (IOC, 1976). The current framework for the implementation of the GIPME Programme was outlined in IOC Technical Series No. 25 (IOC, 1984).

3. With the development of the Global Ocean Observing System (GOOS), scientists from within GIPME have also been involved in the design of the GOOS Health of the Oceans Module (HOTO). HOTO is the GOOS Module that is expected to monitor the condition of the ocean, its resources and amenities, in the context of concerns about environmental degradation. Specification of the objectives and strategic design of HOTO was completed in 1996 and appears in IOC/INF-1044 (IOC, 1996).

4. The 19th Assembly of the IOC in 1997 adopted Resolution XIX-4 that changed, in a fundamental way, the manner of implementation of the GIPME Programme and clarified the relationship between GIPME and HOTO. This decision necessitated a detailed re-evaluation of ocean science activities within GIPME, particularly the objectives and *modus operandi*, to provide guidance to those involved in GIPME and in associated IOC activities such as GOOS.

5. The previous GIPME Strategic Plan addresses solely the issue of 'pollution' in the sense of the introduction of substances into the marine environment and does not specifically cover some non-pollution issues that have become of major concern in the present decade in respect to the protection of the marine environment from the overall effects of anthropogenic activities.

6. Indeed, much has changed in the field of marine pollution during the 24-year period since the inception of GIPME and major changes in policy perspectives have taken place in recent years regarding the protection of marine environment. Specifically, reassessment of the relative importance of different pollutants has taken place because of either the advancement of science or the need to prioritize regulatory actions.

7. The most recent GESAMP Review of the State of the Marine Environment (GESAMP, 2000) highlights as the most serious compromises and threats to the marine environment, aside from possible climate change, the following: physical alteration; overfishing; sewage; eutrophication; and changes in sediment transport. Of these, only sewage constitutes a 'classical' pollution issue; the others result from new information and new perspectives on damage and threats to the marine environment on a global scale. All of the priority issues identified by GESAMP fall within the basic mandate proposed for the GIPME Programme.

8. On the other hand, new perspectives in marine environmental protection require new integrated approaches in research as well as management. The challenge for marine pollution

research is now to link root causes with effects. The starting point is now *the problem* and each *problem* may be multifaceted requiring a knowledge of causes, levels, effects and potential synergism. Links invariably involve interdisciplinary research, including modelling. For example, the issue of effects of increased nutrient fluxes on ocean ecology encompasses understanding and prediction of fluxes through ocean boundaries and interfaces, chemical-biological interactions, marine chemistry in relation to transformations, carbon fluxes, oxygen demand and transport by physical processes. It requires, in other words, interdisciplinary science approach involving the understanding of coupled chemical, biological – ecosystem dynamical ocean processes.

9. These new perspectives involve objectives that are now attainable. Scientific understanding of the oceans and the mechanisms by which contaminants enter, circulate and are removed from the marine environment, has improved substantially. In fact, after two decades of progress in studying major physical, biological and geochemical processes in the marine environment, ocean science is undergoing a major conceptual revolution. It is now feasible to undertake important interdisciplinary studies that were previously intractable (Robinson *et al.*, 1999). It is therefore desirable that the activities of the IOC regarding the protection of the marine environment should closely reflect the new interdisciplinary nature of ocean science.

10. In conclusion, there is reason to broaden the perspectives of the GIMPE Programme beyond 'classical' pollution issues to all issues dealing with the adverse effects of anthropogenic activities on the marine environment except those involving climate change, habitat destruction and fisheries which are addressed primarily by other IOC or international programmes.

THE CHALLENGE FOR GIPME

11. A document has been prepared by the Chairman of GIPME, Dr. J.M. Bewers, in consultation with several experts. It represents the results of a re-evaluation of the needs for interdisciplinary ocean science in regard to the GIPME Programme in the context of new perspectives of damage and threats to the marine environment, its resources and amenities, and scientific advances made in the last two decades.

12. The salient highlights of the review document on GIPME are as follows.

13. The overall focus of the GIPME Programme should be anthropogenic activities (aside from those involving climate change, habitat destruction and fisheries) causing, or likely to cause adverse effects in the marine environment, its resources and amenities, and associated threats to human health (*i.e.*, those arising from exposures to the marine environment or the use of resources obtained therefrom). Such a focus can respond to contemporary demands in a number of areas and programmes, to which GIPME could legitimately provide advice and information, required protocols and approaches for diagnoses and prediction of state, trends and vulnerability of marine systems and/or areas. Such a focus would enable, in principle, a good number of all current issues of concern to governments regarding damage and threats to the marine environment to be addressed within GIPME.

14. Furthermore, in order to be able to provide practical validation of hindcasts and forecasts, there is a need for the development and application of indicators of state and trends in marine systems. It is proposed that the restructured GIPME Programme devote significant emphasis to indicators, especially in relation to sediment quality and benthos, rapid assessment procedures for broad application in coastal areas, and associated modelling that is required to undertake risk assessment.

15. The priority fields of endeavour requiring primary attention within GIPME both for the purposes of satisfying contemporary marine environmental management needs and responding to scientific questions identified in associated IOC programmes such as GOOS are (without any implicit assignment of priority):

- consequences of increased nutrient influxes;
- sources and consequences of changed sediment influxes;
- sources, transport, fate of synthetic organic pesticide compounds;
- development of human health indicators in respect to risks to human health posed by the effects of anthropogenic activities on the marine environment;
- training, development and proving of techniques for rapid assessment of marine pollution; and
- study of benthic indicators of condition.

16. The necessary scientific components of core GIPME activities are thus identified within two core activity envelopes:

1. Transport, cycling, fate and effects of contaminants; and
2. Indicators of marine environmental condition and effects.

1. First Core Activity: Transport, cycling, fate and effects of contaminants

This activity should comprise three sub-activities as follows:

1.1. The consequences of increased nutrient influxes: This activity encompasses fluxes through ocean boundaries and interfaces, chemical-biological interactions and marine chemistry in relation to nutrient transformations, carbon fluxes, oxygen demand and transport by physical processes. The topic is related to eutrophication, harmful algal blooms, hypoxia, changes in species composition and community structure as well as changes in ocean chemistry. It requires an interdisciplinary science approach that includes modelling.

1.2. The sources and consequences of changed sediment influxes: This activity involves fluxes, physical transport, optical effects, sedimentary geochemistry, physical interference and benthic community responses. It also requires a multidisciplinary approach.

1.3. The sources, transport, fate of synthetic organic pesticide compounds: This activity involves agricultural, forestry and aquacultural practices, fluxes, chemical property (hazard) characterization, transformations, fate and biological effects (*i.e.*, ecotoxicology). It is a subject of keen contemporary interest in terms of the effects of human activities on the marine environment.

2. Second Core Activity: Development of indicators of marine environmental condition and effects

This activity should also comprise three sub-activities as follows:

2.1. The development of human health indicators: This topic addresses assessment of risks to human health posed by the anthropogenic mobilization of artificial and natural toxic agents in the environment. It involves the linkages between ocean and human health at the point of exposure

to humans through ingestion, dermal contact and inhalation. The main concern is the ingestion of contaminated seafood and external exposures resulting from direct contact. Elements of research needed include biomarker development, modelling, informatics, training and the transfer of technology.

2.2. Training, development and proving of techniques for rapid assessment of marine pollution (RAMP): The main objective of this activity is the development of methods for rapid assessment of anthropogenic stresses on the marine environment. The emphasis should be on techniques that are simple to use, robust and inexpensive but nevertheless provide a basis for judging environmental condition and enable rapid prioritization among sites. One of the more recent tasks of GIPME has been to develop RAMP through research and training to assist in the design and implementation of the GOOS/HOTO Module. This thrust should be continued.

2.3. The study of benthic indicators of condition: This is envisioned as a science development project fronted by research activities in IOC Member States and is needed for the kinds of pollution assessments that are the responsibility of GIPME. It deals with the development of indicators for assessing the condition of marine benthic communities. It is also expected to meet the science demands for methods to be used within GOOS/HOTO.