Marine Habitat Committee

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REPORT OF THE

WORKING GROUP ON ENVIRONMENTAL ASSESSMENT AND MONITORING STRATEGIES

ICES Headquarters
1–3 March 1999

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 OPENING OF THE MEETING

The 1999 meeting of the Working Group on Environment Assessment and Monitoring Strategies (WGEAMS) was opened by the Chair, Lars Føyn, at 10.30 hrs on 1 March 1999 at ICES Headquarters. Only two members of the WGEAMS were present: the Chair and Dr Eugene Andrulewicz. The opening of the meeting was also attended by Janet Pawlak (ICES Environment Adviser) and Melodie Karlson.

The terms of reference for the meeting are given below (C. Res. 1998/2:33):

a) continue reviewing information collated intersessionally on procedures to assess the combined effects of exposure of organisms to groups of chemically similar, or dissimilar, contaminants; the information should include the report of the Workshop on Biological Effects Methods to be applied to detect 'Combined Effects' in Marine Ecosystems (with WGBEC);

b) review developments in the relationships between ICES and the European Environment Agency and European Topic Centre on Marine and Coastal water in marine environmental monitoring and assessment, and invite representatives of the EEA and UNEP to attend the meeting;

c) consider how far the strategies adopted in the HELCOM COMBINE and OSPAR JAMP allow integrated environmental assessments to be made;

d) review the importance of long time series data for the interpretation of monitoring data and the preparation of assessments and report on the outcome;

e) review the report from the 1998 meeting of the OSPAR *Ad Hoc* Working Group on Monitoring (MON98) and prepare comments on the implications of the MON98 exercise for temporal trends;

f) report on new opportunities for the application of microbiological measurements in monitoring programmes;

g) prepare a report on the relationships between changes in contaminant input functions and consequential environmental responses, taking into account, *inter alia*, the outcome of Theme Session V at the 1998 Annual Science Conference;

h) contribute to the ICES strategic planning process through assisting the Marine Habitat Committee in the following tasks:

   i. formulating tactics to achieve the six objectives adopted by the Committee,

   ii. suggesting and/or developing activities and products to fulfil the objectives,

   iii. estimating the resources required for each activity according to categories that will be supplied.

WGEAMS will report to ACME before its May/June 1999 meeting and to the Marine Habitat Committee at the 1999 Annual Science Conference. It will also report to WGBEC concerning Term of Reference a).

2 ADOPTION OF THE AGENDA

The draft agenda was adopted, but due to the lack of members attending the meeting, it was agreed that many of the terms of reference raised needed a broader discussion than what the two WGEAMS members present felt they could give the various issues. Therefore, only those items on the agenda that the two members present felt it was worth pursuing were discussed properly.

3 ARRANGEMENTS FOR THE PREPARATION OF THE REPORT

According to CM 1999/Gen:6, the deadline for the report to be received by the ICES Secretariat is 19 March 1999. A draft report was prepared during the meeting and the Chair undertook to finalize the final version to be sent to ICES.

4 REPORTS OF ACTIVITIES IN OTHER FORA OF INTEREST TO WGEAMS

4.1 OSPAR SIME

The ICES Environment Adviser, Janet Pawlak, reported on the OSPAR SIME (Working Group on Concentrations, Trends and Effects of Substances in the Marine Environment) meeting 22–16 February 1999.

Of special interest to WGEAMS was the proposal to establish a permanent OSPAR working group on monitoring and assessment, to continue on a permanent basis the work that the *Ad hoc* Working Group on Monitoring (MON) had been doing in the past.

It was indicated at the SIME meeting that the establishment of a permanent working group on assessment and monitoring within the OSPAR framework could divert specialists to that group rather than letting them participate in WGEAMS. This could be further pronounced, as funding through the national environment authorities for attending OSPAR activities seems to be more easily available than for attending environment Working Groups within ICES.

The proposed terms of references for this new OSPAR working group do not indicate that there is very much overlap with the work of WGEAMS. It is, however, worth noting that one of the four items (item c) in the proposed terms of reference for the OSPAR Working Group on Monitoring and Assessment (MON) is devoted to 'review advice provided to OSPAR working groups from, *inter alia*, ICES on guidelines and assessment tools'. WGEAMS felt it somewhat peculiar that MON has, as one of its terms of reference, to review evaluations of its own reports undertaken by, for example, WGEAMS, as could be the case for the WGEAMS agenda item 6 of this meeting.

WGEAMS also felt it appropriate to point out uncertainties about the possibilities that OSPAR working groups may lose valuable information about the marine environment and its living resources, if the tendency that OSPAR working groups tend to narrow their view on the marine environment in the way that only data collected by OSPAR will be used. This may be interpreted from one of the four terms of reference for MON, where it is stated that MON shall assess 'spatial and temporal monitoring data collected by OSPAR through the implementation of the Coordinated Environmental Monitoring Programme'.

WGEAMS noted that for a proper assessment of data collected on contaminants, a wide range of other data is needed. Such data can be data for characterising a certain water mass of a special biotope, like hydrographical data, distribution of nutrients and thereby the potential for primary production, water mass transports/fluxes, distribution and fluctuation in the abundance of ecologically important fish species, data on near-bottom currents and description of the bottom topography.

The above-mentioned criteria for characterisation are found mostly in data that can be provided through the various Working Groups of ICES, and WGEAMS felt it important to underline the unique fact that there exists an international organization (ICES) that includes most of the expertise needed for assessing the various aspects of effects and impacts on the marine environment and its living resources.

4.2 Communication of Scientific Advice

The ICES Environment Adviser drew WGEAMS' attention to the need to prepare scientific advice in a way that the common public and policymakers may understand. This issue was discussed *inter alia* in the report from the Second London Oceans Workshop, 10–12 December 1998 (CSD, 1999), which was presented to the WGEAMS meeting.

WGEAMS discussed the problems of communication and noted that policymakers would like to have simple, understandable advice. In this context, it was also mentioned that the need was expressed by policymakers for simple scientifically based indicators, both for expressing the actual situation/condition in the environment as well as for achievable goals within a defined period of time.

WGEAMS recognized the difficulties in translating scientific advice into common language in a communicable way and especially the difficulties in introducing simple indicators. But WGEAMS felt it important to point to the fact that, as the funding for research is provided by the policymakers, it should be obvious that scientific advice should be formulated in an understandable way.

The problems of finding acceptable means of establishing indicators for describing changes, both positive and negative, should be addressed at the next WGEAMS meeting and considered intersessionally. One example of a type of indicator is described in Annex 3.

Reference

Commission on Sustainable Development (CSD). 1999. Review of progress on strategies under Chapter 17 of Agenda 21, oceans and all seas. The Second London Oceans Workshop. Co-Chairmen's report. London, 10–12 December 1998.

5 IMPORTANCE OF LONG TIME SERIES DATA FOR THE INTERPRETATION OF MONITORING DATA AND THE PREPARATION OF ASSESSMENTS

WGEAMS expressed concern about the widespread problem of keeping long time series of monitoring due to general cutbacks in funding. The fact that assessments of an environmental situation have to be based not only on results from monitoring contaminants but also on other factors that influence the marine environment, such as hydrographic conditions and water transport, was underlined by WGEAMS.

The work within and the results of the North-West European Shelf Programme (NOWESP), an EU MAST Project, clearly demonstrate the importance of long-term data sets, with 'long-term' meaning decades. As an example of the concern that policymakers (governments) most recently have given long-term monitoring, some recommendations from the Second London Oceans Workshop, London, 10–12 December 1998, attended by representatives from 40 national governments, can be cited:

- 'More routine, systematic and long-term observations are required, such as planned by the Global Oceans Observation System. Present monitoring is insufficient to address current problems at ocean, regional and local levels. The scientific skills exist to implement a global observing system spanning ocean basins and providing six months' climate forecasts.
- Efforts to standardize data collection and dissemination need to be encouraged and enhanced.
- Close monitoring of persistent pollutants is needed'.

WGEAMS felt it appropriate that the recommendations from the intergovernmental Second London Oceans Workshop should be followed up within ICES by a strong support of long-term monitoring, not only for contaminants but also of parameters that are important for understanding and assessing the impact of contaminants, such as salinity, temperature, oxygen, nutrients, and plankton, among others.

6 REVIEW THE REPORT FROM THE 1998 MEETING OF THE OSPAR *AD HOC* WORKING GROUP ON MONITORING (MON98) AND PREPARE COMMENTS ON THE IMPLICATIONS OF THE MON98 EXERCISE FOR TEMPORAL TRENDS

To give proper attention to this item, the participants at WGEAMS felt that it required good knowledge of MON98 which was not available, as members of WGEAMS that also attended the MON98 meeting were not present. Further, there was no written report available for WGEAMS to consider.

7 CONSIDER HOW FAR THE STRATEGIES ADOPTED IN THE HELCOM COMBINE AND OSPAR JAMP ALLOW INTEGRATED ENVIRONMENTAL ASSESSMENTS TO BE MADE

Due to the fact that very few persons attended the meeting, WGEAMS found it difficult to deal with this item at the meeting. However, as this item opens for a possibility to discuss monitoring strategies in a broader context, WGEAMS felt that this should be dealt with at the next meeting of WGEAMS. The discussion should then be based on a prepared discussion paper on monitoring strategies and the integration of multiple measurements of different environmental factors for use in integrated assessments. The Chair will prepare a discussion paper for the next meeting.

8 REVIEW INFORMATION COLLATED INTERSESSIONALLY ON PROCEDURES TO ASSESS THE COMBINED EFFECTS OF EXPOSURE OF ORGANISMS TO GROUPS OF CHEMICALLY SIMILAR, OR DISSIMILAR, CONTAMINANTS

The report of the AMAP/EEA/ICES Workshop on Combined Effects in the Marine Environment, (Copenhagen, 16–17 November 1998) was presented to the meeting. WGEAMS reviewed the report and found it very informative and useful for further development of biological effects research and monitoring. However, at the present stage, 'combined effects' require more research and experimental studies before some methods can be recommended for monitoring. Therefore, expected EU support for research projects on 'combined effects' is appreciated. Any new parameters recommended for monitoring will require precise guidelines and a quality assurance programme to achieve comparability of results. (ICES will be willing to elaborate such a programme and guidelines.)

ICES has been developing biological effects monitoring programmes for more than twenty years. The status of this development relative to their potential application in monitoring programmes is given in the 1997 ACMP report, a copy of which is contained in the report of the Workshop on Combined Effects in the Marine Environment. Most of the biological effects methods can be applied to detect 'combined effects' in marine ecosystems.

WGEAMS noted some new aspects considered by the Workshop, such as climate variability and global change in assessing combined effects and effects of UV-B exposure.

This agenda item is a continuation from the 1998 agenda, but again due to the poor attendance at the WGEAMS meeting, any further elaboration on combined effects and the problems of synergism and antagonism between contaminants had to be postponed to next year's meeting. The approach taken by the Workshop is more or less Pan-European, but within the framework of ICES, participation from its Member Countries Canada and the USA should be encouraged, in order to include their experience in this concept.

9 REPORT ON NEW OPPORTUNITIES FOR THE APPLICATION OF MICROBIOLOGICAL MEASUREMENTS IN MONITORING PROGRAMMES

WGEAMS felt it difficult to discuss this item without any specialists in this particular field present at the Working Group meeting. As these techniques may open new opportunities in the study of effects of contaminants in the marine environment and may be included as a routine part in monitoring programmes, WGEAMS would like to continue the discussion on the this topic. Members of WGEAMS were encouraged to look into these techniques intersessionally and prepare for a discussion at next year's meeting. If necessary, a specialist in microbiological measurements from outside WGEAMS should be invited to prepare and present an overview of current techniques suitable for routine measurements.

10 PREPARE A REPORT ON THE RELATIONSHIPS BETWEEN CHANGES IN CONTAMINANT INPUT FUNCTIONS AND CONSEQUENTIAL ENVIRONMENTAL RESPONSES

The report from Theme Session V at the 1998 Annual Science Conference, on 'Recovery and protection of marine habitats and ecosystems from natural and anthropogenic impacts', was made available to the WGEAMS meeting. The papers presented at the Theme Session, according to the report, covered a wide range of approaches to these problems, and demonstrated clearly the need for further work to establish criteria to be used in assessments. The discussion referred from the Theme Session highlights areas of concern that should be the subject of further discussion. WGEAMS noted with interest the following statement from the discussion, 'Scientists need to establish quantifiable criteria, even if somewhat pragmatic ones, to assess likely sensitivity and importance (for instance, criteria for 'rarity'. Such measures and terms help politicians and managers who are not scientists to use approaches which are scientifically based, but which are readily understandable and involve the minimum use of 'jargon' terms, without having to understand jargon.'

This statement fits well into questions addressed by the Second London Oceans Workshop, referred to in Section 4.2 of this report, for example the following 'Do we have the right institutional mechanisms for deciding on, undertaking and disseminating science? What are the critical gaps between the information being required by policymakers and that being generated by scientists?'

WGEAMS recognizes the complexity of the problems connected to changes in contaminant inputs and the possible environmental responses. There is a scientific challenge in predicting, both a response to a change in input and the time required for a response to take place, as well as the challenge of establishing adequate monitoring systems that are able to recognize the environmental responses. In addition, there is an urgent need to establish criteria or indicators for environmental responses that may be commonly understood and accepted by policymakers and managers.

ICES, through its relevant working groups, should be encouraged to deal with these questions. As an input to the discussion, Dr E. Andrulewicz had prepared a discussion paper, 'Review note on sustainable development indicators'. The discussion paper is attached as Annex 3.

The poor attendance at the WGEAMS meeting did not permit further elaboration on this agenda item. But the importance of the questions both in the context of monitoring and assessment should encourage the members of WGEAMS to work intersessionally and prepare for a broader discussion at the next WGEAMS meeting.

11 REVIEW DEVELOPMENTS IN THE RELATIONSHIPS BETWEEN ICES AND THE EUROPEAN ENVIRONMENT AGENCY AND EUROPEAN TOPIC CENTRE ON MARINE AND COASTAL WATERS IN MARINE ENVIRONMENTAL MONITORING AND ASSESSMENT

As the response from the members of WGEAMS for attending the Working Group meeting was rather poor, it was decided not to invite representatives of EEA and UNEP to the meeting. Consequently, this agenda item had to be postponed to the next WGEAMS meeting.

12 CONTRIBUTE TO THE ICES STRATEGIC PLANNING PROCESS

The documents explaining the 'six objectives' adopted by the Marine Habitat Committee were received too late to be distributed to the WGEAMS members prior to the meeting. The WGEAMS members attending the meeting felt that this topic needed a broader discussion than what was possible at the meeting and therefore decided not to deal with this agenda item.

13 ANY OTHER BUSINESS

13.1 The Future of WGEAMS?

According to the membership list, 30 names representing 16 ICES Member Countries are recorded in the ICES Secretariat as members of WGEAMS. Only 10 members acknowledged the invitation for participation in this year's meeting, of which one person reported not to be a member any more, one member confirmed participation while the other responding members were unable to attend.

In spite of the poor response, it was decided not to cancel the meeting as additional persons might have shown up at the meeting without prior notice to the Chair. This could well be the case since the meeting took place at ICES Headquarters in Copenhagen and not at a member institute, where normally hotel arrangements are organized locally and therefore would have required notification to the local organizer.

However, only two members of the WGEAMS attended the meeting in Copenhagen the first week of March this year.

During recent years, participation in the work and meetings of WGEAMS has been rather poor. The problem of attendance has been raised in several reports from WGEAMS, but unfortunately, without any positive results.

Therefore, considering the extremely small attendance at this year's meeting, two options for the future were discussed:

a) to propose the termination of the Working Group on Environmental Assessment and Monitoring Strategies, or
b) to revitalize WGEAMS in order to achieve a representative forum for the discussion of environmental assessment and monitoring strategies in the broadest context.

To propose that WGEAMS should be disbanded was looked upon as too dramatic a proposal. Both the ICES Environment Adviser and the two attending WGEAMS members were of the opinion that WGEAMS is a working group of major importance that has been contributing substantially to the work of ICES, especially in its advisory capacity through the ACME. And further, the type of work supposed to be done by WGEAMS in the future would be increasingly important, as monitoring and assessing the effects of national and international regulations would be more and more important for the regulatory bodies. For ICES, as adviser to Member Countries and international regulatory organizations, as HELCOM and OSPAR, in marine environmental questions, the existence of able working groups is closely connected to the scientific credibility of ICES and thereby the future of ICES. A proposal for termination of a working group dealing with Environmental Assessment and Monitoring Strategies would be a strong signal that ICES no longer is interested in this kind of work, which then will have to be taken over by other organizations.

ICES is in the unique situation of being the only intergovernmental organization dealing with all aspects of marine science in the North Atlantic, and has therefore the possibility through its working groups, advisory committees, and scientific committees to contribute scientific advice on the broadest possible background. In this picture, WGEAMS has a major role as a working group designed to combine and review information from other environmental working groups, and use this for establishing practical criteria for monitoring and assessment that can help to bridge the gap between scientists and policymakers and managers.

What can then be done to revitalize WGEAMS ?

Firstly, the situation of poor attendance has to be brought to the attention of the Delegates as they are responsible for the national representation. It was decided that the Chair will write a letter to the General Secretary of ICES asking him to bring the worrisome situation of the WGEAMS attendance to the attention of the ICES Delegates. In this context, it is of importance that the 30 members of WGEAMS, according to the official membership list, really are aware of their membership, and the fact that membership requires at least some sort of commitment.

Then the importance of the contributions from WGEAMS to ICES should be made clearer. This could be done by, for example, highlighting the contributions of WGEAMS to ACME in a presentation sent out with the information on future WGEAMS meetings. Furthermore, WGEAMS should try to attract attendance and contributions from persons that are committed to monitoring and assessment in their regular work. Thereby work within WGEAMS may give results for the members' own benefit in their daily work.

As funding for monitoring tends to be reduced at national levels, it is believed that support from ICES on monitoring strategies could have a positive effect for the continuation of monitoring programmes. In this respect, the discussion within WGEAMS on monitoring strategies may open up new approaches when it comes to including important parameters other than actual contaminants in the monitoring. This is exemplified by the fact that for assessing the results of contaminant monitoring it is crucial that meta data enabling a good understanding of the actual environment and its living organisms are collected simultaneously.

It is believed that WGEAMS could benefit from taking a more pragmatic view that could help decisionmakers in a better understanding of the marine environment and the effects of various anthropogenic impacts. This may also be a way to make the work in WGEAMS more attractive to attendants as it may lead to more visible results. In this context, it is worth mentioning that monitoring and assessment, for many scientists, may not be so scientifically interesting, although routine measurements of, for example, contaminants require solid scientifically based and quality-assured methods.

The challenge for WGEAMS is to combine scientific knowledge from various fields. Therefore, it is crucial for the outcome of the discussions that the attendants represent broad scientific knowledge. This should be kept in mind when selecting members of WGEAMS.

Furthermore, it is also believed that more time for strategic discussions at coming meetings may be more attractive to the attendants.

Finally, it is believed that the shift of parentage for WGEAMS from ACME to the Marine Habitat Committee has not been positive for WGEAMS. Most of the work in WGEAMS is supposed to be used by ACME in its advisory capacity and therefore it is felt naturally that ACME is the right parent committee. Indeed, prior to having ACME as its parent committee, WGEAMS was under the former Marine Environmental Quality Committee. But even though that Committee was solely devoted to marine environmental issues, and the membership of MEQC reflected this and thereby opened for an extensive discussion of the WGEAMS report, it was found better to shift the parentage to ACME.

13.2 Next Meeting?

To be able to use results from other environmental working groups such as MCWG and WGBEC, the next meeting should take place after these other Working Group meetings, but in due time for having a report ready for the ACME meeting. This indicates a meeting scheduled for late April. The meeting should preferably take place at ICES Headquarters.

14 CONSIDERATION AND APPROVAL OF RECOMMENDATIONS

Due to the poor attendance at the meeting, it was felt difficult to create an action list for the coming intersessional work. The work to be carried out is, however, reflected in the recommendation for the next meeting of WGEAMS, which was agreed and is attached as Annex 4 to this report.

15 CONSIDERATION AND APPROVAL OF THE MEETING REPORT

WGEAMS considered and approved the report of the meeting subject to completion to be carried out by the Chair in cooperation with the ICES Environment Adviser.

16 CLOSURE OF THE MEETING

The 1999 WGEAMS meeting was closed at 18.00 hrs on Wednesday, 3 March 1999. On behalf of WGEAMS, the Chair thanked the staff of ICES for their hospitality and interest. In spite of only having two WGEAMS members present, it was felt that the meeting and the discussions were valuable and constructive, in particular the long discussion with the ICES Environment Adviser, Janet Pawlak, were considered most valuable.

ANNEX 1

AGENDA

1) Opening of the meeting
2) Adoption of the agenda
3) Arrangements for the preparation of the report
4) Report of activities in other for a of interest to the meeting
5) Review the importance of long time series data for the interpretation of monitoring data and the preparation of assessments and report on the outcome
6) Review the report from the 1998 meeting of the OSPAR *Ad Hoc* Working Group on Monitoring (MON98) and prepare comments on the implications of the MON98 exercise for temporal trends
7) Consider how far the strategies adopted in the HELCOM COMBINE and OSPAR JAMP allow integrated environmental assessments to be made
8) Review information collated intersessionally on procedures to assess the combined effects of exposure of organisms to groups of chemically similar, or dissimilar, contaminants; the information should include the report of the Workshop on Biological Effects Methods to be applied to detect 'Combined Effects' in Marine Ecosystems (with WGBEC).
9) Report on new opportunities for the application of microbiological measurements in monitoring programmes
10) Prepare a report on the relationships between changes in contaminant input functions and consequential environmental responses, taking into account, inter alia, the outcome of Theme Session V at the 1998 Annual Science Conference
11) Review developments in the relationships between ICES and the European Environment Agency and European Topic Centre on Marine and Coastal water in marine environmental monitoring and assessment, together with invited representatives of the EEA and UNEP
12) Contribute to the ICES strategic planning process through assisting the Marine Habitat Committee in the following tasks:
    i. formulating tactics to achieve the six objectives adopted by the Committee;
    ii suggesting and/or developing
    iii estimating the resources required for each activity according to categories that will be supplied.
13) Any other business
    13.1 The future of WGEAMS?
    13.2 Next meeting?
14) Consideration and approval of recommendations.
15) Consideration and approval of the meeting report.
16) Closure of the meeting

ANNEX 2

LIST OF PARTICIPANTS

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ANNEX 3

REVIEW NOTE ON SUSTAINABLE DEVELOPMENT INDICATORS

(with general applicability to the Baltic Sea)

Contents

1 INTRODUCTION

There is growing world-wide interest in the concept of sustainable development, particularly in the so-called 'border regions' (such as the Baltic Sea), where recent political changes offer the opportunity to effect a regional, integrated approach to the management of shared resources.

The term 'sustainable development' was succinctly defined by the World Commission on Environment and Development (Brundtland Commission) as being to:

> *Meet the needs of the present without compromising the ability of future generations to meet their own needs' (UNCED, 1987).*

The broadness of the definition is deliberate: the focus is on treating environmental conditions as part of an integrated system comprising natural and anthropogenic effects, with particular focus on the complex interactions among them.

There has been little progress made in the development of measures of sustainable development, and no general agreement on what parameters should be used to measure sustainability. Efforts to formulate a set of sustainability criteria which can be used to indicate whether a path is sustainable have recently commenced (SEI, 1996). In this context, recent attention has focused on the need to develop indicators of sustainable development. The term 'indicator' has been given various definitions, but generally refers to a measure of something. The OECD defined an indicator as:

> *'A parameter, or a value derived from parameters, which points to/provides information about/describes the state of a phenomenon/environment/area with a significance extending beyond that directly associated with a parameter value' (OECD, 1993).*

Indicators include both measures of environmental quality, as well as anthropogenic pressures resulting from social and economic activity.

The OECD has developed a systematic framework for environmental indicators commonly referred to as 'pressure-state-response' (OECD, 1993), which is based on the following causality chain:

> *'Human activities exert pressures on the environment ('pressure') and change its quality and the quantity of natural resources ('state'). Society responds to these changes through environmental, general economic and sectoral policies (the 'societal response'). The latter form a feedback loop to pressures through human activities.' (OECD, 1993).*

Pressure indicators include general social and economic indicators related to wealth, population and other demographics, as well as more specific indicators relating to the consumption and use of natural resources. State indicators are measures of the state of environmental quality, such as concentrations of pollutants. Response indicators include government policies and regulatory efforts, as well as societal responses through individual and collective actions. These response activities usually result in changes in the pressure indicators, thus closing the loop.

Later efforts at indicator development have utilised frameworks based on the OECD framework. For example, the European Topic Centre on Marine and Coastal Environment's indicator project utilises a framework/causality chain as follows: 'driving forces-pressure-environmental state-impact' (ETC, 1997). 'Driving forces' are the socio-economic activities and background state that cause the pressures.

The formulation of sustainable development indicators is seen as a way to quantify, to the degree possible, those measures which can be used to indicate the present state of the environment, as well as the anthropogenic pressures which are critical to its state. The relatively recent increase in interest in developing environmental indicators is a result of the need to provide decisionmakers, including the public, with information that will help them make informed decisions on issues that may have environmental effects. In conjunction with an understanding of system dynamics, a system of indicators can forecast the sensitivity of changes in various inputs to the condition of the overall system or its components.

2 STATE OF KNOWLEDGE REGARDING MARINE ENVIRONMENTAL QUALITY

Marine environmental quality has generally received less attention than other environmental issues, excepting harvesting of marine living organisms and bathing water quality. A major impetus for increased interest in the quality of the marine environment is the significant decline in biodiversity, loss of habitat for commercially valuable species, and declining fish catches in some regions. It is only fairly recently that the various environmental media (air, water, sediments, etc.) have been considered as an interactive system, and that efforts have been focused on sustainable management of resources.

The most highly developed assessment system for marine waters is related to bacteriological/sanitary conditions of marine bathing waters, where classification systems are in place, based on coliform bacteria concentrations. Other important issues are neglected, including eutrophication, toxic compounds, and coastal-related issues. There is, for example, no classification for marine environmental quality as is found for freshwater rivers and lakes.

There is, however, a significant amount of information available for some marine areas, generated by projects such as the Cooperative Monitoring in the Baltic Marine Environment (COMBINE), the OSPAR Joint Assessment and Monitoring Programme (JAMP), and the Arctic Monitoring and Assessment Programme (AMAP). The reports generated by these activities include a significant amount of information, but generally not in a form that is easily used by non-technicians. These reports tend to focus on biological and chemical measures, and not management-related effectiveness. The lack of such information relates to the general lack of a comprehensive approach to environmental management.

Difficulties in measuring the state of the marine environment are compounded by natural fluctuations in measures, both spatially and temporally. In addition, marine dynamics are complex, and generally only partially understood.

3 GENERAL ISSUES RELATED TO INDICATORS

There are a number of issues related to the development and use of sustainable development indicators. These include the issues discussed below.

3.1 Selection of Indicators

Indicators cannot perfectly represent the state of the environment or the complex interrelationships between the natural environment and anthropogenic activities, due to the complicated nature of ecosystems. It is therefore necessary to develop criteria for the selection of indicators that maximises usefulness, given information availability and the level of understanding of ecosystem functioning.

The OECD has developed a set of criteria that fulfils three objectives: policy relevance and utility for users, analytical soundness, and measurability (OECD, 1993). These criteria have been utilised by subsequent indicator development projects with some (generally slight) modifications.

3.2 Number and Complexity of Indicators

Indicator systems need to strike a balance between sophistication, as measured by the number of indicators and degree of functional representation, and simplicity and cost considerations.

For example, the International Chamber of Commerce (ICC) Sweden has developed a proposal for 'an initiative to contribute to the reduction of hazardous emissions into the Baltic Sea in view of restoring the quality of the water to the same level as it was in the 1940s' (ICC Sweden, 1997). They suggest three indicators: sight depth of water, healthy seals, and healthy fish. Although easy to understand, such a group of indicators does not effectively represent Baltic Sea environmental quality. On the other hand, very sophisticated systems including a large amount of data and complicated mathematical formulas may be a more accurate reflection of environmental conditions, but practitioners may not be able to make use of it. The information 'output' of an indicator system should be easily understood by non-technicians in order to facilitate use in decision making.

3.3 Reference Values

Data in and of themselves are useless for interpretation and assessment in the absence of corresponding information to compare them with. So-called 'reference values' therefore must be identified, in order to assess relative degrees of

degradation, trends, as well as progress made in solving environmental problems. A simple definition of reference value is that it is:

a value 'against which indicators can be compared so that users are able to assess the significance of values associated with them' (ETC, 1997).

Types of reference values include:

- background (before pollution) values—indicator level in the absence of anthropogenic effects;
- present values—values measured under current environmental situation;
- future values—expected value if current trends continue;
- target values—indicator level that is considered to be an acceptable target.

Target values are utilised to measure:

'the distance(s) between the current environmental situation and the desired situation (target)' (Smeets and Weterings, 1997).

Background values and recent values are objective numbers obtained from research and monitoring data. Future values are calculated (sometimes with sophisticated statistics and modelling), however, they are also based on available results and on estimated temporal trends. Target values are generally subjectively chosen, because ecosystem dynamics are at best only generally understood, or because the targets are arrived at politically. For example, the Baltic Sea States Ministerial Declaration of 1988 targeted a 50 percent reduction in pollution discharges within the Baltic Sea by 1995. The 50 percent targeted reduction was basically arbitrary.

Identification of reference values has generally not been undertaken in a systematic way. OSPAR adopted background concentrations for contaminants in water, biota, and sediments in 1997 (OSPAR, 1997). The concepts used in the OSPAR Workshop could be utilised as a starting point for developing similar types of values in other water bodies, such as the Baltic Sea.

3.4 Sub-systems

Indicator development and ecosystem modelling must be done in consideration of the uniqueness of some sub-systems. Indicators should therefore be developed within a multi-tiered system, with increasing levels of specificity for smaller sub-systems. Indicators must therefore be ecosystem-specific to the extent necessary to accurately reflect system conditions, dynamics and biotopes. The level of sub-system analysed is therefore dependent on the specifics of the sub-systems. If a higher-level system is representative of a sub-system, there is no need for further specificity.

4 REVIEW OF PROGRESS IN THE DEVELOPMENT OF SUSTAINABLE DEVELOPMENT INDICATORS

Sets of indicators have been developed or are in the process of being developed, both generally and for more specific areas. In addition, integrated systems of indicators are being developed. Two systems of particular interest are the OECD Core Set of Indicators (OECD, 1993), and the Indicator Project of the European Topic Centre on Marine and Coastal Environment (ETC, 1997). These are detailed below, followed by a listing of other indicator development projects.

Presently, indicators are utilised in a non-systematic way in national annual and periodic reports, as well as multi-national bodies. These reports utilise a variety of indicators, and are generally not comparable. To date, there have been few efforts made to utilise indicators in a more systematic way.

4.1 OECD Core Set of Indicators

OECD developed a core set of environmental indicators in 1993, utilising the 'pressure-state-response' causality framework, which links indicators into a systematic framework, which characterises the interrelationships between economic activity and the state of the environment. The indicators are general in nature as well as scope.

A list of issues which 'reflect current environmental challenges' was selected at a Workshop of the Group on the State of the Environment (OECD, 1993). Thirteen issues were thus identified. A number of the issues identified have coastal-related implications including eutrophication, toxic contamination, biological diversity and landscape, and fish resources. Subsequent workshops developed individual indicators for each issue. For example, nine indicators for eutrophication were identified. They are:

anthropogenic pressure indicators:

- emissions of N and P into water and soil
- apparent consumption of fertilisers, measured in N, P
- wastewater discharges
- livestock density

environmental state indicators:

- BOD/DO concentration of N and P in inland and marine waters

government/society response indicators:

- percentage of population connected to sewage treatment with biological and/or chemical treatment
- percentage of population connected to wastewater treatment
- user charges for wastewater treatment
- market share of phosphate-free detergents.

Although the application of the resulting indicator set to specific water bodies is limited due to its general nature, this project laid important groundwork for future indicator development projects.

4.2 Indicators at the European Level for Coastal Zone Characterisation and Management

The European Topic Centre on Marine and Coastal Environment has developed a set of indicators for the European coast, using a variation of OECD's 'pressure-state-response' framework, for the European Environment Agency (ETC, 1997). They undertook a pilot study analysing the following issues:

- pollution (heavy metals)
- eutrophication/saprobiation
- fishing
- loss and degradation of habitats
- groundwater extraction
- climate change.

Three criteria were utilised to select issues for indicator development:

- the occurrence of an environmental issue on a European scale
- multi-national, non localised source of problems
- transboundary character.

The resulting pilot project included the development of a qualitatively scaled system based on actual data. Data for Netherlands coastal areas were utilised for most indicators, due to their availability. The Netherlands coast was divided into three sub-regions, based on morphological and hydrological characteristics, degree of homogeneity, and data availability (ETC, 1997). The lack of readily comparable, comprehensive national-level data from EU countries was an obvious shortcoming of the analysis, particularly in regard to time-series data for trend analysis. Nevertheless, the pilot project represented an early attempt at actually 'running' an indicator system simulation.

The applicability of indicators identified by this project to the development of sustainable development indicators for localised areas such as the Baltic Sea is significant, though the limitations of issues to those of European scale

eliminates some issues of major importance to water bodies exhibiting special characteristics, such as the Baltic Sea, from consideration.

4.3 Other Indicator Development Projects

A number of other indicator development projects are under way. These include:

- European Environmental Pressure Indices Project. The European Commission's Eurostat has developed sets of indicators for ten policy fields, one of which is 'Marine Environment and Coastal Zones.' The six indicators for this policy field are: eutrophication, overfishing, development along shore, discharges of heavy metals, oil pollution at coast and at sea, and discharges of halogenated organic compounds. The indicator sets are being aggregated into pressure indices, one for each policy field (DG 34/F3/00151, 1998).
- The Nordic Council of Ministers has released 'Indicators of the Environment in the Nordic Countries' (HELCOM EC MON/TC INPUT, 1998).
- UNEP's Global Environmental Outlook project is also utilising the pressure-state-response framework (HELCOM EC MON/TC INPUT, 1998).
- The Food and Agricultural Organisation (FAO) of the United Nations has developed socio-economic indicators for agriculture, including both general economic categories as well as agriculture-specific practices (Borysiewicz, 1997).
- ICES co-sponsored with OSPAR the Workshop on Background Concentrations (OSPAR, 1997). ICES accepted the definitions of background concentrations and reference values. However, ICES has not always agreed with how these definitions have been applied in actual practice in the derivation of background concentrations and reference values.
- Project SCOPE - The World Resources Institute is in the process of developing indicators for sustainable development for the UN Commission on Sustainable Development (HELCOM EC MON/TC INPUT, 1998).

5 ISSUES RELATED TO APPLICATION OF INDICATORS IN THE BALTIC SEA REGION

The Baltic Sea is a unique ecosystem, with attributes of both oceanic and freshwater systems. It is also subject to severe anthropogenic pressure. For purposes of illustration, an example of general indicators for five environmental issues of importance in the Baltic Sea is included in Appendix 1. These issues are eutrophication, persistent harmful substances, exploitation of living resources, biodiversity, the coastal zone environmental quality, and oil pollution.

A number of issues specific to the Baltic Sea and its catchment area must be considered in the development of sustainable development indicators for coastal areas of the Baltic Sea. These include the issues listed below.

5.1 Unique Dynamics of the Baltic Sea

Such factors as salinity, bottom contour, and water exchange result in biotopes and system dynamics which are unlike those of other European water bodies such as the North Sea, the Mediterranean Sea, and the Black Sea. Baltic Sea conditions are also characterised by a high degree of variability. Indicators must be developed in consideration of Baltic Sea system dynamics.

5.2 Sub-system Variation

Due to morphological, climatic and other natural factors, the Baltic Sea is in reality a group of sub-systems exhibiting diverse conditions. These sub-systems react in different ways to anthropogenic inputs, and therefore require somewhat different management strategies. For example, the Kattegat is to a relatively significant degree influenced by the open waters of the North Sea. The Gulf of Bothnia, meanwhile, exhibits oligotrophic (phosphorus-dependent) productivity, in contrast to the rest of the Baltic Sea, which is nitrogen-dependent. There is also a need for further divisions within the so-called Baltic Proper, where significant differences in hydrological conditions, coastal type, and drainage areas exist. In addition, different portions of the Baltic Sea are subject to different anthropogenic pressures, related to terrestrial and marine use, as well as natural conditions (wind, currents, river runoff, coastal dynamics, etc.). The development of indicators must account for these variations.

5.3 Socio-political-economic Aspects

Relatively rapid changes in socio-economic activities are under way in the Baltic Sea region. These changes will have profound effects on the coastal zone. Anthropogenic effects will change, including the amount and distribution of effluent loads, quality of sewage treatment, agriculture production practices, land use, and marine resource use.

5.4 Current Monitoring Activities

Through organisations such as HELCOM and IBSFC, as well as cooperating national governments, a significant amount of monitoring of the Baltic Sea environment is under way. There is a wealth of information available for open sea areas, but information on coastal areas is fragmentary, and insufficient for input into an indicator system.

The shortcomings of current monitoring programmes have generally been identified, and efforts to collect additional data and to standardise monitoring are under way. New programmes such as COMBINE will assist in building up a more complete picture of the Baltic Sea environment in the medium term.

6 HELCOM ACTIVITIES RELATED TO DEVELOPMENT OF INDICATORS

The fourth component of the GEF-sponsored Baltic Sea Regional Project calls for the development of sustainable development indicators for Baltic Sea coastal areas (HELCOM EC MON, 1998). HELCOM PITF-MLW has pledged its support and is expected to play a role in the development of this component of the GEF Project. The Ninth Meeting of HELCOM PITF MLW, held in Copenhagen in April 1998, agreed to consider the issue at the MLW 10 Meeting in September 1998.

The EC MON meeting, held jointly with TC INPUT in Poland in May 1998, pledged its support to the development of sustainable development indicators, in the context of its support for the GEF-sponsored Project. The meeting specifically noted that 'to the knowledge of EC MON, indicators for sustainable development have not been developed yet, and it should be one of the tasks of the GEF project.' (HELCOM EC MON, 1998).

As requested by participants at a consultation meeting held to support preparation of the proposed Project, a document briefly reviewing the current state of activities related to the development of indicators as well as future activities was drafted for the above-mentioned EC MON 3 meeting. This document provides a review of the current state of development of indicators in Europe, briefly discussing issues related to the development of indicators specific to Baltic Sea coastal areas within the framework of HELCOM (HELCOM EC MON/TC INPUT, 1998). Findings include:

- Current HELCOM monitoring activities collect data on several of the indicators identified by the EEA, the Nordic Council of Ministers and/or Eurostat. These include: water transparency, tot-N and tot-P, metals, organic micropollutants, herbicides, marine mammal populations, point-source and diffuse pollution load, and dumping of dredged spoils.
- Others are under consideration within CMP/EC-NATURE, including endangered species, fish communities, and seabirds.
- Ecotoxicological indicators/biological effects are inadequately covered by the HELCOM monitoring programme.
- Variable characteristics of coastal areas 'will play an important role in the assessment.'
- HELCOM's activities that could be considered as being useful to the development of indicators have been limited to monitoring.

The EC MON paper recommended that:

1) Ecotoxicological indicators should be developed.
2) 'A set of indicators which characterise the Baltic marine environment and for which reference values and present values can be assessed should be developed (e.g., indicators which relate to eutrophication or contaminants).'
3) 'Attempts should be made to develop overall ecological objectives which may constitute background concentrations of natural compounds.'
4) User-friendly models should be developed; for example, 'to analyse the response of the marine environment to possible change of load to different sub-regions.'
5) 'Efforts should be made to improve the timely presentation of results/data by using modern systems.'

7 CONCLUSIONS AND SUGGESTIONS FOR FURTHER ACTION IN THE BALTIC SEA REGION

The development of sustainable development indicators for specific water bodies is both justified and timely. It is justified in particular for the Baltic Sea due to its uniqueness, both in terms of natural conditions and anthropogenic pressures, as well as the critical need to effectively and efficiently manage this international resource. The timing complements efforts under way to improve the effectiveness and standardisation of monitoring programmes, and modelling efforts under way or under consideration.

Indicator systems already developed and projects under way have generally been well designed and are based on solid principles, and can therefore serve as the basis for developing Baltic Sea indicators. The development of sustainable development indicators for Baltic Sea coastal areas can thus be considered an extension of previous efforts, with a focus on identifying indicators which accurately represent the Baltic Sea ecosystem and, where necessary, its important sub-systems. There are already in place a number of HELCOM bodies that could apply their expertise to developing indicators.

A significant amount of preparatory work must be done in order to develop sustainable development indicators for the Baltic Sea. This includes developing a conceptualised framework for the project, including the important task of defining measures of environmental quality. OSPAR has made some progress in this matter through the development of Ecological Quality Objectives (Skjoldal, 1997). There is likely to be a good deal of discussion (and possibly disagreement) on this.

Initial efforts to develop sustainable development indicators for the Baltic Sea should concentrate on development of environmental state indicators. Anthropogenic pressure indicators would be developed subsequently, because only those human activities which impact Baltic Sea environmental quality need be considered. In addition, efforts should initially be limited to a small number of particularly important issues, such as eutrophication, persistent harmful substances, exploitation of living resources, and biodiversity.

In order to develop an effective, integrated system of indicators, a number of supportive actions need to be undertaken:

- review of existing modelling for its applicability to the development of indicators
- additional monitoring and environmental data for coastal areas
- utilisation of existing information in databases for open sea areas
- development of a coastal Geographic Information System
- additional scientific research for better understanding of ecosystem dynamics.

Developing a comprehensive system of sustainable development indicators for the Baltic Sea will help identify critical information needs, and could therefore be used as a basis for identifying further research needs and designing effective monitoring programmes.

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APPENDIX 1

Illustrative example of 'pressure-state-response' framework for development of sustainable development indicators

Note: The following examples of general indicators for some environmental issues of importance is for illustrative purposes. It is not a complete identification of all related indicators.

Issue: Eutrophication

Eutrophication has been defined by OECD as 'over-nourishment of aquatic plants' (OECD, 1993). This is a particularly important issue in semi-enclosed basins such as the Baltic Sea, having caused significant adverse biological effects over the past few decades.

anthropogenic pressure indicators

- discharge of nutrients from point and diffuse sources
- discharge of nutrients from untreated sewage
- airborne discharges of nitrogen and phosphorus
- agricultural runoff of fertilisers

environmental state indicators

- enriched winter concentrations of nitrogen and phosphorus
- N/P ratio imbalanced
- more frequent presence of toxic algal species
- Secchi-depth visibility reduced
- depth range of macrophytes reduced
- changed species type and distribution

government/society response indicators

- reduction of nutrient discharges/construction of wastewater facilities
- adoption of best agricultural practices/sustainable agriculture

Issue: Persistent Harmful Substances /Contamination

Presence of chemicals which are toxic, persistent, and liable to bioaccumulation. These include inorganic (heavy metals), organic (some biocides and industrial compounds, usually halogenated, and some polycyclic aromatic hydrocarbons) and organometallic compounds (organic compounds of mercury and tin).

anthropogenic pressure indicators

- application and use of toxic compounds in agriculture and industry
- discharges of toxic compounds into water
- emission of toxic compounds to atmosphere/deposition into the sea

environmental state indicators

- environmental contamination (levels/concentrations in water, sediments and biota)
- bioaccumulation of some contaminants (levels/rates in organisms and food chain)
- multiple stress factors on marine species/communities (stress proteins)
- ecotoxicological and other biological effects (e.g., on reproduction, immunology, community structures)

government/society response indicators

- improvement/construction of wastewater treatment facilities
- ban or significant reduction in production and/or use of substances (e.g., DDT)
- reduction of toxic emissions from industry

Issue: Oil (Petroleum hydrocarbons) pollution

Oil (petroleum hydrocarbons) pollution is defined here as pollution of the marine environment by crude oil, crude oil derivatives (except solvents) and polycyclic aromatic hydrocarbons from oil as well as derived from combustion of fossil fuels.

anthropogenic pressure indicators

- marine transport (unintentional and intentional discharges)
- accidents/collisions at sea
- land-based discharges (sewage outfalls and rivers)
- atmospheric deposition (from transport and combustion of fossil fuels)

environmental state indicators

- oil residues in sea water and sediments
- oiled/beached birds
- oil slicks on the sea surface
- PAHs in water, sediments, and marine organisms
- PAH-related effects (e.g., liver neoplasms)

government/society response indicators

- regulations on discharges (e.g., on offshore oil and gas industry)
- regulations on transport (including ship requirements)
- reception facilities in ports
- inspections of marine transport (e.g., aerial surveillance)

Issue: Exploitation of Living Resources

'Living resources' are defined here to mean commercially valuable fish species. Some of the following ideas of indicators are taken from documents of the International Baltic Sea Fishery Commission (IBSFC, 1998).

anthropogenic pressure indicators

- landings of fish per country/fishing mortality (e.g., total amount of landings in tonnes of cod, salmon, herring, sprat, etc.)
- total kilowatts per fishing area per country (total effort)
- number of full-time fishermen engaged in the area, by country

environmental state indicators

- fish stock size
- spawning stock biomass
- recruitment

government/society response indicators

- regulation of landings (total allowable catches (TACs), per country)
- technical measures (fishing gear, number and size of nets, etc.)
- temporary closure of fishing (fishing grounds, time of fishing, etc.)
- reduction of number of fishermen

Issue: Coastal zone environmental quality

The coastal zone includes the marine/terrestrial interface and adjacent marine and terrestrial areas.

anthropogenic pressure indicators

- demographics - permanent population, temporary population
- non-marine land use (housing, commercial, tourism, industry, etc.)
- marine-related land use (shipbuilding and repair, fishing, marinas, mariculture, etc.)
- coastal defence measures
- loss of coastal wetlands through anthropogenic activities
- exploitation of mineral and living resources

environmental state indicators

- natural morphology
- percentage of the coastal zone in a natural state, including morphology, wetlands and lagoons, river mouths, etc.
- natural plant communities

government/society response indicators

- coastal land use planning (restrictions on use of privately owned land)
- protective measures - designation of protected areas
- limits on anthropogenic activities
- licensing of specific uses (e.g., mineral extraction, mariculture facilities)

Issue: Marine and coastal biological diversity

Biodiversity has been defined as 'The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (OECD, 1993). For the purposes of this discussion, biodiversity is limited to organisms permanently inhabiting (or occasionally visiting) marine and coastal areas.

anthropogenic pressure indicators

- physical habitat destruction or degradation (e.g., marine aggregate extraction, heavy trawling)
- discharges of nutrients and toxic substances
- overexploitation of living resources
- human-mediated transfer of non-indigenous species
- disturbance due to recreational activities (e.g., hunting, sailing, etc.)

environmental state indicators

- total number of species
- (natural) community/matrix structure
- presence of keystone: indicator/rare/sensitive species

- presence of keystone communities

government/society response indicators

- protection of habitats
- protection of endangered species
- establishment of protected areas

ANNEX 4

RECOMMENDATIONS

The following recommendations are numbered according to the relevant agenda item.

WGEAMS recommends that:

4.1 ACME consider an approach towards OSPAR in order to secure that the proposal for establishing a permanent OSPAR Working Group on monitoring and assessment, MON, does not lead to a situation of double work between WGEAMS and MON.

5 ACME and MHC support the need for more routine, systematic, and long-term observations, not only for monitoring contaminants but also data of biological, chemical and hydrographical importance needed to interpret the results of the contaminant measurements.

6 ACME recognize the report of the AMAP/EEA/ICES Workshop on Combined Effects in the Marine Environment as an important contribution, but that 'combined effects' require more research and experimental studies before some methods can be recommended for monitoring.

ACME and MHC encourage participation in this work within ICES, particularly from Canada and the USA to benefit from their broad experience from their national monitoring programmes.

13.1 ACME consider the serious situation of the recent years' poor attendance at meetings of WGEAMS and discuss how ACME can contribute to increased commitment in the work of WGEAMS.

ACME consider the present parentage of WGEAMS, noting that the work of WGEAMS is mainly focused on advice to ACME and therefore a shift of parentage back to ACME is most appropriate.

13.2 WGEAMS (Chair: L. Føyn, Norway) recommends that it meet for a period of five days in late April 2000 at ICES Headquarters, Copenhagen, to:

a) review the various requirements for communicating scientific advice and the need to establish a set of credible indicators;

Justification: *Communicating scientific advice to policymakers and managers may often be a problem. This problem is, inter alia, mentioned in the report from Theme Session V at the 1998 ASC and in the report from the Second London Oceans Workshop. While the participants at the Theme Session were scientists, the participants at the Oceans Workshop were mainly managers and policymakers. This indicates that there is a common understanding of the gap in communication.*

The introduction of acceptable indicators, as presented for discussion in Annex 3 of this report, may be a tool for a more pragmatic way of presenting results from monitoring programmes.

b) continue reviewing information collated intersessionally on procedures to assess the combined effects of exposure of organisms to groups of chemically similar, or dissimilar, contaminants; the information should include the report of the 'Workshop on Combined Effects in the Marine Environment' (to be sent to the WGEAMS members by the Chair).

Justification: *This is a continuation of an item from the 1998 and 1999 agendas. Most national and international pollution control measures are based on the regulation of individual compounds. It has long been recognized that this may reflect a fragmented view of the mechanism of impact of marine pollutants, whereas in reality organisms are usually exposed to complex mixtures of similar and dissimilar substances. The purpose of this agenda item is to revisit the problems of synergism and antagonism between contaminants, and the possibilities of interactions between apparently unrelated substances, and hopefully to assess whether current monitoring and assessment procedures can take account of these processes. Possible interactions are in particular relevant in the case of the discharge of produced water from oil and gas production platforms.*

c) consider how far the strategies adopted in the HELCOM COMBINE and OSPAR JAMP allow integrated environmental assessments to be made and to discuss monitoring strategies in a broader context based on an introductory discussion paper prepared by the Chair.

Justification: *This is partly a continuation of an item from the 1999 agenda where an examination of the current state and possible future of methods for integrating multiple measurements of different environmental factors was wanted by ACME. Basic data for such integrated assessments are produced by monitoring. A review of the recently revised HELCOM and OSPAR monitoring programmes is suggested, in order to examine the extent to which the strategies and designs in these programmes can assist in integrated assessments.*

Monitoring of environmental factors is not only taking place within HELCOM and OSPAR but also in the western part of the Atlantic. Experience from such national monitoring programmes may be valuable additions to the design of general monitoring programmes.

d) report on new opportunities for the application of microbiological measurements in monitoring programmes.

An expert on microbiological measurements should be invited to present an overview of methods.

Justification: *This is a continuation of an item from the 1999 agenda which was not discussed because there was no specialist in this particular field present at the WGEAMS meeting. However, new developments in molecular techniques may open significant new opportunities for investigating the effects of contaminants in the marine environment on important marine microbiological processes.*

e) prepare a report on the relationships between changes in contaminant input functions and consequential environmental responses.

Justification: *This is a continuation of an item from the 1999 agenda which was not completed.*

It is generally accepted that there is normally a time lag between changes in contaminant inputs and consequential environmental responses. However, the length of the time lag and the form of the response is often difficult to predict. The objective of this item is to collate examples in which both input and response functions have been recorded and to develop a conceptual framework within which to view environmental responses to changes in stress of this type.

f) review the developments in the relationships between ICES and the European Environment Agency and the European Topic Centre on Marine and Coastal water in marine environmental monitoring and assessment and to invite representatives of EEA to attend the meeting.

Justification: *This is a continuation of an item from the 1999 agenda which was not followed up due to the small attendance at the WGEAMS meeting. However, it is necessary that ICES develop mutually beneficial working relations with EEA and participation and discussions with representatives of EEA at WGEAMS meetings is valuable for the relationship.*

g) discuss the practical use of risk assessments based on a presentation by an invited representative from the oil industry.

Justification: *Risk assessments are in common use, in particular by the offshore oil and gas industry. The methods used in risk assessments* ***are*** *to some extent unfamiliar to marine scientists. It will therefore be valuable to initiate a discussion on the practical use of such methods.*