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THE ALLIANCE BETWEEN GIPME AND THE HOTO MODULE OF GOOS

by

The IOC Secretariat

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1. Abstract

The Global Investigation of Pollution in the Marine Environment (GIPME) is an international cooperative programme of scientific investigations focussed on marine contamination and pollution. GIPME was established in 1976 in response to the recommendations of the United Nations Conference on the Human Environment in Stockholm in 1972. GIPME investigations focus primarily on the coastal zone and shelf seas but also deal, where appropriate, with the open ocean. The Programme assesses the presence of contaminants and their effects on human health, marine ecosystems, and marine resources and amenities, both living and non-living. GIPME is sponsored by The Intergovernmental Oceanographic Commission (IOC), The United Nations Environment Programme (UNEP) and The International Maritime Organization (IMO). In addition the International Atomic Energy Agency is a partner through its Marine Environment Laboratory.

The results and declarations arising from the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, in particular The Framework Convention on Climate Change and The Convention on Biological Diversity, and the recommendations of Agenda 21, Chapter 17, have expanded the original scope for which GIPME was designed. In particular, it is required that there be an adequate ocean observing system to develop a further understanding of and to monitor change in the marine environment. One aspect of such an observing system relates to the environmental health of the oceans which is envisaged to be implemented within the GIPME context and available mechanisms. This, together with the natural maturing of the Programme, has led to revising the manner in which GIPME addresses and implements actions to address marine environmental contamination/pollution problems. This paper describes the evolution of the GIPME Programme to allow it to efficiently deal with these recent developments and needs, in general, and to serve as a framework for the implementation of The Health of the Ocean (HOTO) Module of The Global Ocean Observing System (GOOS).

2. Introduction

The Intergovernmental Oceanographic Commission (IOC) established a Programme for the Global Investigation of Pollution in the Marine Environment (GIPME) in response to Recommendation 90 of the United Nations Conference on the Human Environment (Stockholm, 5-16 June, 1972). The overall objective of the GIPME Programme was seen to provide a scientifically-sound basis for the assessment and regulation of marine contamination and pollution, through the execution of sensibly planned and implemented international, national and regional monitoring programmes.

Aspects of the GIPME Programme (referred to as the Marine Pollution Monitoring System, MARPOLMON) were constituted as a resource for not only addressing environmental concerns and responsibilities of the IOC, but those of The United Nations Environment Programme (UNEP) and the International Maritime Organization (IMO) as well. As a result, the GIPME Programme is co-sponsored by IOC, UNEP and IMO. One particular element of GIPME is also co-sponsored by IAEA: the preparation of manual and standards and reference materials. A specific objective of the MARPOLMON System has been to provide information on the incidence and distribution of contaminants in the marine environment which leads to an assessment of contamination in the marine environment. This information, coupled with a knowledge of the biological effects of contaminants,

will then provide the means of making an assessment of pollution in the terms defined by The United Nations Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP).

The Comprehensive Plan for GIPME (IOC, 1976) was developed to comprise four major stages. These are: 1. Mass-balance determinations (including baseline measurements); Contamination assessment; 3. Pollution assessment; and 4. Regulatory action. The first stage requires that certain criteria are fulfilled prior to advancing to the second stage, that is, the development and proving of sampling and analytical techniques, in order to ensure that intercomparative data are gathered on the sources, incidence and distribution of contaminants. Providing the scientific and technical basis for conducting regional chemical monitoring activities and baseline measurements has been groups of experts. One, on Methods, Standards and Intercalibration (GEMSI), has directed its attention to the analytical methodology and intercalibration required in the Programme. A second group of experts on the Effects of Pollutants (GEEP) has addressed the extrapolation of a contamination assessment to pollution assessment, as described in the Comprehensive Plan for GIPME (IOC, 1976) and its implementation (IOC, 1984). This has required an additional component; that is, an accurate evaluation of the effects of contaminants (either simply or in complex mixtures) upon components of the marine ecosystem (either at the single species level or, preferably, at the ecosystem level). A third group, experts on Standards and Reference Material (GESREM), was formed to coordinate the development and provision of standards and reference materials for the GIPME Programme, and has comprised the vital data-gathering activity, being directed at determining accurately and precisely the levels of selected contaminants in several phases and in various regions of the world s oceans. It has attempted to maintain acceptable scientific standards to ensure the quality of the data generated. These three GIPME groups of experts, GEMSI, GEEP and GESREM, have worked in concert over the years towards achieving the objectives of the GIPME Comprehensive Plan.

The cooperative arrangments between the partners are detailed through a Memorandum of Understanding. In particular, a tripartite MOU between IOC, UNEP and IAEA serves as a basis for the cooperative effort in preparation of manuals, guides, standards and reference materials.

It should be noted that although major data gathering activities are being conducted around the world, in many instances these are not motivated by a desire and/or need to solve marine pollution problems. Information being acquired within such efforts is nonetheless compatible for use in the GIPME strategy and as a contribution to the data base of the MARPOLMON System. The emergence of such a data base, assuming that its quality and intercomparability are maintained at an acceptable level, may also have benefits as a resource in research studies addressing biogeochemical processes including temporal and spatial influences and the construction of mass-balances for the purpose of assessing residence times and imbalances. Thus, GIPME was designed to have a built in potential for playing a role in ocean sciences from a broader perspective than the mere study and elucidation of marine contamination and pollution. This is particularly relevant now, with additional responsibilities arising from the United Nations Conference on Environment and Development (UNCED, 3 - 14 June 1992), since through the GIPME Programme, there is the possibility of obtaining data from many areas of the open ocean, as well as coastal and enclosed seas, on a regular and long term basis through the consent and involvement of participating countries. The importance of the Programme to the implementation of aspects of the health of the ocean in GOOS addressed below.

3. The GIPME Strategy

In developing the GIPME Programme and devising a strategy for its implementation, equal attention was not given to all possible marine contaminants that could be envisaged. There are a number of reasons why such a decision was made. Priorities (both scientific and socio-political) among regions often differ and these have an influence on regional aspects of the Programme. Also consideration was given to collaboration with organizations such as the International Council for the Exploration of the Sea (ICES) and this ensured the use of common analytical approaches, particularly for organic contaminants. As a result, priority was given to the analysis of certain heavy metals, the petroleum-derived and halogenated hydrocarbons, microbiological parameters, nutrients and artificial radionuclides, especially those useful as tracers. Since the importance (i.e., the consequences to human health and the marine ecosystem) of a particular contaminant varies from area to area, any form of universal ranking was clearly unjustified. However, GEMSI and GEEP, in collaboration with GESREM, have been concentrating on these classes of contaminant, with the recognition that the International Atomic Energy Agency (IAEA) has primary responsibility for artificial radionuclides.

From an ideal point of view, all environmental media justify attention if construction of mass-balances are to be achieved. Therefore, since an over-riding interest in the GIPME Programme has been the development, wherever appropriate, of oceanic mass-balances, programmes in regional areas have been encouraged to provide as complete a description as possible of the area being monitored, the physical setting, the mode of entry of the contaminant (i.e., river, input, aeolian, etc.), and the marine chemical properties of the contaminant in question. This has permitted any data set produced to be interpreted in broader context than merely regional issues.

The methodologies being employed for determining contaminant levels are not universal. Indeed, it is clearly unrealistic to expect that all participants in a MARPOLMON activity will possess similar analytical capabilities or facilities. Methods used should, however, have been demonstrated to yield data comparable with other methods. Such demonstrations have resulted from intercalibration activities, inter-laboratory comparisons and internationally coordinated exercises (e.g., IOC, 1982 and Knap et al, 1986) at all stages of the Comprehensive Plan for GIPME. All methods accepted by GEMSI as appropriate for an intended measurement have been proposed as the methods of choice in the MARPOLMON System and suitable methodological protocols have been made available by the IOC and UNEP. In all cases, complete description of methods (i.e., meta data) have been requested with all reported data, as well as statistical aspects of the data (e.g., details of replication, variability of results, blank values and descriptions of standards or reference materials used).

It has been necessary in some cases to employ less selective and specific methods of analysis than ideal to set up a framework of laboratories for the purpose of training, intercalibration and familiarization with sampling and logistics, with the plan to move towards wider employment of more specific, more sensitive and more insightful techniques of measurement.

The time scale of a particular activity has been determined by the intended purpose of monitoring (e.g., baseline determination, hot spot or trend analysis) and the extent of turnover in the system. Since the physical dynamics and the biogeochemical properties of individual systems can be expected to vary from location to location, the setting of rigid time scales is for the most part

impracticle. It can be said, however, that if trends are to be detected, reproducibility of the adopted methods and the precision of the measurements must be clearly established, so as to demonstrate statistically any increase (or decrease) outside this variance. In such cases, plus or minus three sigma units of such variance has been suggested to provide sufficient evidence that a trend is. Or is not, being observed. The reproducibility of the analysis and sampling, as well as the duration and frequency of the monitoring effort, must be such that short-term oscillations are filtered out . For trend monitoring purposes, it has been suggested that a doubling (or a 50% decrease) of the concentration of a contaminant in a decade may be a reasonable change to recognize a trend.

4. The Global Ocean Observing System

The two conventions signed at the United Nations Conference on Environment and Development (UNCED, Rio de Janeiro, 1992) - the Framework Convention on Climate Change and the Convention on Biodiversity, and the recommendations of Chapter 21 of Agenda 21 - require the establishment of an adequate observing system to develop a further understanding of and to monitor change in the marine environment. Many of the processes that control the variability and change of global climate are themselves controlled by processes in the ocean. Public perceptions of risk are only eased when governments are seen to be keeping the environment, including the ocean, under close observation. If the UNCED goals of sustainable development and integrated oceans management are to be achieved, a much more integrated system of data management, as well as a programme for detecting biological distress signals, must be developed. To do this, continuing systematic, long-term, global observations of marine physical, chemical and biological conditions, analogous to the World Weather Watch, operating under the auspices of the World Meteorological Organization (WMO), are required.

The scope and purpose of such an effort mandate a sound scientifically based strategy and long-term international commitment. Many regular observations of the ocean are conducted by research programmes with limited funding, finite duration and single objectives, such as the global climate change research programmes. Other observations are made by operational agencies for specific purposes but are in limited parts of the world ocean, typically have only sparse coverage, and usually concentrate on the upper ocean and sense a limited number of variables. The requirements of the customers of such observations demand global coverage, including the polar regions and scientifically designed, robust, cost-affordable long-term routine and systematic observations. Most importantly, such an activity must be based on the principle of timely, full and open access to ocean data.

The objective of the GOOS is a permanent system of global and systematic observations adequate for forecasting climate variability and change; for assessing the health or state of the marine environment and its resources, including the coastal zone; and for supporting an improved decision-making and management process, which takes into account potential natural and man-made changes in the environment and their effects on human health and resources.

The GOOS is meant to be an internationally co-ordinated system for systematic operational data collection (i.e., measurements), data analysis, exchange of data and data products, technology development and transfer. The GOOS is aimed at using a globally co-ordinated, scientifically based

strategy to allow for monitoring and subsequent prediction of environmental changes globally, regionally and nationally. Data is planned to be generated by repeat sampling and remote sensing, using sea surface and subsurface instrumentation in the open sea and in coastal regions worldwide, including enclosed and semi-enclosed areas.

Guided by the IOC, WMO, UNEP and the International Council of Scientific Unions (ICSU), the planning for the GOOS has been taking place within five specific areas:

- climate monitoring, assessment and prediction;
- monitoring and assessment of living resources;
- monitoring the coastal environment and its changes;
- assessment and prediction of the health of the ocean; and
- marine meteorological and operational services.

The GOOS is meant to be a set of activities that constitutes operational oceanography and its related efforts, including some directed and applied research. GOOS is being developed to be oceanography for social and economic purposes , co-ordinating and fostering ocean operations and applications that are long term, routine, globally relevant, scientifically based, systematic and affordable.

5. The Health of the Ocean Panel

It was within the above context that an ad hoc Panel was set up by the IOC in February, 1993, to develop a scientific and technical design for the Health of the Ocean (HOTO) Module of the GOOS. The ad hoc Panel met twice under the co-sponsorship of IOC and UNEP. In 1994, a Joint Scientific and Technical Committee for GOOS (J-GOOS) was established and the ad hoc Panel became a subsidiary body of this Committee, which is jointly sponsored by IOC, ICSU, WMO and UNEP. The HOTO Panel met again in 1995 and finalized its Strategic Plan which was subsequently endorsed by J-GOOS and published by IOC (IOC, 1996). The HOTO Panel has been reconstructed under new Terms of Reference (Table I) to continue developing this aspect of the GOOS.

The HOTO Module of GOOS provides a basis for the assessment of the state and trends in the marine environment as it is affected by anthropogenic activities, including, inter alia, increased risks to human health, harm to marine resources, alterations of natural change and general ocean health.

The term health of the ocean is operationally defined as a reflection of the condition of the marine environment, from the perspective of adverse effects caused by anthropogenic activities, in

particular, habitat destruction, changed sedimentation rates and the mobilization of contaminants. Such conditions refer to the contemporary status of the ocean, prevailing trends and the prognosis for improvement or deterioration in its quality.

Although the measurement of contaminant loads can and must be measured, such measurements by themselves cannot provide comprehensive quality criteria. Biological indices will have to be identified at four levels; sub-organismal, individual, population and community. Molecular, cellular, physiological and behavioral disturbances and pathological manifestations will be needed to reflect responses to the individual organism level. At the population and community levels, effects might manifest themselves in changes in the reproductive success of species, the disruption of the dynamic balance between producers and consumers, or deviations from the natural range of biomass variability leading to abnormal phytoplankton blooms or mono-specific swarms. Critical habitats - such as coral reefs, estuaries, temperate and tropical wetlands, including mangroves, submerged macrophyte communities and other spawning and nursery areas - will require identification of more specific biological indices. In all cases, biological indices will have to be assessed against the background of natural variability.

Within the overall design of the HOTO Module, several areas of initial emphasis are recommended:

- Development of a set of reliable, relatively easily applicable biological distress indices reflecting the condition (i.e., health) of the marine environment;

- Monitoring the extent of habitat losses in coastal zones:
- Monitoring the effects of altered sediment loads on the coastal zones;

- monitoring concentrations and trends of contaminant loadings in coastal zones in relation to community responses;

- Further development of methodologies for the evaluation of assimilative capacities of coastal marine areas for contaminant introductions;

- Reclamation of available data/information on contaminant levels/community responses at regional and national levels as baseline information for HOTO monitoring activities; and

- Development of monitoring/assessment protocols directed at public health protection for marine environmental protection and marine resource use.

6. GIPME Orientation and HOTO Implementation: advantages for management

When considering the scopes and objectives of GIPME and HOTO, as described above, it should come as no surprise to anyone that a decision was made to implement initial HOTO activities (e.g., pilot projects) within the context of the GIPME Programme taking advantage of the mechanisms and framework available. However, in making this decision and following up with developing plans for implementation, a re-examination of a framework for environmental management within the GIPME Programme and the planning and execution of activities which

mutually catered to the specific goals and priorities of GIPME and HOTO was required to ensure the most efficient use of available resources, both human and monetary.

Figure 1 depicts a framework linking problems, science, monitoring and management that is considered to be applicable not only for GIPME programmematic purposes but also for directing the development of the HOTO Module, either by itself or as an integral part of another activity (e.g., the implementation of a coastal zone effort which at a minimum will require a combination of certain elements of the Climate Module and the HOTO and Living Marine Resources Modules).

In addition, the modus operandi of the continued implementation of the GIPME Programme required re-evaluation to ensure harmony would be realized between GIPME and HOTO objectives. Since February, 1996, when this consideration of the GIPME Programme was initiated by the Executive Secretary of the IOC and the Chairman and Vice-Chairman of GIPME, and information on this being made available to UNEP and IMO, the GIPME Programme has been managed by consensus through a GIPME Experts Advisory Group (GESAG). Members of the GESAG are the Chairman and Vice-Chairman of GIPME, Chairmen of the three groups of experts which formally constituted the organizational structure under which GIPME Projects were implemented, a representative of the Marine Environmental Sciences Laboratory (MESL) of the IAEA Marine Environmental Laboratory (MEL) in Monaco, and additional experts chosen from a roster of experts, the selections being dictated by the problem(s) being addressed as depicted in Figure 1. GESAG is administratively coordinated by the Head of the IOC Marine Pollution Research and Monitoring Unit and all co-sponsors are expected to play integral roles in the group.

7. What Does the GIPME/HOTO Alliance Mean, and What Will it Offer e.g., to the Marine Scientist?

The implementation of the GIPME Programme and HOTO is intended to occur, region by region, in concert and ideally amalgamated, with other GOOS components, particularly the Climate, Living Marine Resources and Coastal Zone Modules. Its benefit to the solving of national and regional problems and as a basis of regulatory actions have been addressed above. What GIPME and HOTO potentially offer the marine scientist is a scheme of continuing measurements accomplished in a more comparable manner, that can be used by individuals for their own applications. The global development is planned to be through national and regional implementation activities that address identified problems in specific geographic areas and assess their extent in time and space. Individual scientists, therefore, should seize the opportunity of becoming involved in the planning and implementation of such specific monitoring activities. MARPOLMON and HOTO data ,ideally being synonymous, will be made available in raw form and in a range of collated and interpreted forms that will be useful for a suite of marine and non-marine applications. GIPME and HOTO also will provide a mechanism for obtaining a measurement series on which individual scientist can base, or piggyback, any specific measurement requirements that they have for scientific and/or management applications. This then is the promise of GIPME and HOTO. The entire sequence of operations within GIPME and HOTO, if implemented as intended, will provide a vastly improved store of basic marine environmental data with higher spacial and temporal resolution than available ever before. This will mean that individual scientists can reduce the effort they have to devote to routine measurements and co-ordinate their efforts on the necessary incremental measurements for their own purposes.

ANNEX I

References

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ANNEX II

TABLE I

REVISED HOTO TERMS OF REFERENCE

The HOTO Panel will be responsible for:

- Ensuring a continuing up-dating of the Strategic Plan for HOTO to adequately reflect development and understanding arising through relevant research and technology;

- Further analyzing the nature of marine processes and vectors for human disease transmission to ensure that the most appropriate variables relating to threats to human health are included in the HOTO Module design;

- Developing specific HOTO Module designs for several marine regions, including spacial and temporal resolutions of sampling, to test the validity and comprehensiveness of the Strategic Plan for HOTO and to determine the specific measurements/variables required from other modules/programmes to support HOTO measurements and their interpretation;

- Identifying the scientific components for training, mutual assistance and capacity building, where necessary, for undertaking the regional assessments;

- Examining the content of existing operational systems, both national and international, dealing with the health of the oceans with a view of advancing GOOS;

- Co-ordinating with other GOOS Modules for the purposes of ensuring compatible strategic and scientific development of all GOOS Modules. In particular, identifying the requirements, nature and availability of models that can facilitate the proper development of HOTO products and/or allow prognostic prediction of potential/future conditions relating to the health of the oceans;

- Maintaining liaison with research and monitoring activities to ensure that assessments and predictions of the health of the oceans are based on sound and contemporary scientific knowledge;

- Developing interaction with other scientific and technical bodies having relevance to furthering the development of GOOS (i.e., ICES, PICES, EURO-GOOS, etc...); and

- Defining HOTO products relevant to the requirements of specific users and describing the procedures leading from the base variable measurements, through scientifically-proven interpretation, to the preparation of such products.

FIGURE I

FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT