Study Group
Science and Technology
Lisbon
14 - 16 March 1997

IWCO/EC/WP10

Draft Report

I - Opening

The meeting was opened by Ulf Lie who acted as Chairman of the Study Group. The Coordinator of the Independent World Commission on the Oceans, Mário Ruivo, gave a welcoming address to the participants on behalf of Dr. Mário Soares, Chairman of the Commission.

II - Adoption of the agenda

The agenda was adopted without modification.

III - Items under discussion

The three main components of the issues under discussion are science, technology and society. Trends in the evolution of science and technology need to be examined in the context of their implications for institutions and management objectives.

There is a great ignorance about the oceans. Most of the oceans are still unexplored and our understanding is not keeping pace with the unprecedented changes taking place in the ecological system. We are taking so much for granted in our relationship to the system on which we are so dependent. The period of understanding of the ocean is still ahead of us.

1. Trends in science and of its technology for scientific research and management of the ocean

a) Technological tools

Technology is vital to the understanding of the ocean. Most of the technology used in studying the ocean entails observation from above (satellites) or from the surface (ships). Very little technology has been deployed in getting below the surface of the ocean. Manganese nodules, hydrothermal vents and bacterial sources for metal fixing are but a few examples of areas for the application of science and technology.

The increasing power of computers – including memories and CD roms is allowing better, more complex graphics, improved visualization and greater use of virtual reality, leading to improved data collection, more comprehensive presentations and larger data sets to call upon.

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Although the Rapporteur´s report gives a good description of the technological tools for marine science, more space could be devoted to *remote sensors* – both satellite-based and in-situ types (autonomous, moorings and acoustic). There is a need to develop satellite algorithms where *suites of sensors* are used. The aim should be to use mooring data as validators of satellite data, so that computer models can be operated iteratively with direct and remotely sensed environmental variability as inputs and with outputs that allow us to understand as well as to predict oceanic processes and events. Prediction of extreme events would be an important social tool in creating credibility. *Acoustic devices*, that sense the interior of the oceans, should be seen as complementary to satellites that sense the surface. The role of acoustic tomography and thermometry should be stressed.

Other supportive technologies that could be noted include *miniaturization techniques* (e.g. *miniaturization of navigation systems), biological and genetic tools, (use of) offshore platforms and submarine communication cables.* Further progress is needed in energy (improvements in *batteries* and in the *Sterling engine), new systems of propulsion, new materials for fabrication* and improved *techniques for the interpretation of radar images.*

b) Concepts and methods for managing ocean use

Everyone should be made aware that oceans are important. Since public understanding is critical in influencing decision making, science and technology have a role to play in providing ammunition for the public to put its arguments to authorities. What scientists and engineers have to offer is not confined to data but includes methods. Scientific method involves the acquisition of knowledge through experimentation and observation. Methods are themselves constantly evolving. Examples of recent methodological trends include the simulation of systems, including marine ecological systems and the need to operate under partial or complete ignorance.

In contrast to the idea that one can collect data and increase understanding of ocean systems there is the parallel notion that certain types of ocean problems are inherently unpredictable. We must learn to live with unpredictability and not give the false impression that oceanography can solve all problems. Hence the need to give operational meaning to the "precautionary principle". Scientists can contribute to this task through (I) examination of the consequences of different marine management options, (ii) setting up management systems that change as knowledge emerges, (iii) experimentation (by applying one management regime in one area and another in a different area), and (iv) long-term continuous monitoring of the consequences of the marine management system.

The attuning of scientific advice to management objectives is not a passive but an inter-active activity. Scientists must present realistic options, pointing out conflicting objectives (as, for example, the fisheries management objectives of (I) no variation in catches, (ii) high catches and (iii) zero chance of exterminating the resource).

Principles for the utilization and management of *coastal resources* need to be incorporated in the Commission's work, paying due attention to the activities that have been taking place internationally since UNCED to operationalize that concept. One difficulty when it comes to management is the lack of precision in defining coastal zones which may depend on physical, cultural and economic factors. It may even be argued that it is futile to try to do so. The point is to avoid conflicts among different classes of users of coastal zones. To optimize among different environmental uses is what all states are aiming for. If we recognize that most ocean problems are generated on land, we cannot avoid taking into account coastal activities in managing the sea. This having been said, some analysts feel that coastal zone management is subject to the same conceptual difficulties as *multispecies and ecosystem management*. Here there are two schools of thought – one which argues that we must have ecosystem models that are useful for management and the other which argues that this is impossible. A compromise approach is to continue doing single-species management but to take inter-species interactions into account as they appear over time.

Management in the sense of politics can be very ephemeral since the political agenda is changeable. Hence, the carrying out of base-line studies is important – for example, monitoring, surveying and the establishment of up-to-date hydrographic charts. The work of scientists is not limited to advanced science but also includes monitoring of basic information and establishment of baselines.

This is in line with the precautionary approach to decision making and also relates to GOOS. One concept that is attracting increasing interest is that of *observatories,* which have been introduced in Portugal in public health and other fields and could be extended to marine issues. Observatories represent a combination of facts from all sources and public discussion among scientists, producers and the public in order to consider their implications. They offer a means of democratizing information to both decision-makers and people in general and help to create credibility and confidence.

c) Globalization and time scales of research and monitoring

Technological change is setting the pace for research and development. The speed and complexity of change calls for an interdisciplinary approach in studying and managing the ocean. This can best be achieved through cooperation, particularly at the international level. Global observation systems such as GOOS (and the associated GCOS and GTOS) need funding and institutional build-up. However, this does not suffice by itself since the build-up of marine expertise takes time. The large sets of data that would be generated by such systems require considerable knowledge in order to be utilizable. It may turn out that some countries will be unwilling to share with the global community data emanating from their coastal zones, thereby impeding the establishment of the global observation system. It is, therefore, imperative that all countries see themselves as stakeholders in the wise use of the oceans.

Globalization is eroding societal structures. Governments are losing the capacity to manage, including the capacity to manage the ocean. Recent geopolitical changes have also had implications for the management of science and technology as it applies to the ocean. An important consideration is how to stimulate people's willingness to pay for science and technology.

The time span of science has to be far larger than that of managers and politicians. In the case of living resources, for instance, it is very long. Computers today make it possible to examine alternative scenarios for the behavior of stocks of living resources over time. It is necessary to bring together the resource time scale with the economic time scale in order to produce a pragmatic management solution.

2. Implications of science and technology trends for:

a) Nature of scientific advice to decision makers

The scientific community needs to recognize its responsibility to communicate with decision makers and the business community in a language that is understandable. This applies especially to probability statements. Scientists should be encouraged to disseminate their research results to the community as rapidly and understandably as possible. Communication between scientists and the public would be enhanced by increasing the scientific literacy of the public through, in the first instance, increased science training of non-science students both in secondary schools and in universities.

Advice given to decision makers should indicate the degree of certainty involved in arriving at the conclusions. The new graphic tools (GIS, visualization, virtual reality) should be used in presenting information to decision makers in as easy and comprehensible a way as possible.

Scientists should be urged to cooperate in study groups and strategic sessions in order to harmonize their positions on important ocean issues.

b) Interaction between scientists and the decision makers

This can be viewed as achieving a balance between the aim of conservation versus the aim of development. It is important to establish this balance in a relationship that is based on equality and synergy.

c) Social perception of science and participation in decision making

The public and relevant stakeholders need to be involved not only in the decisions on coastal matters but also in proposing the actual questions to be taken up for research, thereby increasing the likelihood of their accepting the findings. This was one of the ideas behind the organization of the Independent Brazilian Commission on the Oceans which includes ship owners, builders, oil companies and representatives of the mass media sit together.

As regards research and scientific information, it would be useful to examine ways and means of tapping the vast resources of the business community, while at the same time recognizing that the role of industry in carrying out R&D varies across countries and is in fact quite marginal in most developing countries where the public sector and universities do most of it. Even in the European Union there has been a noticeable failure to involve business in marine science and technology, perhaps because the subject by its nature is basic science-oriented compared with other sectors where industrial spin-offs are more evident. Brazil, however, has succeeded in raising the share of industry in total national R&D expenditures from 10 percent up to 25 percent today. The Brazilian experience suggests that well-crafted tax incentives may be one way of increasing business spending on ocean-related R&D.

d) Application of the concepts sustainable use of renewable resources, sustainable development and integrated management

It is to be noted that it is not only renewable but also non-renewable resources that need to be used in a sustainable way. Moreover, the Commission should not focus its attention unduly on sustainable fisheries but should look much more than it does now at issues and sectors outside of fisheries.

In connection with renewable resources the Commission should at the very least warn the public about the limitations of the concept of *maximum sustainable yield* in the population dynamics of stocks as a management and decision-making tool. Although the simplistic concept was abandoned as an operational tool by biologists a generation ago, it is still enshrined as a concept in UNCLOS and is still used by economists in "explaining" the collapse of fisheries.

It is noteworthy that scientists are in the process of re-defining the concept of *sustainable use* which will have enormous implications. Going beyond sustainable use, there is a very strong case for promoting *non-lethal* uses of resources that have more value alive than dead (e.g. whale watching). *Sustainable development* is an economic concept that does not necessarily encompass the sustainable use of the resources on which such development is based. Thus, it is possible to have sustainable development without sustainable use and vice versa.

Marine scientists should be very circumspect about giving their seal of approval to schemes for *fertilizing* the ocean, for boosting its capacity to *absorb carbon* dioxide and for farming the oceans (*aquaculture)* all of which may have far-reaching and unpredictable consequences for the sustainability of the ocean and its resources. Nor should scientists reject these and other types of ocean-related technological schemes outright without careful examination of their impact in particular locations and circumstances. The important point is that they should not be regarded as panaceas for increasing the "bounty" that humankind can reap from the ocean.

The approximately 1200 marine *protected areas* around the world are too few, are in many instances only protected on paper, and represent a small proportion of the total ocean space. The creation of such areas is in principle a good idea which permits the pursuit of at least three convergent goals: (I) common stewardship over areas that are "no-man´s land". (ii) implementation of the precautionary principle in the zones selected and (iii) the creation of observatories in the zones selected. However, there is no way at present to declare a protected area on the high seas. Attempts to identify ways of circumventing this limitation are worthy of support.

3. <u>Contribution of marine science to the development and use of ocean technology</u>
4. <u>Contribution of marine science to major issues</u>

Much of marine science and marine technological innovation is driven or *triggered* by certain issues. In the past, these were related to the military, industry (offshore oil, fisheries and shipping), climate change and basic research (scientific curiosity). Technology which has been created in response to past issues, needs to be adapted/adjusted to meet new scientific and technological requirements. Shown below is a tabulation of many of the issues that appear to be relevant as triggers today. (Major categories of issues are underlined and *over-arching* issues are shown in italics).

a. <u>Culture</u>

origin of life
origin of universe
marine anthropology
our origins

b. <u>Wealth</u>

fish
hydrocarbons
transport
hazards
energy
waste capacity
space
tourism

c. <u>Quality of life</u>

risk minimization

d. <u>Life support</u>

climate

health
greenhouse
clean energy
tourism
waste removal
hazards

biodiversity

e. Don't forget (unclassified)

training
funding
technology transfer
ethics
economics
social
management
selective
case histories
risk/uncertainty
coupled ocean/atmosphere
social sciences
economics
institutions
decisions
mariculture
coastal zone
market value

These issues or "triggers" provide a useful way of coming up with focal points for the paper on science and technology, keeping in mind that some are technological (micro) and some conceptual (macro) in nature. An alternative set of categories for classifying all of these issues would be the three *I) peace and security, ii) use of resources and iii) life support systems.*

As a general observation, risk is not a sufficient justification for more science. The role of science is to identify problems and then seek to solve the problems it has identified. Nevertheless, we may ask why science has not in many instances been put into action even though its findings and their implications have been accepted at the theoretical level. The answer has to do with management and resources and with the public awareness that is required in order to get these resources deployed. In this respect, scientists need to present cases with which the public can identify.

Two specific issues on which the Study Group commented in detail are climate variability and waste capacity. Concerning *climate variability,* through the study of the interaction between the atmosphere and the tropical ocean, scientists now have the ability to forecast the occurrence of an ENSO (El Niño/Southern Oscillation) event more than 6 months in advance (prediction of its intensity is less accurate). Peru is now using this knowledge to plan its fishing and farming activities. Indonesia uses this knowledge to predict droughts and floods. The United States also uses such information, to some extent, for its climate forecasting. However, it must be said that climate forecasting for mid- and high- latitudes is still in its infancy owing to a lack of understanding of the mechanism of variability. Public support is needed to (I) study seasonal and inter-annual climate variability and (ii) refine the ability to make ENSO predictions, including the establishment of a global monitoring system.

As regards *waste capacity,* the tragic large-scale mercury poisoning incident at Miyamata, Japan some time in the 1960s generated public concern about trace metal pollution in coastal areas. From extensive scientific studies, it is now known that: (I) trace metal pollution is only a problem in the consumption of bivalves produced in certain "polluted" areas because of the accumulation of such metals in the bivalves. By and large, trace metal pollution is not a problem in the coastal seas. Organo-chloride pollution from pesticides is slightly more serious. On the other hand, eutrophication (organo-nitrate) is a serious problem all over the world. Its obvious manifestation is in the frequent occurrence of harmful algal bloom (HAB) all over the world. HAB fouls the water and can harm people through the consumption of contaminated bivalves (again, because of the accumulation of HAB toxins in the bivalves).

5. The vision of ocean science

Although the entire contents of the statement "The Oceans – A Shared Vision", which was adopted by the Second International Conference on Oceanography held in Lisbon in November 1994 (and is annexed to the Annotated Agenda) can be endorsed, it lacks punch and does not in any way absolve the Commission from the task of adopting its own declaration. Such a declaration should contain both a "vision" and concrete recommendations for implementation of that vision.

Attention is called to the scientific and technological capacity building resolution contained in Annex VI of the Final Act adopted by UNCLOS in 1982 "On development of national marine science, technology and ocean service infrastructures". Although conditions prevailing during the 1980s did not permit this resolution to be implemented, the time now may be ripe for doing so. In order to mobilize resources for the implementation of the resolution, the idea would be to supplement the present ad hoc and fragmented approach to national capacity building with a series of regional and sub-regional-level activities that would be in the common interest of both North and South. Funding for these activities would take place through the creation of consortia of funding and development agencies including support and participation from the private sector and possibly navies. It would make sense today to bring together in this context, not only the Law of the Sea but also the Climate Change and Biodiversity Conventions.

The need for some kind of initiative of this kind is reinforced by the major problem that the international cooperation envisaged in Chapter 17 of Agenda 21 is not being funded and that our global understanding of the oceans and the related problem areas is slowing down because information on the extended EEZs is not available.

As the experience in parts of Asia and Latin America seems to show, in order for a consortium-type of initiative to work it is crucial to have a critical mass of scientists and technical experts in the countries themselves in order to permit the necessary capabilities to be acquired, without which international cooperation will not work. Aid programs have done little to remedy this deficiency. A related problem is that bilateral and multilateral financial resources, though they have been available for support of national marine programs, have not been forthcoming in support of regional and subregional activities.

IV - Recommendations, closing

The recommendations of the Study Group are embodied under the separate items that were discussed during the meeting.

The meeting was adjourned in the presence of Dr. Mário Soares, Chairman of the Commission who congratulated the Study Group and its Chairman for the completion of its work and apologized for not being able to be present for the full meeting.

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