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REPORT OF THE WORKING GROUP ON ENVIRONMENTAL ASSESSMENT AND MONITORING STRATEGIES

Norrköping, Sweden, 2-5 May 1988

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WORKING GROUP ON ENVIRONMENTAL ASSESSMENTS AND MONITORING STRATEGIES
(Norrköping, Sweden, 2-5 May 1988)

1. OPENING OF THE MEETING

The Chairman, Dr J E Portmann, opened the meeting at 9.30 hours on 2 May 1988 and welcomed the participants.

Mr H Dahlin, Director of the Oceanographic section of the Swedish Meteorological and Hydrological Institute (SMHI) welcomed the participants to his Institute and to Norrköping. He provided some information on the types of studies conducted by SMHI. Noting that this was the first ICES Working Group meeting hosted by SMHI, he wished the participants a successful meeting.

Each participant then introduced him- or herself, indicating the main area of work. A list of participants is attached as Annex 2.

2. ADOPTION OF AGENDA

The agenda was adopted as proposed. It is attached as Annex 1.

3. ARRANGEMENTS FOR PREPARATION OF WORKING GROUP REPORT

The Working Group agreed that individual participants would prepare specific sections of the report, according to requests by the Chairman.

4. REPORT FROM STATUTORY MEETING AND NORTH SEA CONFERENCE

The ICES Environment Officer, J Pawlak, presented a list of Council Resolution from the 1987 Statutory Meeting relevant to the environmental work of ICES.

Questions were raised about work on modelling. It was noted that a joint session on water quality modelling had taken place at the 1987 Statutory Meeting and another session, concentrating more on modelling the transport of contaminants, was scheduled to take place at the 1988 Statutory Meeting. A Study Group on Baltic Sea Modelling had been established at the 1987 Statutory Meeting.

The Working Group noted that, for various reasons, the Chairman of the three working groups requested to attend this meeting had been unable to attend (Marine Chemistry Working Group (MCWG), Working Group on the Biological Effects of Contaminants (WGBEC), Working Group on the Statistical Aspects of Trend Monitoring (WGSATM)).

Concerning the tasks for the meeting of the Working Group on Shelf Seas Oceanography, it was questioned whether task (d) (consider nutrient trend analyses for the shelf: methods and results) was appropriate since the group is composed mainly of physical oceanographers. On discussing this question, it was felt that the Shelf Seas Oceanography Working Group would certainly be the group to review nutrient data in terms of physical oceanographic condition. However, it was considered that the MCWG is the appropriate group to discuss methods of measuring nutrients and evaluating nutrient data quality. Accordingly, the Working Group agreed that there should be close cooperation between the Shelf Seas Oceanography Working Group and MCWG in the consideration of items related to nutrients.

The Environment Officer then summarised the outcome of the Second International Conference on the Protection of the North Sea, that had been held in London in November 1987. She drew particular attention to an invitation that ICES and the Oslo and Paris Commissions jointly coordinate the activities to increase scientific understanding of the North Sea and the preparation of environmental assessment. As a result of this request, ICES and OSPARCOM had proposed the establishment of a Coordination Group (North Sea Task Force) consisting of representatives of ICES and the Oslo and Paris Commissions, as well as representatives of countries around the North Sea. The intention is that this group would provide appropriate coordination of the activities in relation to the North Sea, but that so far as possible the existing technical and working groups under OSPARCOM and ICES would actually carry out the work. A decision on the establishment and funding of this Coordination Group/Task Force and associated Secretariat expenses was to be taken at the Joint Meeting of the Oslo and Paris Commissions in June 1988.

In the discussion of this topic, several members questioned whether such a task Force was actually necessary. It was also felt that, if the Group were established, its terms of reference must be very clear if unnecessary work was to be avoided. The Chairman indicated that this danger was recognised and pointed out that the preparatory meeting for the Task Force had recognised the possibility for contributions from WGEAMS, among others, in the development of the new guidelines for regional assessments.

5. GUIDELINES FOR THE PREPARATION OF REGIONAL ENVIRONMENTAL ASSESSMENTS

The Chairman introduced this agenda item with a brief history of document WGEAMS 1988/5.1. This was based on the review of the original ICES Guidelines on Regional Assessments prepared for the first (1987) meeting of WGEAMS, with additions and amendments made to take account of comments made at and following this meeting. The paper now consisted of a number of sections, each of which was briefly reviewed by the Chairman - an Introduction which included reference to the experience gained from regional assessments carried out since the initial ICES experimental Guidelines were developed, the purpose of regional assessment reports, the Recommended Approach for their production, the Procedure and Format of the assessments and their Content. An annex was also included, outlining a Framework for Making Assessment, the structured approach of which had been adopted for the preparation of the Quality Status Report for the North Sea.

The document provoked considerable discussion among the Group and a number of alterations were suggested, especially to the more descriptive sections of the report leading to the Recommended Approach and Procedure. The main points were:-

With regard to the actual structure of the assessment report, it was agreed that an additional tier was required - a 1 to 2 page succinct, condensed summary designed for senior scientific administrators and other policy-makers. This should include a statement of the range of action considered to be available as a result of the assessment, expressed in a forthright manner to facilitate decision-making.

Some discussion also took place on the requirement for another summary geared towards the general public. It was generally agreed that this would be valuable, but there was some uncertainty as to who should be responsible for its production.

Some Members of the Group expressed concern regarding the use of the disciplinary approach for the production of assessments, since it was felt important that multi-disciplinary overviews be carried out. It was agreed to emphasize strongly that scientists involved in any assessment should not work in isolation and that each discipline was not meant to exist in its own right. It was also suggested that, with the disciplinary approach, there was a possibility of the omission of some uses to which the area being assessed could be put. It should be emphasized that all such uses must be considered in any assessment.

The importance of modelling was agreed. In addition to providing useful information in its own right it had the additional benefits of providing a useful vehicle for the synthesis of available information and also stimulating reluctant scientists to provide best estimates of the data required to fill any gaps in knowledge.

Many of the Group felt that the absence of quantitative standards/guidelines hampered the decision-making process and sensible action was less likely to be taken, following an assessment, without such reference values. It was agreed that making progress towards the production of standards was extremely important, but obviously would be very difficult. In the meantime, it was essential that whatever the uncertainties, some attempt should be made to draw conclusions from the available data. The strength of such conclusions, which should also include what had been found not to be a problem and was not therefore considered of concern, would of course be dependent on the quality of the data available. Some guide as to the inherent degree of confidence in the conclusions should always be included.

As a contribution to discussion on this agenda item, Dr Bannink had produced a paper (presented in his absence by Dr Kerkhoff) on the organisation of the transfer of information between scientists and policy-makers. This provoked considerable discussion, particularly on the role of both parties in the assessment process and what were "real world" or simplified political situations. Many of the Group felt that scientists should act to initiate and drive the assessment process. Some interesting discussion took place on who could actually be considered to be the "policy-makers".

The Chairman concluded the discussion with the observation that, although a number of points which had been made were found on closer inspection to have been adequately covered in the text of WGEAMS 1988/5.1, it was apparent that parts of the latter required more extensive amendment. A revised draft would therefore be prepared. This was presented to the Group and discussed under Agenda item 14 (approval of the report). The text, revised to take account of that discussion is attached as Annex 3.

6. STRATEGIC PLAN FOR MONITORING

The Chairman introduced a paper entitled "Philosophy, Principles and Strategy on Monitoring" that had been prepared as a revision of a paper discussed at the previous meeting of the Working Group. A document on this topic was

regarded by the Chairman as an important product of the working group and on this basis the tabled draft was opened to discussion.

In the initial discussion, a number of major observations were made. First, it was pointed out that the paper focussed on the monitoring of contaminants and this needed to be placed firmly in the context of the broader purposes of monitoring as specified by ICES and the European regulatory commissions (namely for human health protection, for determining the health of a marine area and for trend detection purposes). Second, the stated definition of 'monitoring' in respect to the combined effects of contaminants, whether it should really be restricted to studies involving repeated measurements. It was also suggested that the definition overemphasised effects on man, and that some improvement in the distinction between 'monitoring' and 'research' should be made. Finally, it was felt that the measurement of fluxes required greater stress and some reflection of the fact that monitoring can be used as a mechanism of providing answers to questions raised by policy-makers.

Reference was also made to an Annex (I) on monitoring is the 1978 ACMP Report which it was advocated should be studied before finalising the present paper. There was also a need for some caution in respect to links between the incidence of contaminants and adverse effects to reflect an appropriate balance of evidence.

The Working Group then embarked on a detailed discussion of the terms 'monitoring' and 'research'. Some members could see little distinction between these terms while others discerned marked differences in which monitoring is a sub-component of research. There seemed to be a conviction among some that research involved a considerably larger intellect and motivation than did monitoring and, indeed, these convictions were reflected in a rather derogatory sense, in the paper. It was finally agreed that some clarification of the relationship between research and monitoring was required to place monitoring in a better context and, to a limited extent broaden the definition of monitoring to cover all potential uses of this type of activity.

The Group then considered the detailed content of the paper and a number of suggestions for revision were made either to clarify the text or to adequately qualify some of the point-form entries. It was agreed these would be taken into account in the revision of the paper which would be undertaken during the meeting. The revisions would include clarification of the objectives, the formulation of interim standards, the sources of uncertainties in data acquired to answer specific questions, greater stress on mechanisms for periodic evaluations of monitoring programmes and consideration of signal-to-noise ratios is the selection of areas, and matrices for sampling of particular contaminants.

Before closing the discussion, the Chairman raised a number of more practical questions in relation to the formulation and conduct of contemporary monitoring programmes. For example, were there instances in which cooperative monitoring, involving contributions from a number of laboratories, was less appropriate than having the entire sampling and analysis carried out by a single agency/laboratory. It was decided that appropriate, if largely generic, advice on the selection of options for the design and conduct of monitoring would be provided in the latter part of the revised document.

A revised version of the working paper was duly prepared and was discussed under Agenda item 14. A number of changes were agreed and the revised form of this paper as attached as Annex 4 to this report.

It was noted that JMG had requested advice on the usefulness of adding additional contaminants to the JMP programme and the choice of sampling matrices for existing and new contaminants. The generic advice on the practical aspects of programme design would provide some basis for responding to these questions and a sessional sub-group was established to deal with responses to the specifics of the JMG request. This sub-group produced a draft matrix table summarising what matrices might be suitable for monitoring each of the contaminants of interest to JMG for their purposes a, c and d (ICES purposes 1, 2 and 3). It was agreed this should be forwarded directly to ACMP as an initial attempt at answering the JMG request.

7. REVIEW OF THE EXISTING ICES COOPERATIVE MONITORING STUDIES PROGRAMME

A brief summary of the present ICES programme was given by Mr Franklin (Published in Coop. Res. Rep. 126). During the discussion the activities and decisions of other international organisations came up, on several occasions and these caused some confusion, accordingly relevant information is summarised briefly in Appendix I.

Purpose 1: Monitoring with respect to human health.
Referring to both the JMG classes and those used in the 1985 Baseline study report it was noted that neither of these classes were in any way related to good human health standards/criteria. Human health criteria for fish consumption exist in a few countries eg for mercury, PCBs, DDTs, dieldrin, HCB and HCHs. However overall agreement about the various levels does not exist. Consequently comparison of data, collected for purpose 1, to commonly accepted criteria is impossible. It was agreed (as had JMG) that monitoring with respect to human health must be continued if concern about the residue levels exists, but the need for concern has to be the exceedence of human health criteria established in the different countries. It was agreed that action in such cases must therefore be the responsibility of those countries in which residue levels approach or exceed national standards. Since the JMG "upper" class levels do not necessarily match these, it was questioned whether continued purpose 1 monitoring was necessary in all areas where "upper" levels were found.

Purpose 2: Monitoring to establish geographical distribution. As the 1985 Baseline study had identified very little new information about hot spot areas a baseline survey for the same contaminants in 1990 was not considered worthwhile. This decision does not preclude a further baseline study for some of those contaminants at some future date and it was agreed that if serious reasons exist one might be organised. Reasons identified were eg: results of the trend monitoring studies which demonstrate increasing levels; concern about (increasing) inputs; increased concern for human health due to the levels found (changing standards); results of biological effect studies, which show a concern for the marine environment itself; new toxicological data.

For new contaminants it was recognised that the organisation of a baseline study will introduce problems with comparibility, precision and accuracy of data. From that analytical point of view a stepwise procedure of analytical quality assurance is recommended for new contaminants before monitoring

commences. If more rapid action were required a preliminary survey might be undertaken by a single laboratory or country, followed by a broader scale survey with a few specialist laboratories and in the last phase a baseline survey for all countries to cover the whole ICES area. During the first and second phase there will be enough time for other laboratories to develop a proper analytical method for the particular contaminant.

Purpose 3: Monitoring to establish temporal trends. A common agreement about the need for ongoing trend monitoring studies was present. A more detailed discussion took place under item 8.

Biological effects monitoring There was a general feeling that the reductions in efforts for chemical monitoring studies should be compensated for by deployment of the released facilities in association with biological effect studies. However it is still too early to include biological effects monitoring on a common and cooperative basis in an updated programme.

The stepwise procedure mentioned above for new contaminants was considered to be the proper approach to a baseline survey on biological effects.

Publication of data available to ICES It was agreed that in principle the data in previous years already collected for the human health purpose in the ICES coordinated monitoring programme should be published if possible. However, it was realised that problems with the interpretation could appear because of the lack of commonly accepted criteria. The need for a volunteer was indicated.

As a start, a number of names were suggested to the Environment Officer, of people who might be able to advise on the practicability and usefulness of such a publication. If they agree that further action is worthwhile, and are prepared to produce a draft report, it was agreed to refer consideration of the initial draft to MCWG, since it has several qualified members to do this job.

Advice to IOC on mussel watch. It was noted that IOC had, at an inter-secretariat levels, asked ICES for advice on its proposed mussel watch programme. After a brief discussion, during which several doubts were raised as to the value of such a programme, the WG identified G Topping, being the Chairman of MCWG as the person most suitable to act as the formal representative of ICES since he is involved in the IOC Mussel watch group and can therefore advise on the outcome of with the mussel monitoring component in the baseline study of 1985.

8.1 REVIEW OF PROGRESS ON BIOLOGICAL EFFECTS (MONITORING)

Dr Lars Føyn presented the report of the Working Group on the Biological Effects of Contaminants - April 1988 (WGBEC). This was discussed at some length and the following observations were generally agreed.

- The WG is operating in the development and the testing of techniques (eg benthic community studies - studies on flatfish species - bioassays of the toxicity of compounds accumulated in the surface microlayer).

- There is no suggestion that a single technique might be used to evaluate effects, and this is in accord with the conclusions of a report prepared by Professor McIntyre and Dr Davies for OSPARCOM.

- Distinction has to be made between methods designed to gain an idea of the general quality of the marine environment and methods designed to evaluate effects of contaminants.

- The WGEAMS would like to see emphasis on the development and testing of simple techniques applicable in the field and yielding results that can be interpreted in terms of potential impact on the well-being of the organisms concerned.

- The testing of biological effects techniques is of limited relevance in the absence of appropriate chemical measurements (on sediments, water and biological tissues, bioaccumulation capacity).

- Simulation modelling can give a good idea about potential effects in relation to natural variation and should be considered in some detail.

- Reservations were expressed as to the value from biological point of view of bioassays in the surface microlayer; because of the effect of the turbulence, the surface layer has to be defined and many of the organisms which become caught in the surface microlayer would not survive, regardless of the presence of micropollutants (irradiation effects - blindness etc).

- Other techniques must be considered as well; in this context concern was expressed as to the apparently scant attention paid by WGBEC to the review of biological effects studies of Dr McIntyre in the framework of JMG (OSPARCOM).

- In testing of techniques a polluted site should be checked against a control site.- Definition:

> The objective of biological effects monitoring is to provide a statement of health for the marine environment through the measurement of the response of organisms to a change in ambient quality.

Finally it was noted that the WGBEC had spent a considerable amount of time discussing the proposed Meteor workshop - perhaps to the exclusion of its other tasks. Several members expressed concern over the way in which the planned workshop might eventually be run. In particular the extent to which it would reflect experience gained from the OSLO workshop, the influence of GEEP's developed interests relative to the more applied interests of ICES and the types of effects that it might be practical to measure at sea in relation to the proposed pollution gradients.

8.2 REVIEW OF PROGRESS ON TREND MONITORING OF CONTAMINANTS IN MARINE MEDIA, ESPECIALLY BIOTA

Dr Bewers summarised the relevant results of the recent meeting of the Working Group on the Statistical Aspects of Trend Monitoring (WGSATM). At this meeting, the WGSATM completed its application of the six-model statistical procedure, developed the previous year, to the data on contaminants in fish muscle tissue submitted for trend monitoring purposes under the Cooperative ICES Monitoring Studies Programme. A draft report on these results had been

prepared. The WGSATM had also continued its review of (a) the application of multivariate procedures versus univariate procedures in the study of temporal trends in contaminant levels, (b) the influence on the results of statistical analyses for trends of pooling specimens prior to chemical analyses, and (c) the influence of fat content in the estimation of contaminant trends. In addition, the WGSATM had reviewed issues relevant to the possible use of surface sediments in trend monitoring. In considering this report, the Working Group agreed that the WGSATM was working well and at the correct tempo to fulfill the requirements of its terms of reference.

The Working Group then considered the trend monitoring component (Objective 3) of the Cooperative ICES Monitoring Studies Programme, as part of the review of this programme it had begun under Agenda Item 7. The Working Group agreed that trend monitoring of contaminants in marine organisms should be continued. This will ultimately provide information on whether concentrations in an important component of the marine environment are decreasing in response to input controls. The Working Group agreed that it would not indicate which contaminants and substrates should be examined to assess whether trends are detectable, this decision should be left to the WGSATM since the concern at present should be with what is feasible rather than what is necessary.

The frequency of trend assessment monitoring was discussed and it was agreed that the monitoring should continue on an annual basis for the present time. The Working Group agreed to this frequency, despite its realisation that trends in contaminants in the marine environment occur slowly. Its rationale being that a substantial number of data sets are needed before trends can be determined with certainty. In addition, the possibility of an anomalous year in terms of contaminant concentrations has been identified in the course of the overall analysis of the trend data; such anomalous data would be very difficult to identify with sampling frequencies longer than once per year.

Recognising the problems in statistical analysis caused by inconsistent data sets, the Working Group encouraged laboratories that are contributing to this programme to collect their data in a consistent manner each year. It further suggested that other laboratories should check their records to establish whether any other suitable data sets were available. The Working Group noted that after the WGSATM has been able to analyse enough data on a consistent basis, it will be able to indicate which biota/tissue is the best medium to indicate temporal trends for each contaminant of concern and to streamline the guidelines, where possible.

In concluding the discussion on this topic, the Working Group expressed its appreciation to the members of WGSATM, for the work conducted to date and encouraged new persons with appropriate expertise to join them.

9. PLANS FOR THE CONDUCT OF NEW REGIONAL ASSESSMENTS

The Working Group discussed this item in view of the latest development of activities of the North Sea Conferences and the North Sea Task Force as well as the Baltic Environment Protection Commission.

The Baltic Commission has adopted the procedure of making periodic assessments with five year intervals. The second periodic assessment will cover the period 1984 - 1989. Each chapter is normally written by a group of experts where the members are nominated from all the Baltic countries. However, ICES

has been assigned the task of preparing the chapter on the Baltic sea fisheries taking due consideration also to the possible influence by the environmental conditions. Once the chapter has been drafted it will be passed through the working groups and committees of the organisation before the product is delivered to the Helsinki commission.

The Second North Sea Conference had proposed establishing a special North Sea Task Force to interlink the ICES and OSPARCOM organisations. Furthermore the Conference had decided that a new assessment of the quality of the North Sea environment should be carried out starting in 1991 or 1992 in advance of the next Conference to be held in 1992 or 1993. Several members of the group questioned the usefulness of making such an evaluation for the third time in such a short period after the two Conferences. However, remembering that the latest assessment suffered from improper balance between the description of different aspects of the environmental conditions, it was realised that this third status report would offer an opportunity to restore the balance in the information. In this context the attention of the group was drawn to the fact that the Conference had agreed in principle to follow the guidelines for regional assessments recommended by ICES.

The discussion then turned to a general consideration of the kind of assistance that ICES could provide to the benefit of the Conference, as well as to the member states in the process of making regional assessments. It was pointed out that as the newly adopted guidelines called for disciplinary groups to draft the various chapters in such a report, ICES could offer its services as a coordinator, or to follow the progress of the work, with two clear objectives in mind. The first being to extract from any assessment the commonalities that could be of use for further similar work and the second being to see whether the guidelines would need further modification.

The discussion then focussed on whether the North Sea should be treated as one entity, or as subregions, in the assessment work. Realising the advantages and disadvantages of both approaches it was concluded that a subregional division should be used initially and that these assessments should be linked, either by a main chapter providing the balanced synthesis of the information, or in preparation of à final overall document. The subregions should cover all areas of the North Sea and it was suggested should be the Wadden Sea, the German Bight, the Southern North Sea Bight, the Channel to the east of 5° W (unless the Channel is considered as a whole in a separate assessment) the north-eastern coast of the United Kingdom, the northern North Sea, the central North Sea and the coastal areas of the Kattegatt-Skagerrak area (particularly the border area between Norway and Sweden).

Other areas of great interest for the conduct of regional assessments were identified. These included (in order of priority) the Gulf of Maine/the George's Bank, the New York Bight, the Gulf of St. Lawrence, the New York Bight, the Gulf of Maine/the George's Bank, the Bay of Biscay (both the French and the Spanish parts), the Iberian Peninsula (the Spanish and Portugese coastlines facing the Atlantic Ocean) and, although outside the ICES area, Golfe du Lion.

10. IDENTIFICATION OF TOXIC SUBSTANCES BEFORE THEY CAUSE POLLUTION

As an introduction to this topic, Professor Grimas described some studies of benthic ecology in the Baltic Sea which emphasised the importance of long data sets and adequate control areas in the separation of anthropogenic changes from those arising from natural causes. He went on to present a report on the usefulness of Zoarces viviparus (the viviparous blenny, or eelpout) in biological effects studies, which indicated that the growth and survival of juveniles, whilst still inside the female, were sensitive to external environmental conditions. The eelpout could be used in this way as an indicator of environmental quality, or for effluent screening, etc.

The group noted that the significance of toxic substances in the environment to organisms was a function of both toxicity and exposure, and, in some cases, the same variables in relation to decomposition products. The prediction of the significance of inputs was therefore complex, and site/area specific. From a purely toxicological point of view, experience of pesticide screening in Canada was gradually leading to the ability to predict toxicity from chemical structure. In the Netherlands, and elsewhere, this was becoming formalised into a system of quantitative structure-activity relationships. The system was now useful for relatively simple compounds, but could not accommodate more novel structures or particularly toxic radicles on otherwise relatively harmless molecules.

Additional pointers could be obtained from the study of inputs, through knowledge of industrial production and discharge practices, and of the toxicity of effluent (derived from toxicity tests). Such tests should bear in mind the most significant exposure pathway to the target organism, and the most sensitive stage of the life cycle of that organism.

The Group emphasised the need to maintain the necessary perspective and balance in environmental assessment, and not to concentrate on one or more particular aspects of environmental impact to the exclusion of others.

11. ANY OTHER BUSINESS

11.1 Standards for dredge spoils

Dr Kerkhoff introduced a paper, which had originally been prepared for discussion at SACSA, and requested comments from the Working Group on the approach proposed. The paper proposed a set of standards that might be applied to the quality of dredge spoils permitted for disposal at sea. The standards were based on levels of the substances concerned found in standard soil samples and had originally been derived for use in relation to the application of river dredgings to land.

The general view of the working group was that the paper outlined in interesting approach to the problem, but that it failed to take into account a number of important factors and therefore the conclusions reached were of doubtful value. Particular points made were that the concentrations of contaminants in land soils were not necessarily typical of those found in marine sediments, that the contaminants considered were primarily metals whereas organics might be of at least equal importance and that the bioavailability of the contaminants in dredge spoils and indeed of sediments could vary markedly. Thus, it is the effect that really matters, not what the

level of a contaminant is relative to a standard. Concern was also expressed that the development of purely numerical standards ignored both the economic and social consequences of a dredge spoil failing the standard.

11.2 ICES involvement in future monitoring studies

The Chairman briefly outlined the history behind ICES involvement in environmental quality monitoring, both from a standpoint of development of programmes and their actual conduct. He noted that in a substantial part of the ICES area, other organisations were now also involved in very similar programmes. He therefore invited views from the members on the extent to which ICES should continue to be involved in the organisation and conduct of monitoring of environmental quality.

In the discussion that followed some concerns were expressed that if ICES did not maintain an active role it might lose the expertise necessary to advise on programme needs. It was however pointed out that since the same people would continue to be involved this was more a theoretical than a practical possibility. The conclusions from the discussion were that ICES must maintain a close interest in the conduct and results of monitoring programmes, but that so long as other organisations adequately conduct the monitoring ICES should not be directly involved. It was however agreed that, if requests were made for the organisation of a programme of monitoring, whether of biological effects or contaminant levels, for the entire ICES area, then it would be appropriate for ICES to assist. However this would not be the case if the area concerned was more restricted, or the interest in the conduct of such programmes was confined to only a few countries. It was further agreed that these conclusions referred only to the routine conduct of monitoring and that ICES should maintain an interest and active role in approaches to monitoring and the development of new techniques and methods and even in preliminary surveys. Thus ICES should continue to collect and assess results of trend monitoring (cf item 8). It was also agreed that ICES should continue to provide data handling services for monitoring results and that contributing countries should continue to flag such results as immediately available to ICES as appropriate.

12. PLANS FOR THE NEXT MEETING

The working group discussed a wide variety of proposals for topics to be considered at its next meeting and agreed on a list of items as laid out in Recommendation 2 at Annex 5.

13. DATE AND PLACE OF NEXT MEETING

Mr Joanny indicated that his institute (IFREMER) would like to act as hosts for the next meeting of the members agreed. This offer was accepted unanimously. It was further agreed that the best dates for the meeting, taking account of national holidays in France, the needs of ACMP and the likely timetable of other working groups with an input to WGEAMS activities, would be 25-28 April 1989.

14. CONSIDERATION AND APPROVAL OF THE REPORT

The working group agreed to adopt the report by correspondence on the understanding that it would be distributed within about a week and be open for comment for about two weeks after receipt. The revised working papers considered earlier under agenda items 5 and 6 were however discussed in detail and further changes were agreed. The revised versions of these two papers are attached to this report as Annexes 3 and 4 and it was agreed should be considered as representing completion of these two tasks.

15. CLOSURE OF THE MEETING

There being no further business the Chairman thanked the members for their active involvement in the discussions which he considered had been both lively and successful. He asked the group to record in the usual way their appreciation of the facilities and services provided by Mr Carlberg and his colleagues at SMHI and declared the meeting closed at 1435 hours.

ANNEX 1

DRAFT AGENDA

1. Opening of meeting.

2. Adoption of Agenda.

3. Arrangements for preparation of working group report.

4. Report from Statutory Meeting and North Sea Conference.

5. Define guidelines for regional assessments, including how regions should be delineated and the protocol for development and preparation of regional assessment reports. Draft paper to follow.

6. Complete the strategic Plan for monitoring i.e. the basic protocol for definition of needs and how to meet them, matrices selection. Draft paper to follow.

7. Review, in the light of the Strategic Plan, the existing ICES Cooperative Monitoring Studies Programme, including mussel monitoring component, and make recommendations as to its future content and conduct (if any).

8. Review progress on biological effects monitoring and trend monitoring of contaminant levels in various media, especially biota.

9. Taking due account of the activities of the North Sea Task Force and the Baltic Environment Protection Commission, draw up plans for the conduct of new regional assessments.

10. Consider what advice can be given on procedures for the identification of toxic substances in the marine environment before they attain concentrations high enough to cause pollution.

11. Any other business.

12. Plans for next meeting.

13. Date and place of next meeting.

14. Consideration and approval of Recommendations and report.

The meeting will begin at 0930 hrs on 2 May.

ANNEX 2

List of participants

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ANNEX 3

Guidelines for the Preparation of Regional Environmental Assessments

Introduction

Some years ago discussions within ICES fora led to the suggestion that much might be gained by summarising available scientific understanding about particular sea areas. Two of the principle perceived benefits were the ability to make clear comparisons between different marine areas and identification of gaps in available information or scientific understanding. In order to promote such assessments a set of guidelines was drawn up. These were published in the 1983 Report of ACMP (CRR No 124) and included the recommendation that a number of pilot regional environmental assessments should be conducted with a view to testing the guidelines. The intention was to review them in the light of the experience gained and, if appropriate, to revise them.

Since those initial guidelines were written two regional assessments have been produced within the ICES framework - those for the Kattegat and Skaggerak (CRR No 149) and for the Irish Sea (CRR No 155). ICES scientists have also been involved in two more regional environmental assessments, those for the Baltic published by the Helsinki Commission, and for the North Sea, published in connection with the 1987 Ministerial Conference on the North Sea (DOE, 1987). It is clear from these four reports that the process has the benefits initially envisaged. Moreover, it has two further attributes that were perhaps not fully appreciated when the concept was first discussed in ICES. These are that when all the scientific data are gathered together, they often reveal a total picture which is rather different from that perceived when only part of the picture is known. Also, it is now apparent that in addition to being of interest to scientists, a regional environmental assessment document can provide a very sound basis on which to base administrative decisions regarding action to rectify pollution or prevent other threats to the resources[1] of a particular area.

The original ICES guidelines have been reviewed in the context of the benefits referred to above and the need to re-formulate them in a broader context than purely ICES. This document presents a revision of these guidelines for the conclude of future regional environmental assessments.

The Purposes of Regional Environmental Assessments

The following statement of the purpose of a regional environmental assessment was developed by the ICES/OSPARCOM secretariats in preparation for the preliminary Meeting of the North Sea Scientific Task Force:

"The results of an environmental assessment provide the basis for strategic analysis of the requirements for regulatory action necessary to protect the marine environment in a given area, particularly for determining the adequacy and/or shortcomings of existing environmental regulations and controls pertaining to the protection of the environmental health and quality of the marine environment. It can form the basis of appropriate management plans".

[1] Throughout this document resources means marine organisms, exploitable or otherwise or some other usable resource eg sea bed deposit or amenity interest.

Thus, the primary purpose of a regional environmental assessment is to provide an authoritative synthesis and evaluation, from a multi-disciplinary perspective, of scientific information pertaining to a specific marine area. In this sense, the regional environmental assessment is a product of a rigorous and detailed review of data on conditions in the subject marine area: the objective of which is to determine the nature and severity of environmental disturbances and trends that are the consequence of anthropogenic activity.

It should be noted that this is rather different from the environmental impact assessments (EIA) carried out in connection with a planned local development, although the regional environmental assessment may well provide information that can be used in an EIA.

The Nature of a Regional Environmental Assessment

In connection with the preliminary meeting of the North Sea Scientific Task Force mentioned earlier, the ICES/OSPARCOM secretariats proposed the following definition of a regional environmental assessment:

"An environmental assessment is an evaluation of the conditions and quality of the environment of a defined marine area; it identifies anthropogenically induced changes or disturbances to the ecosystems in that area. As an integral part, an assessment will lead to the production of a Quality Status Report[1] which will contain statements regarding the extent of scientific understanding of the area, including gaps in knowledge or issues of uncertainty".

This proposed definition was also adopted. A regional environmental assessment should therefore provide an analysis of existing or perceived concerns regarding damage to the environment and uses of a marine area in the context of all relevant scientific information. It should show where these concerns are supported by scientific findings and indicate where regulatory action would be justified, either to rectify existing adverse effects or to forestall potential threats. Equally, it should reveal where concerns are unwarranted and provide the basis for such conclusions. It should particularly indicate where concerns cannot be resolved and specify the types of additional information required from further research and monitoring programmes to enable such issues to be resolved quickly and efficiently. Finally, the report should attempt to assign some priority to the environmental concerns about a particular marine system in relation to the significance and severity of adverse effects on the system and its amenities.

The results of the regional environmental assessment should serve to determine the adequacy and/or shortcomings of existing regulations and controls aimed at protecting the health and quality of the marine environment, and the continued viability of its resources and other amenities. The assessment therefore forms the basis for the introduction or development of management plans. Usually when writing reports for scientific colleagues, scientists offer alternative explanations and options, rather than single positive statements of a position or choice. This tends to be interpreted as reflecting uncertainty and indecision. It is therefore important that the assessment be restricted to the collection, review and evaluation of scientific data. These data should be provided in a form that is wholly intelligible to a non-scientific audience. In short, the task of

[1] As used by the North Sea Task Force and Quality Status Report has the same purpose as a regional environmental assessment

the scientists is to collect and analyse the information and explain its implications in clear unambiguous language for the policy makers and the public to use for reaching conclusions and environmental protection decisions. In this latter context, it is important that the assessment of what is, and is not, known about an area be kept entirely separate from the process of defining management options. Thus as a separate and subsequent step, scientists may be called upon to advise on the likely consequences of different management options proposed by policy makers eg for the control of particular activities or for remedial measures developed to rectify or forestall adverse effects.

Content

To be useful the entire regional assessment should be brief so as to ease assimilation of the information contained within it and of giving proper and clear emphasis to the most serious environmental disturbances and the uses or activities of man which cause them.

Experience with the regional assessments conducted to date suggests that it is important the users be able to accept the scientific basis underpinning statements of fact and conclusions. This tends to argue against brevity. The Quality Status Report produced in connection with the Second International Conference in Protection of the North Sea, and the Report on the Status of the Irish Sea, overcame this difficulty by developing summary documents or sections of 8-20 pages derived from more extensive reviews and tabulations of data.

If the regional environmental assessment is to be used subsequently in a public education context the main conclusions should be published separately in a readily assimiable illustrated format. For Ministerial or Senior administration use the key issues requiring action (and those not requiring further attention) should be spelt out in a 1 to 2 page Executive Summary. The more extensive summary, and the detailed assessment from which it is derived, will provide the necessary substantiative statements.

Regional environmental assessments are likely to be required periodically for individual areas and uniformity of presentation is strongly recommended. This will allow identification of problems common to several areas, which alone might not merit action but together might present a more pressing case e.g. litter on beaches derived from shipping. Use of a common approach might also lead to signs being identified in several areas which together might lead to the conclusion that an issue of uncertainty may not be one of real concern e.g. mercury in tuna or swordfish, as a pollution issue when the mercury is naturally present.

The main types of marine information needed for the preparation of an assessment are physical (hydrographic), chemical and biological (including fisheries related data). A disciplinary approach greatly simplifies the initial stages of the preparatory process. While the final document should contain a multi-disciplinary analysis, the main body of the document should be individual disciplinary perspectives each of which should take account of the various uses of the region and its resources and the way in which they interact. In the North Sea Quality Status Report a separate chapter was prepared detailing the uses made of the area by man. Such a chapter tends to be descriptive and simply adds to the length. It is therefore suggested that provided the various uses are kept clearly in mind from the start the individual disciplinary sections can adequately cover the various uses made of the region and its resources and the extent to which they interact and affect each other or the quality of the environment.

Procedure and Format of the Assessment

Areal Coverage

Assessments should be conducted on a regional basis and where the region involves interests of more than one state should involve international cooperation. Eventually the areas for which regional environment assessments are prepared should include ones that are not regarded as being stressed so that they can act as references to ones that give cause for concern. It is not possible to give general guidelines as to the minimum or maximum geographical extent of an area, but natural boundaries such as surrounding land masses or current systems should provide the basis, rather than national EEZ or latitude longitude lines. For large sea areas such as the North Sea and eastern seaboard of North America it may be appropriate to assemble separate assessments for several sub-areas for subsequent collation into a single report rather than attempting to conduct the assessment over an entire area at once. If such an approach is adopted the sub-areas might be delineated either by natural physical or hydrographical boundaries or by perceived common interests e.g. in the North Sea, the Waddenseas.

Format

Each regional environmental assessment should be accompanied by an overall summary. This should be developed after the remainder of the report has been completed and should be written in clear but precise terms. It should state succinctly what is known well and what is either not known or uncertain and should identify, wherever possible, effects and the probable causes. A maximum length of 9-10 pages is suggested; what cannot be said in this space is probably not necessary. It is important that this section clearly addresses the responsibilities of both the scientific managers and environmental policy makers so that they can take well informed decisions on the necessary courses of action in terms of further research or monitoring work or control of certain activities. It is equally important that it should clearly state what is not a matter for concern.

This basic requirement should also be borne in mind when the main body of the assessment document is prepared. The main body should comprise self contained disciplinary sections each of which should start with a review of the existing knowledge of the area concerned. This should be gleaned so far as possible from existing published information rather than requiring a large data-gathering exercise which might itself consume significant effort. Where unpublished data are required, emphasis should be placed upon obtaining information summaries from scientists closely involved in the discipline and region of interest.

The subsequent part of each disciplinary section should attempt to describe the extent to which the region has been, or might become, affected by anthropogenic activities or uses of the area in their broadest sense and in turn the effect one use might have on another.

Thus, in the context of the section dealing with physical characteristics anthropogenic activities should include dredging, in connection with both port and harbour operations, and the extraction of mineral resources from the sea bed. It should also include the impact of changes in the terrestrial environment e.g. reduced run-off due to impoundment of rivers, major alterations to natural coastlines through the construction of barrages and flood protection or land

reclamation schemes. Whilst some such changes will clearly be regarded as beneficial to Man's interests they may also have adverse effect e.g. interference with fish migration patterns, traditional spawning areas or fishing grounds.

The chemical disciplinary section should include information on inputs to the marine environment from the atmosphere, rivers and from direct discharges, including dumping and routine shipping activities. Each of these sources, and any others, should be assessed in terms of their impact on the concentrations found in the environment including sediments, and their impact on man's other uses of the sea. Wherever possible this section should include an assessment of the speciation of the contaminants and their behaviour between input and loss from the system, e.g. by transport out of it or by incorporation into the sea-bed.

Similarly the biological section should include information on the flora and fauna present and assess whether this matches the normal expectations for the area and the extent to which species appear to be under stress e.g. by alteration of population density or size of individuals, limitations in reproductive success or susceptibility to disease as a consequence of man's activities.

In each case the sections should include an assessment of whether trends are detectable and the extent to which these can be attributed to anthropogenic impacts as opposed to natural processes. Modelling procedures, physical, chemical and biological are now being developed and can greatly assist in this process. Each section should conclude with an evaluation of the degree to which evidence of the effects of anthropogenic activities has been acquired and where additional information is needed to confirm such effects. In view of the fact that intercalibration results show many analyses still present major problems for a large number of laboratories, critical evaluation of the level of confidence which can be placed on the data utilised in a regional environmental assessment must be an essential part of the report, i.e. data that are unreliable should not be used or be used only with considerable caution.

In order to be in a position to make an overall assessment of the quality of a given environment, relative comparison scales are necessary. Hence regional environmental assessment reports should utilise pertinent toxicological data as well as all applicable standards/criteria and guidelines available. If the latter are insufficient to permit definitive statements as to acceptability of the observed effects the report should include recommendations as to measures which can be used. It may be necessary in this context to set arbitrary standards which should therefore have reasonable safety margins included, to assess the state or quality of the region in that context.

Based on the three disciplinary sections an overall assessment of the region concerned can be prepared. The overall aim of this final section would be: an interdisciplinary review of all the available information on an area and from this to assign priorities to those concerns requiring action. Equally important, this section should clearly state those issues which do not require further attention.

A structured approach to the preparation of this section is strongly recommended. This should take the following form

Review the evidence for environmental effects, and assess the strength of the evidence against the following questions:

a. Can an effect or change be detected with reasonable confidence?

b. Can the geographical area in which the effect occurs be defined with any spatial gradient, and/or trends over time?

c. Can a cause be attributed to the change or effect?

d. If the cause is anthropogenic, what is the significance of the change or effect? Can we relate it to the background situation or a standard/criteria/guideline.

e. Can a list be prepared, with reasonable confidence, of changes which are adverse, significant and which can be associated with a cause?

The issues which need to be addressed include effects on plankton populations, benthos, fish and fisheries (including those for molluscs and crustacea), fish disease incidence and marine mammals and birds.

In essence the overall regional environmental assessment constitutes a synopsis of the conclusions reached in the disciplinary sections, but every effort should be made to relate the disciplinary sections to one another and to weigh their relative importance in striking an overall balance between the disciplines. This overall assessment should ultimately form the basis for initial intercomparisons of the environmental conditions and severity of anthropogenic effects in different regions. The disciplinary sections would provide greater detail for these intercomparisons, whilst any background documents, cited in the assessment, would provide even greater detail, if needed.

The layout, or format, of the assessments would therefore be as follows:

1.	Executive Summary	1-2 pages
2.1	General circulation and physical oceanography .....)	10 pages
2.2	Extent of anthropogenic modifications to the physical oceanography)	
3.1	Incidence and distributions of potential contaminants and general marine chemistry .....)	10 pages
3.2	Modifications to chemical fluxes and extent of contamination .....)	
4.1	General biology and fisheries of the area .....)	10 pages
4.2	Biological trends and/or disturbances due to anthropogenic activity (including exploitation of fisheries resources) .....)	
5.	Overall Assessment	8-10 pages
6.	Acknowledgements and list of contributors	
7.	References	

ANNEX 4

Philosophy, Principles and Strategy of Monitoring

Basic Concepts and Definition

Several years ago ICES, through its Advisory Committee on Marine Pollution considered the question of monitoring in relation to the marine environment (ICES 1978). Their opening comments were as follows:-

"To monitor a situation is to keep it under observation or surveillance. The phrase environmental monitoring in a pollution context is, however, often used in two senses. In its widest sense, it is taken to mean the repeated measurement of pollutant concentrations (or effects) so that changes can be followed over an area and/or a period of time, i.e., spatial or temporal trends. Such trends may be followed, for example, in order to relate them to changes in levels of input. In a more restricted sense, the phrase is often applied to mean the regular measurement of pollutant levels (or effects) in relation to some standard or in order to judge the effectiveness of a system of regulation.

It should be noted that the potential usefulness of a data series obtained through monitoring depends critically upon our means of interpreting the data. Adequate interpretation is related, among other things, to our understanding of the effects of the pollutant and the processes influencing its distribution when introduced into the marine environment. These aspects need to be considered both in relation to the selection of the sampling media and to the planning of the spatial and temporal distribution of the sampling.

An effective programme to control or reduce marine pollution requires that we know what harmful substances are entering the marine environment, where and in what quantities, and, if possible, from which specific sources. The monitoring of inputs is therefore also of major importance, since the data from such a programme are essential for the full and proper interpretation of environmental monitoring data and the conduct of mass balance studies."

Since that time many other organisations have become involved in monitoring and it is now appropriate that the approaches adopted by them and in use by ICES be reviewed. The fundamental requirement identified by ACMP in its report remains as important today as it was then.

It is essential that monitoring should have a clearly defined objective, that the measurements made are designed so as to be usable in meeting that objective and that the results be reviewed at regular intervals in relation to that objective. The monitoring scheme should then be continued, revised or even terminated as appropriate. All too often monitoring programmes continue unchanged long after they have ceased to produce useful data in the context of the original objective. The basic purpose of monitoring outside the context of gathering data in connection with basic or long term research aims will be in connection with a desire to protect a marine resource. Marine resources in this context might be marine species, exploitable or otherwise, or some other usable resource e.g. sea-bed deposit or simply an amenity or scenic interest.

Although much is now known about the marine environment, there is still a lack of basic knowledge and descriptions of the marine ecosystem as a whole. There is a need to extend this area of knowledge and this calls for more monitoring and

modelling of biological and ecological variables. In order to be able to assess the quality and health of the environment, there is a need to be able to distinguish between natural variability and induced effects. This can only be achieved by monitoring programmes that include biological effects or produce data that can be compared to known and agreed effects levels. Thus, biological input to monitoring programmes is essential and at the present time must be focussed on the development of test procedures that yield readily interpretable results in the sense that the effect is of significance to the well being of the animal or indicates the presence of a particular contaminant. Alternatively attention might be focussed on species whose presence indicates a particular phase in environmental stress and decline in environmental quality.

This last point emphasises the need for a clear conception of the purpose of monitoring. It is essential that before any programme is drawn up and any measurements are made that the following questions be addressed

1) what exactly do we wish to measure

2) why do we wish to monitor a particular variable, contaminant or biological effect

3) how can that measurement be achieved and is monitoring the most appropriate approach

4) in what compartment or at which locations can measurement most effectively be made

5) for how long do we need to continue measurements in order to meet the originally defined aim.

With these thoughts as background the following new definition of monitoring is proposed:-

Monitoring is the repeated measurement of an activity or a contaminant or its effects, whether direct or indirect, on the environment. Its ultimate purpose is the control of exposure of the organism or interest most likely to be first affected to the activity or contaminant in question, whether this target be man or some specified element of the marine resource.

Thus, monitoring is used first to assess the need for pollution prevention measures, either by comparing concentrations in the environment with exposure standards or by examining for critical effects. The next stage in monitoring is to use the results in an on-going way to assess the effectiveness of any protection measures introduced as a result of the first phase. It will be noted that the definition does not apply to monitoring compliance with effluent standards. It could however apply equally to regional environmental monitoring or to site specific monitoring carried out in connection with assessing the effectiveness, in environmental protection terms, of controls on a particular discharge. Also the measurements need not necessarily be repeated frequently. If the first data obtained lead to the conclusion that there is no risk either to the marine resource or to man, further measurements should only be repeated at infrequent intervals, certainly years rather than months. Given this definition it should be noted that initial surveys are regarded as being a precursor to monitoring rather than a necessary component thereof. Depending upon the nature

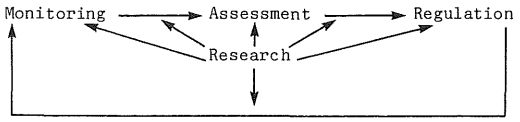
of the results obtained they may lead to a need either for control measures and monitoring to assess their effectiveness or for more measurements on which to better base the assessment of the need for controls.

The definition clearly links monitoring effort, either with establishing the need for control measures to limit a particular activity which influences the marine environment, or to assessing the effectiveness of these measures, once they have been imposed, either in terms of eliminating a biological effect considered undesirable or in reducing exposure levels. It should also be clear that monitoring should not be restricted to measurements of contaminants and their pathways between source and man. It should also include pathways to marine resource targets and means of assessing impacts on the marine ecosystem. Whether the target identified is man, a marine species or some other element of the marine resource, the decision on the need or otherwise to impose controls on the input or activity in question will depend on there being a clear statement of what is not acceptable. This might take the form of a standard or simply be a statement of what is expected is general environmental quality terms e.g. species mix consistent with the physical characteristics of the area.

Since the environment is subject to natural changes e.g. climate, as well as those induced by man it is important that an understanding is established of these natural changes and the way these might affect either contaminant levels or biological characteristics. This implies long-term data sets on parameters which establish the basic characteristics of the marine media, eg water temperature and salinity, transparency and chlorophyll levels and nutrient concentrations, since it is these that can provide clues as to the reasons for changes in species, etc that may be of more concern to man and other elements of the marine resource.

In addition to the collection of these sorts of data there is a fundamental need to recognise the requirements of decision makers. Especially it is necessary to recognise that they will require the results on finite time scales and that they will expect the results to be presented in a readily interpretable form. Thus, in common with the formulation of regional assessments, part of which will be based on a collection of accurate monitoring data, a basic requirement of monitoring is that it yields accurate data. These in turn will provide the basis of sound, reliable advice to administrators on the need for environmental protection measures and the effectiveness of protection measures already introduced.

It may be apparent from the foregoing that there is a close link between monitoring and research in the sense that much research is required if controls are to be applied effectively and to enable the monitoring to be conducted with maximum efficiency. The inter-relationship is illustrated in the Figure below.



From this it will be apparent that the border line between what is research and what is monitoring will often be rather indistinct. However, the basic separation is that monitoring is related to the regulation of an activity within defined limits via assessment of the need for such regulation or the effectiveness of regulations already applied. Research on the other hand is required at various levels to understand better e.g. an ecosystem, fluxes and fates of contaminants and to allow monitoring to be conducted efficiently and cost effectively.

Clarification of Objectives

The objectives of monitoring can be specified as follows:-

1. To determine whether adverse effects are occurring.

2. To identify what causes them.

3. To determine whether environmental levels exceeed those which would cause harm to man, marine organisms or other marine resources and amenities.

In the event that it is not possible to achieve any of the above objectives, it may alternatively suffice either:

4. To establish whether the trend (spatial or temporal) in environmental levels or observable effects is increasing or decreasing.

or 5. To establish how high the environmental concentration of the contaminant in question is relative to background.

It will be noted that the first three of these objectives all require an understanding of biological effects and their cause as well as the acceptability of the effect in relation to the defined objectives or uses of the area. This sort of understanding will be provided via research activities. In some situations where the results of research are lacking arbitrary decisions may be unavoidable due to a lack of understanding and knowledge. Even if this is the case they should be based on scientifically derived facts. The last two questions provide for this. For example a steadily increasing trend in concentrations or detectable biological change could reasonably be considered undesirable simply because it represents a marked deviation from the norm. For similar reasons if the concentration of a contaminant can clearly be shown to be markedly above normal for the area or species this could, in the absence of any other form of standard, be considered undesirable. In both cases the decision to recommend action should take account of sources of inputs and the levels in relation to the uses of the area.

Whichever objective is being addressed it should be apparent that the validity of the conclusion drawn will depend upon three critical factors: the quality of the data in accuracy and precision terms, the statistical reliability of the original sampling design and the interpretation of the results.

Whilst it is obvious that good quality data are necessary at all times, attention should be paid to the level of accuracy and precision required. This can only be judged in relation to the aim. For example if one is looking for trends at the $\pm$20% level, high precision will be called for (plus accuracy if data from several laboratories are to be used). If on the other hand one is demonstrating

compliance with a standard which is several times higher than the concentrations actually being encountered, the level of precision (and accuracy) required is lower. There may be occasions when it is extremely difficult to measure accurately the parameter of interest eg river inputs. In such situations the limitations of the data must be clearly stated and if comparisons are made between data from different sources it is essential that the data compared be collected according to a common pattern, so as to eliminate differences which would be method determined. It should be noted that there are other examples where the method used determines what is measured e.g. method of solvent extraction for lipids in the context of lipid associated contaminants. In either type of context the choice of method must take due account of the defined objectives of the monitoring to be undertaken.

Strategy for meeting objectives

The approach adopted in monitoring must be related to the objective intended. However, several approaches may prove viable and appropriate, depending upon the circumstances. Those most commonly likely to be suitable are indicated below.

First identify the resource at risk and then the substances or activities most likely to threaten the resource it is desired to protect. This obviously requires at an early stage a fairly thorough assessment of what activities are already in progress and which substances are likely to enter the area in question and via which routes. On the basis of what is known about the resources to be protected and the substances most likely to affect them, attention can then be focussed on those problems which actually need attention and the effort required to establish all inputs accurately is therefore reduced. Alternatively, information on inputs can be used to focus environmental monitoring effort on those substances or effects which are most likely to be encountered at levels considered to be significant. An understanding of input fluxes within the marine environment (obtained through research) will usually permit even sharper focus of the monitoring effort.

The next steps assume the existence of maximum acceptable levels of inputs or effects in order to protect the resource in question. This requires an understanding of the working relationship between rates of input and environmental concentrations, ideally via a model of exposure pathways, and the effects it is desired to avoid. It also assumes that a maximum acceptable level has been set or can be derived. This might be defined in primary standard terms or for practical monitoring reasons (cf definition) relative to a secondary or tertiary standard which is in turn relatable back to the primary standard. Standards do not always exist and it is often argued cannot be defined. However the use of simple data, even data from acute toxicity tests, can be used to derive standards which will, due to the inclusion of large safety factors, suffice pending the derivation of more accurate standards from more thorough biological testing including field verification of laboratory test results and tests with mixtures of substances. Such standards would ideally be based on the prevention of effects at the population level for marine resources and the critical group level for man. Again it is worth drawing attention to the need for research to enable the monitoring to be conducted effectively and the results to be interpreted reliably in relation to the defined objective.

If monitoring data are to be used for the regulation or control of activities some form of model will be required to link inputs with levels in the environment or biological effects. This need not be a complex mathematical model but might

be a simple unsophisticated conceptual model which merely assumes that a relationship exists between inputs and environmental levels and is based on an empirically derived relationship. Provided a sufficient safety margin is built in, this approach may be adequate to establish a theoretically permissible scale of input such that the defined standard is not exceeded. Testing and fine tuning can then proceed on the basis of practical experience. Where large inputs are concerned, or where several discharges might interact, it is preferable to use a more complex mathematical model and this is now becoming a feasible option. As such models are developed it should be possible to delineate the consequences in terms of environmental fate and exposure levels in various sectors, of a series of inputs of a given contaminant. This in turn should allow full predictive capacity as to critical targets and pathways. They should also serve to focus the monitoring and allow both frequency and geographical scope to be reduced, thereby allowing concentration on monitoring input rates to as to ensure input limits are not exceeded. Whatever sort of model is used it will of course have to be validated.

Design of future monitoring programmes

The foregoing text outlines the Philosophy and Principles that should underpin all future monitoring operations. The strategy for the future should be based on these ideals.

On the last occasion when the purpose of monitoring was reviewed by ICES three main aims or objectives were identified:-

1) identification of possible hazards to human health of contaminants in fish and shellfish

2) identification of contaminant levels over broad geographical areas

3) identification of trends in contaminant levels at a particular site in time.

All of these assumed monitoring of contaminant levels in organisms but it is now feasible in many cases to measure, equally reliably, concentrations in water and sediments. These might therefore now be used for objectives 2 and 3.

In addition to these extensions from organisms. We now clearly need to add examination of environmental characteristics that will allow us to identify changes in the environment that might have ecological consequences. We also need to include some means of assessing the potential impact of man's activities or contaminant levels on marine organisms and whether marine organisms are exhibiting undesirable effects and especially whether these will be significant at the population level. Both of these require an ability to monitor biological effects.

General Guidelines on selection of techniques etc

The following general guidelines should provide some assistance in selecting the most appropriate monitoring techniques for the problem in question. Detailed guidelines on monitoring using marine organisms, sediments and sea water have been provided in past ACMP reports and are currently under review. Details of these will be published separately as soon as the reviews are complete. If the following guidelines are followed it is hoped some of the effort currently

devoted to routine monitoring, can be deployed on research programmes designed to establish a better understanding of the marine environment and what constitutes a pollution problem.

Biological Effects

At present a wide variety of techniques are available that are capable of demonstrating an effect occurs. Some are simple to conduct, others more complex and not all are readily amenable to conduct in the field. A difficulty in many cases is that although an effect is clearly detectable its significance is unclear in terms of the well-being of the organism or species in question. Such techniques are not suitable for routine application to monitoring programmes and are probably best regarded at present as research techniques. From the standpoint of monitoring as defined in this document the most useful biological effects are those that can be interpreted as definitely being likely to adversely affect the ability of the species to survive, grow normally or reproduce. If the effect can be linked to a particular type of pollution this would provide an added bonus, but the fact that the effect is clearly adverse must be a fundamental requirement. On the basis of a recent review prepared for the Oslo and Paris Commissions few techniques which meet this requirement are yet available and fully tested. It is also apparent that the technique used must be one that is suitable for the problem in question - no one technique is likely to suit all situations.

Substrate (compartment) selection

When the ICES Guidelines on monitoring were published in 1983 they dealt only with monitoring contaminants in marine organisms. It is now possible to use sea water and sediments in addition to the various species and tissues then proposed. Some monitoring programmes have tended to suggest that monitoring should be conducted using each of the possible media. This is now clearly no longer necessary and future programmes should take due account of what can be done using one medium and yield adequate results in the simplest possible way. Thus for example it is possible to analyse samples of fish liver for a range of metals and establish trends over time it is not necessary also to measure any of these same contaminants in sea water for the same purpose. A matrix table could be provided to cover the various options available and indicate the most appropriate choice. This however presupposes that the contaminants of interest are known. It should be noted that whereas chemical methods of monitoring are well developed, those for biological effects monitoring are still at an early stage.

Selection of contaminants and where they should be monitored

In the past this has been based largely on the black and grey lists of the various pollution prevention conventions. These were mostly developed in the early 1970s and were based on perceptions of problems as they were then seen and what it was known could be controlled. It is now apparent that some of those originally listed substances do not present serious pollution risks in a marine context and certainly do not do so on a general scale, whereas other substances not listed do present a serious hazard. The recognition of these new substances results from either a better understanding of what is likely to be harmful or from an appreciation of the likely scale of their input to the marine environment.

It is therefore recommended that the choice of which contaminants should be monitored depends first upon the perceived aim i.e. why may there be concern, and second on whether there is real reason for concern in the area in question i.e. is there an input of sufficient scale and is there a target likely to be affected. One certainly should not have to monitor regularly for all contaminants at all sites and definitely it should not be necessary to use more than one substrate or effect to meet each aim.

How to conduct monitoring

Whether what is being measured is a biological effect or the concentration of a contaminant, the level and accuracy of the method used should in general be the minimum necessary to achieve the desired objective. In general the greater the level of accuracy and precision required the greater the level of effort likely to be used to achieve the aim. Thus it would only be justifiable to use a method capable of more than the minimum, if by so doing it were possible to obtain several answers or measure several determinands in one operation. However, under no circumstances should additional measurements be taken unless there is a clear indication that they may prove useful in the future.

In cooperative programmes involving several laboratories it will of course be necessary to ensure that all are producing comparable data. Especially for new contaminants this may not be possible initially and it may therefore be appropriate to allow a single laboratory with proven capability to conduct preliminary measurements in order to demonstrate the scale of a problem. If further measurements are considered necessary on a wider basis, it is almost certain that national authorities would wish to assure themselves of access to the data at the earliest possible opportunity. This would necessitate comparability assurance between different countries but the principle of having lead laboratories for particular contaminants, at least per country, would limit the difficulty of achieving this end.

Reporting data

Once the monitoring programme is underway it will be necessary from time to time to report the data to some coordinating centre so that it can be reviewed and assessed relative to the originally stated aim and/or established standards/criteria. It is essential that the data be reported in adequate detail to meet this requirement. In this context however it should be noted that although nowadays it is relatively easy to transmit data from centre to centre by tape, discette or electronically, collecting and recording data involves effort and costs money. What is collected and transmitted should therefore be tailored to need and be the minimum necessary to meet that need.

ANNEX 5

RECOMMENDATIONS

1. It is recommended the new regional environmental assessment guidelines annexed to this report should be adopted as replacing those earlier proposed by ICES and should be used in all future regional environmental assessments.

2. It is recommended that every effort be exerted by the countries concerned to conduct as soon as practicable regional environmental assessments, according to the new guidelines, in the following areas Gulf of St Lawrence, New York Bight, Gulf of Maine/Georges Bank, Bay of Biscay, west coast of the Iberian Peninsula and the North Sea. The latter should preferably be built up from separate assessments of sub-areas covering the whole of the area but selected according to the extent of common characteristics or problems. It is suggested these might be Wadden Seas, German Bight, Southern Bight, Channel east of 5°W, north east coast of UK, the coastal areas of the Skaggerak especially the area between Norway and Sweden, the central North Sea and the northern North Sea.

3. The working group on environmental assessments and monitoring strategies should meet at IFREMER Brest from 2-5 May 1989, in order to:-

a) Review, if available, the reports on the baseline study of metals in sea water and monitoring for the purpose of assessing risk to human health of contaminants in fish and shellfish.

b) Review the existing guidelines and as necessary revise and develop new ones for the monitoring of contaminants in marine organisms, sea water and sediments and advise on the quality of data required to meet different objectives.

c) Consider the development of standards/criteria against which to judge environmental data taking due account of the activities of FAO/WHO in this field and national standards (Background papers volunteered for this topic).

d) Review progress with regional assessments in the areas suggested as requiring priority attention.

e) Consider, as a progression from the conduct of regional environmental assessments, the development of habitat protection policies (background paper volunteered) and the use of modelling of ecosystems (background paper volunteered).

f) Review progress in the development of biological effects techniques and statistical methods for the assessment of temporal trends in data on contaminant levels.

g) Consider further the possibilities of identifying toxic compounds before the cause pollution, including the question of the effects of mixtures of chemicals in field situations.

h) Commence a review of national monitoring programmes focussing in 1989 on nutrients in the marine environment.

i) Consider developing definitions of key terms acronyms and symbols with a view to their general adoption by ICES countries.

Appendix 1

Relevant information about monitoring programmes in other international organisations.

JMG

Purpose a (= purpose 1 of ICES) = monitoring with respect to human health. For their interpretation JMG has identified three classes for the compounds in their programme: lower, medium and upper. These are not statistically derived and the classes have no relation to human health criteria. JMG has agreed that monitoring for puurpose a has to be continued only in areas with values in the upper class.

Purpose b = Biological effects monitoring. JMG has identified a serious need for biological effect studies and has asked ICES advice for monitoring activities on this subject.

Purpose c (purpose 2 of ICES) = Baseline survey. In the baseline of 1985 JMG uses some of the same classes as for purpose a, and in others a system of quantiles, a hot spot area is defined as an upper region if at least two values in an upper class have been observed. As the geographical survey of 1985 has not identified unexpected hot spot areas JMG expressed doubt about the organisation of a similar programme in the future and asked ICES for advice.

Purpose d (= purpose 3 of ICES) = trend monitoring programme. The trend monitoring studies has just started so JMG decided to continue this purpose. Sea water is not recommended for assessment of trends in trace element concentrations, though some countries have indicated they may continue such studies in some areas.

TWG Noted at their 1988 meeting that the Commissions have already decided to organise a new baseline survey. Based on the former guidelines (a baseline every 5 years) a survey for organisms would have to be run in 1990 and a survey for seawater in 1992. There is still some discussion about changing the years to one year for both matrices. It is not clear whether the TWG has taken account of the need for further baseline surveys or of the resources required for them. Concluding their discussion in 1988 they agreed a survey of contaminants would be desirable at some future date but it was not agreed whether this should be in 1990 or 1992 and they decided to ask JMG whether there should be further monitoring for purpose (a).