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International Council for the  
Exploration of the Sea

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*REPORT OF THE WORKING GROUP ON  
ENVIRONMENTAL ASSESSMENTS AND MONITORING STRATEGIES*

Copenhagen, 4 - 7 May 1987

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## 1 OPENING OF THE MEETING

The Chairman, Dr J.E. Portmann, opened the meeting at 9.30 hrs on 4 May 1987 and welcomed the participants to the first meeting of this Working Group.

The participants (list attached at Annex 1) then introduced themselves and indicated their main areas of research or management interest.

## 2 ADOPTION OF AGENDA

The Working Group reviewed the draft agenda and adopted it. (The Agenda is attached as Annex 2).

## 3 REPORT FROM 1986 STATUTORY MEETING

The Working Group took note of relevant Council Resolutions from the 1986 Statutory Meeting, particularly the terms of reference and tasks for other working groups dealing with environmental topics.

The Working Group then gave detailed consideration to its own terms of reference and the tasks for this first meeting. The question arose as to possible overlap with the activities of other groups. The members agreed that potential overlap with the work of other ICES working groups was not large, but that there was potential for greater overlap with the work of groups outside ICES such as JMG (and the equivalent in the Baltic).

In discussing the terms of reference and what they encompass, the Working Group agreed that it will interpret its terms of reference so that they go beyond an assessment of possible impacts of pollution or contamination on fisheries. Accordingly, the Working Group intends to look at the environment as a whole, including the impact of pollution/contamination on various uses of the marine environment, including amenities.

Concerning the development of detailed plans for monitoring studies and the assessment of their results, the Working Group noted that it will oversee such activities and recommend how they should be carried out, but that it will not necessarily become involved in the details of such work.

## 4 CONSIDERATION OF STRATEGIC PLAN PROPOSALS

The Chairman introduced his paper, WGEAMS 1987/4, which had been sent to all members in advance of the meeting. The purpose of the paper was to examine the problems currently associated with monitoring and to stimulate thoughts on how these could be overcome. To this end a definition of monitoring was proposed, the possible aims outlined, and the basic requirements for a sound monitoring programme were set out. The Chairman explained that the eventual intention was to redraft the paper as a basic statement of the requirements for monitoring and the strategies which should be built into future monitoring programmes.

In the discussion which followed the Chairman's presentation, there was general agreement that existing attitudes to monitoring need to be rethought and that the paper put forward several useful items. There were, however, numerous points which could be added and others which, though covered, were insufficiently clear. Among the main points made were the following:

- a) Monitoring should have a broader approach including more biology and ecology. At present there is a lack of basic knowledge and descriptions on the marine ecosystem as a whole. In order to be able to assess the quality and health of the environment, we need to be able to distinguish between natural variability and induced effects. This implies a need for biological effects monitoring, early warning systems, etc. which in turn will require the involvement of trained biologists in monitoring programmes. Interpretation of monitoring results needs biological input. At the same time the appreciation of true needs from biological effects studies may lead to the development and application of more readily interpretable test procedures.
- b) More simple, measurable parameters would be desirable, which are practical at sea, etc., including biological as well as chemical measurements. Consideration should be given to the re-introduction of some basic routine measurements, e.g., Secchi disc readings of water transparency, temperature, salinity, nutrients, as long-term changes in such parameters can provide clues as to reasons for more substantial changes in species, etc.
- c) Whatever is done and at whatever level, statistical thinking is a fundamental requirement and a systematic approach is always possible and should be pursued.
- d) The definition of monitoring should not be restricted to pollutants/contaminants and their pathways from source to man but should include the need to protect resources in their most general sense.
- e) There is a fundamental need to recognize the requirements of decision-makers. If these are not met or results are not properly timed and reported, others may take over and the results may be that decisions are taken in the absence of scientific facts. This means a need for reports tailored to various levels of understanding; a careful balance between biological/chemical information, human health aspects, cost/benefit, etc. Thus the eventual use of information should be recognized. It was agreed that the overall aim of both monitoring and assessments is to provide accurate data in as complete a form as possible so that sound and correct advice can be offered to administrators on matters such as the need for environmental protection measures or statements regarding environmental trends.
- f) The low-grade image of monitoring is partly a result of the way information is presented. Monitoring, especially trend monitoring, takes time compared to quick "sensations".

- g) There is an ill-defined boundary between monitoring and research. For example, it is questionable if identification of new substances like dioxins is monitoring. Establishing the dimensions of the problem is probably research, but routine following-up in time is certainly monitoring.
- h) There is usually far too long a time between the identification of problems and the implementation of routine monitoring. Sometimes conventional programmes delay decisions on national level. As a consequence, adjustment of the frequency of observations frequently takes far too long and the introduction or expansion of monitoring for other contaminants is delayed or seriously prejudiced.
- i) Future monitoring programmes should take more account of industrial discharges as sources of input. At the same time the possibility of diffusive uses leading to environmental problems should not be ignored, e.g., the use of chemicals in agriculture.
- j) Before the inclusion of new substances in monitoring programmes, analytical techniques must be defined and the feasibility of accurately monitoring the substance has to be assured. This also applies to "old and well-known" analytical procedures.
- k) National considerations versus international interests and priorities have to be taken into account. Based on experience to date, national strategies should allow for international needs and change as necessary. On the other hand, in some areas, national programmes could be acceptable only if the highest possible level of known techniques is adopted.
- l) In relation to marine resources, it was agreed that the main need is to protect against impacts which have consequences for populations rather than impacts at the level of well-being for individuals. However, this raised the question of the possible loss of more sensitive strains, e.g., genotypes, phenotypes, within the marine resource as a whole. These losses, unlike most others, cannot be reversed.

Throughout the discussion there was an underlying recognition of the need for more research work. It was also agreed that, although perhaps not issues that need to be discussed in the final paper, some assurance should be sought that monitoring of "special" pollutants such as radionuclides and "natural" pollutants such as algal toxins, are covered.

In concluding the discussion under this item of the Agenda, the Chairman pointed out that there would be a further opportunity to discuss the strategy of monitoring later in the Agenda. The intervening items were expected to lead to further ideas and perhaps some reappraisal of the first thoughts outlined above. He added that the discussion had been helpful and stimulating and that it should be possible to incorporate the views in an amended paper which the Working Group might consider at a future meeting.

## 5 REPORT OF THE 1985 BASELINE STUDY OF CONTAMINANTS IN FISH AND SHELLFISH

In introducing this topic for discussion, the Chairman outlined the background to the conduct of the study and explained that the main assessment of the results had been conducted by a special ICES/OSPARCOM/HELCOM working group during a one-week meeting in early February. The outcome of that meeting had been a rough draft of a report on which comments had since been submitted by several members. Extensive redrafting had been undertaken of some sections by the original authors. Further editing had since been carried out and the preliminary conclusions and recommendations had been redrafted and extended. The Chairman explained that the Working Group was charged with ensuring that, so far as practicable, the assessments on different contaminants were comparable and that the text and supporting illustrations and tables were clear and as complete as necessary. The second important task was to agree the conclusions and recommendations and to finalize a brief summary report which it was intended, in view of the interest in the North Sea, would go via the Chairman of the ACMP to the Joint Meeting of the Oslo and Paris Commissions.

In response to a question on the status of new data, the Chairman explained that it had been decided at the February meeting to set a deadline for assessing new data. New data and corrections following that meeting could be included in the tables of all data submitted, but in general it would be impractical to amend the overall assessments. A disclaimer to this effect was included in the introduction. The Working Group accepted that this was the only practical course open and agreed that no further data should be accepted for inclusion in the report after 8 May.

The Chairman then opened discussion on the draft report by posing a number of questions, which had arisen in the course of editing the text, on which guidance was required. In the course of the ensuing discussion, a number of additional points were made and the main conclusions drawn were as follows:

- a) An executive summary should be added.
- b) The procedure followed for mercury, in which the data are divided into quartiles, illustrated by box and whisker plots, should be followed for the assessments of all the metals.
- c) Maps should be produced illustrating the distribution of sampling and the highest values encountered, but should be restricted to those for which reasonably sized data sets were available.
- d) A listing of ICES rectangles with the corresponding JMP areas should be included in the report together with their names and a map showing the positions. Reference to JMP areas in the text was considered confusing for two reasons: in some instances more than one JMP area occurs in one ICES rectangle, and the text would become unclear if too many sets of letters and numbers were included.



- e) Although the original guidelines specified that only certain tissues and contaminant combinations should be used, the report should include assessment of other combinations, because they supplement the data base and often illustrate the reasons for their original exclusion (i.e., the necessity of following specified guidelines).
- f) The report should only select and detail areas for which high values were reported. The areas with low values are of less interest.
- g) For certain metals, e.g., lead and zinc, the assessment had excluded the highest reported values; the report should explain why this was done.
- h) The system of units should be  $\mu\text{g}/\text{kg}$  for pesticides and  $\text{mg}/\text{kg}$  for metals. Three significant figures should be given in the tables and text, i.e., 117.8 will be reported as 118. Further rounding was felt undesirable as it might render cross-check identification of data from summary to full tables difficult.
- i) The summary tables should include the number of areas/samples actually included in the upper quartile; for a variety of reasons it is not necessarily 25% of the total number of data points reported.
- j) In this context, it was noted that the guiding principle had been that all data should be included in the quartile analysis. However, in some cases the assessors had felt that certain data were too extreme and should be excluded. Where this had been done, an explanation should be given.
- k) The report should be understandable to both scientific and lay readers. To this end, common names of species would be used in the text but an appendix would list the full Latin names, the common name(s), and the common name used in the text, e.g., Gadus morhua, Atlantic cod, cod.
- l) The text of the report should include reference to FAO/WHO standards for all the contaminants (and tissues) for which they are available. National standards might be used if available.
- m) More detail should be provided on the intercalibration exercise which accompanied the metals part of the study, but, as full details of the intercalibration would be published separately, it would suffice to summarize the results.
- n) Since one of the aims had been to achieve good geographical coverage, it would be useful to include a table showing how many samples of each species had been collected by how many countries and for how many areas.

In addition to these general points, a number of more detailed points were made, e.g., in relation to the lay-out of tables, identification of areas with generally higher contamination levels (i.e., several contaminants rather than one only), and clarification of particular wording in the text.

Discussion then turned to the draft conclusions and recommendations. These were agreed with a number of amendments and it was decided that the conclusions should be placed as an executive summary at the beginning of the publication. A key question in this context was whether or not the originally specified aims had been met. It was agreed that they had, and a text stating this was drafted and agreed.

It was agreed that the executive summary would provide the basis of a short summary which would be submitted to the Oslo and Paris Commissions' Secretariat. Some additional explanation of the basis of the study was considered appropriate and the Environment Officer undertook to produce the necessary report to the Commissions (Annex 3).

The Working Group took note that, after further editing to take account of all its comments and suggestions, the report was expected to be considered and approved by ACMP in June. It was generally felt that if ACMP decided to publish the report, it would be worthwhile ICES publishing the main findings, e.g., by a short article in one or more of the popular scientific journals as a counter to the sensational statements made in relation to the quality of the marine environment. For example, whilst the report certainly supports calls for more information about the natural conditions of the sea, it does not support popular suggestions that human health is at risk or that the North Sea is dead.

#### 6 TREND MONITORING OF CONTAMINANTS IN BIOTA, SEDIMENTS AND WATER

The Chairman of the Working Group on Statistical Aspects of Trend Monitoring (WGSATM), Dr Uthe, presented a preliminary draft of the report of the recent meeting of his working group and the pre-meeting workshop. The latter had been convened to conduct a statistical analysis of the 1977-1985 Cooperative Monitoring Programme (CMP) data held by ICES. The Workshop participants had only managed to complete a preliminary assessment of trends in data on contaminants in muscle (62 sets) using the stepwise procedure for statistical analysis published in the 1986 report of ACMP. In at least 28 of these analyses the procedure had indicated a need to investigate in detail the characteristics of the data sets. Lack of uniformity in sampling structure from year to year had been revealed in a number of cases. An appraisal of the performance of the method of statistical analysis and of the data quality had been initiated.

Although none of the work had been completed, the working group had agreed to continue the work intersessionally and were proposing early publication of the results. In this context, Dr Wilson explained the findings to date and the basis of the problems encountered. These confirmed the validity of the guidelines on sampling of biota for the purposes of assessing trends in contaminant levels and the importance of initiating a well-designed monitoring programme. Both the data submitters and the statisticians analysing the results are required to check both the scientific basis and the sense of an apparent statistical trend (i.e., a statistical trend is suspect unless a reasonable explanation can be found).

Other topics discussed by WGSATM were the analysis of the data on contaminants in liver tissue and the application of multivariate approaches to contaminant data analysis. Both of these would be continued interessionally. It was hoped that a report on the analysis of some CMP data sets using the multivariate approach would be available in 1988 in a form suitable for both scientists and persons concerned with environmental assessments. A further assessment of pooling techniques had suggested that statistical problems could be encountered if certain assumptions on the creation of a pooled sample were not met. Pooling did, however, appear to be viable provided that strict protocols are followed and the pooling sampling structure is consistent from year to year. However, there are consequent losses in the power of the statistical tools and possibilities of variance reduction.

The role of fat as a covariate in the regression of contaminant concentrations in fish liver tissue had been investigated using some Norwegian data sets. The results showed that the length covariable was more appropriate when cadmium and PCB were expressed on a lipid basis rather than a fresh weight basis. The Marine Chemistry Working Group was requested to consider whether data were available on contaminants versus different measurements of lipid or lipid classes. This would allow assessment of the need for more selective lipid determination for use in trend studies.

In recognition of the interest in mussel watch type studies in relation to trend monitoring assessment, it was intended to carry out statistical modelling of mussel results interessionally. WGSATM had had a presentation on the use of mussels as monitors for chemical contaminants by Dr Helmut Fischer, whose main conclusions were that in mussels contaminants fall into three categories:

- 1) Inert substances, e.g., PCB, which rapidly attain equilibrium. In such cases the animal acts as a passive monitor and frequent sampling is required.
- 2) Nutritionally required substances, e.g., zinc. In such cases mussels are poor monitors unless the levels are such that the regulatory mechanism is swamped.
- 3) Toxic substances, such as cadmium, mercury, silver and lead, where the animal binds the metal essentially irreversibly to protein and integrates exposure.

He also demonstrated that since nutrient status affects growth, contaminant concentrations in soft tissues are influenced by growth or starvation. This can be overcome by using shell weight as a covariate to the metal soft tissue burden.

Finally, WGSATM had discussed the desirability of producing leaflets detailing the important considerations which must be taken into account in a monitoring programme for trend assessment purposes. These would emphasize both the need for and the details of the necessary protocols.

In the discussion which followed, the Working Group considered the request for rapid publication of the preliminary statistical analysis of the CMP data on contaminants in fish muscle tissue to

be reasonable in view of the importance of communicating the lessons learned to date as soon as possible. It was emphasized, however, that the report should stress that it deals only with the statistical analysis of the data sets and makes no attempt to consider the data in terms of environmental and fishery information. It was further emphasized that a statistical analysis which identifies significant trends should only be accepted if there were good physiological and environmental data from the sample sites supporting the observed trends. With the understanding that the preliminary report would identify problems in the past data submissions and only contain statistically valid information as well as the cautions mentioned above, the Working Group approved the direct submission of the report to ACMP with a view to its early publication.

The Working Group also emphasized the need to stress that participants in trend assessment programmes must recognise that in most instances the identification of trends requires monitoring over an extended number of years and warned against the possibility of misinterpretation of short time series. Most studies to date are of less than five years duration. A period of the order of 10 years for biota and 50 years for sediments might prove to be the appropriate series required for confidence in interpretations.

There was considerable discussion on the utility of fish as environmental monitors. While there is justification for studying trends in fish alone (human health and resource production protection), there was much to commend adoption of a more holistic approach to environmental monitoring. Recognising the potential utility of multivariate approaches in integrating various environmental sectors, the Working Group also encouraged research into the applicability of this technique to supplement the existing methodologies.

Discussion then focussed on the work load being imposed on the few statistician members of WGSATM. It was noted that, while the Chairman is attempting to recruit more statisticians willing to spend time intersessionally analysing the data, it is conceivable that in the not too distant future the Council would have to employ a full-time statistician dedicated to contaminant and pollution work, rather than rely on volunteers.

The Group discussed the comments of the WGMS and MCWG on the role of sediments and seawater data in trend monitoring. Although it is obvious that all three media can be useful in rapidly changing hot spot situations, it was felt that sediments and seawater data required more research. A proposal from MCWG that maximum expected changes be estimated prior to extensive seawater monitoring studies was endorsed.

Finally the Group considered the preparation of leaflets as suggested by the WGSATM. There was general agreement that the preparation of such detailed information was desirable. However, it was pointed out that the contents of the leaflets would only become accepted as protocols after considerable discussion by the participants and their agreement. The Chairman noted that there was one basic protocol which must be accepted, i.e., that participants select a monitoring scheme and ensure that it is

consistently adhered to each time a sample is taken. The leaflets would simply supply a lot of detail on protocol designing for each participant who would then have to use his own information to generate optimal sampling strategies.

#### 7 CONSIDERATION OF THE CONCLUSIONS OF THE PRELIMINARY ASSESSMENT OF BASELINE SURVEY DATA FOR TRACE METALS IN SEA WATER

Dr Wilson introduced this item by presenting document WGEAMS 1987/7, entitled "A preliminary review of the 1985 Baseline Study on Trace Metals in Coastal and Shelf Seas Waters". This had been prepared by a Sub-Group of the Marine Chemistry Working Group at its meeting earlier in the year. The Sub-Group had examined all the data on metals in sea water available to ICES for 1985.

From these results it was evident that in some respects the 1985 component of the Baseline Study had been less than successful, despite the efforts that had been made by the participating institutes. In addition to the analysis of distributed uncompromised sea water samples (6/TM/SW), the participating laboratories had been encouraged to sample water at one or more of four reference stations, as this would make it possible to assess the overall performance of each laboratory. Regrettably, only two participants had been able to sample at the reference sites in 1985.

As judged from the criteria laid down by the organizers of the intercalibration exercises, only four laboratories out of the eighteen from which data had been available had been able to produce acceptable results on the content of dissolved mercury in sea water. This situation was in many respects typical of the results for most of the other metals.

In discussing these conclusions, several possible explanations were offered for the somewhat disappointing preliminary results of the first year of the baseline study. Many of the data sets had been collected as parts of national or other programmes and were reported according to guidelines other than those designed for the study, i.e., they were not really intended to form part of the baseline study. In several cases, important supporting information was lacking and this made it impossible to evaluate and qualify the results. Many of the participating laboratories had apparently not previously participated in intercomparative studies and had only limited experience in the work in question.

It was recognized that several of the laboratories need to improve their performance. The Working Group concluded that efforts should be made to find a feed-back mechanism to the participating laboratories to give them information about their results in the hope that this might lead to improvements in the final year of the study. It was suggested that, in future, intercalibrations should be conducted in at least two parts so that participants with problems could correct them before the final exercise. In relation to the present study, the most likely means of achieving this are through participation in bilateral intercalibration exercises and analysis of reference material available from Canada. The Working Group concluded that it would actually save efforts and resources of participating laboratories if a recommendation

could be passed on through the ACMP that laboratories take advantage of these available means of assistance in order not to waste effort with inadequate analytical methods in the existing survey and, perhaps even more importantly, so as to ensure that, should a further study be undertaken, they would be able to contribute to it in a meaningful and worthwhile manner.

The Working Group agreed to keep the question of the baseline survey of metals in sea water under review. It was also concluded that, if the outcome of the study in 1986 and 1987 proves more successful, an attempt should be made to compare the contamination pattern with that revealed by the Baseline Study of Contaminants in Fish and Shellfish.

## 8 COMPILATION OF THE IRISH SEA STATUS REPORT

The Chairman explained that work on this report, which was seen as a contribution to the Regional Assessment series of ICES, had been undertaken initially by a group of UK scientists. That report, WGEAMS 1987/8, had been made available to ICES and the task before the Working Group was to decide how to take account of comments from various ICES Working Groups and what material to include from the complementary report which has been prepared summarizing the recent Irish data on the same area, WGEAMS 1987/8.1. The ultimate aim is to prepare a composite report for consideration by ACMP in June 1987.

Several members of the Working Group questioned whether the task with which they were presented was a sensible one. It was pointed out that since the area was principally of interest to the UK and Ireland a bilateral ad hoc group would have been a better mechanism. Many members felt they were so unfamiliar with the area that they could not usefully contribute. It was suggested that the task of reconciling two different views from two different reports would be extremely difficult under such circumstances. Both the Chairman and Mr Boelens, the author of the Irish report, reassured members that there was no real conflict and that the task was relatively straightforward.

The Chairman suggested that the most efficient procedure would be for Mr Boelens to suggest which material he felt should be included in the composite report which the Working Group had been asked to produce and that members should indicate their agreement or otherwise as he proceeded. On this basis the Working Group examined the Irish Report and agreement was reached on what material was relevant. In several instances clarification of the text was suggested and some additions to assist in the overall understandability of the combined report were made, e.g., consideration should be given to the production of pie diagrams showing relative inputs, flow should be included for the Irish rivers.

Discussion then turned to the comments of other ICES working groups on the original UK document. Most of these were considered to be relatively minor and easily incorporated. The comments of the fish disease experts in WGPDMO, the sedimentologists in WGMS and the preliminary comments of the Working Group on Shelf Seas Oceanography provoked some debate. The former had pointed out that there simply was not enough information about fish diseases

in the Irish Sea to draw any conclusions. It was agreed that the main body of the report properly carefully avoided this pitfall, but several members felt that the summary section on this and other points did not reflect such a cautious stance. The WGMS had expressed reservations about the description in the summary section of a "mercury fly-wheel effect" and the Shelf Seas Hydrographers had expressed surprise at the total lack of any mention of radioactivity, a comment endorsed by several of the Working Group members.

The ensuing discussion led to the conclusion that both the original UK document and the likely product of its amalgamation with the Irish data could not be considered an Assessment in the ICES context, but would rather be a Review. It was agreed that the exclusion of any reference to radioactivity was a strange anomaly and that if ICES, through ACMP, decided to publish the Review a completely new summary should be prepared. In response to the criticism on radioactivity, it was pointed out that inclusion of data on radioactivity would detract attention from the true problems of the area, it is dealt with adequately in other publications, and there was a question of the competence of existing ICES Working Groups to deal with this topic. Most members, however, considered that inclusion of some mention was desirable, even if only in relation to water movements.

It was pointed out that the amount of time available for detailed study both before and during the meeting had not been really adequate for such reports. Several members of the Working Group indicated that they would like to have had more time to study and comment on the report and that they were concerned over the extent to which they would be considered responsible for its production. In drawing the discussion to a close, the Chairman assured members that he and Mr Boelens would take all the suggestions into account in producing a combined text for ACMP. He also undertook to draw the attention of ACMP to the reservations members of the Working Group had expressed in relation to certain aspects of the report and their responsibility for it.

In recognition of the Working Group's concerns, it was suggested, and agreed, that all members should be given an opportunity to study the composite report prepared for the ACMP's June meeting. Any comments supplied to the Chairman by mid-September would be drawn to the attention of ACMP in October with view to their possible inclusion.

#### 9 CONSIDERATION OF THE IRISH SEA AND SKAGERRAK/KATTEGAT REPORTS IN RELATION TO MONITORING STRATEGIES

In order to ensure that members were familiar with the report on the Regional Assessment of the Skagerrak and Kattegat (WGEAMS 1987/9), and in particular the main problems encountered in relation to monitoring, the Chairman asked its editor, Dr Hognestad, to introduce the report.

Dr Hognestad pointed out that it had taken three years to produce the report. He added that in producing its final report the Working Group had adhered to the ICES Guidelines and in the end found them helpful. They had chosen largely to ignore coastal waters,

especially fjord areas, and had encountered a lack of data in offshore areas, especially of long-time series data, and on biological effects and species interactions. One interesting feature of the outcome was that at the start of the study most members had perceptions of the existence of environmental problems which, on a thorough examination of the available data, proved false or of only local significance. This alone had made the exercise worthwhile. A further worthwhile consequence was that joint activity between the countries concerned was now taking place in the area studied.

There then followed some comments on the detail of the report, most of which focussed on data, especially old data, which were said to be available but which had not been considered (the same incidentally applied to the Irish Sea report). However, the Chairman pointed out that, as the report was essentially final and in press, detailed discussion on these lines was not appropriate. Instead, attention should be focussed on the general lessons which could be learned, in relation to monitoring requirements, from the two Irish Sea and Skagerrak/Kattegat reports. From the ensuing discussion the main conclusions drawn were as follows:

- a) The information gained by monitoring may lead to a new understanding of a geographical area which in turn could call for changes in the monitoring programme itself.
- b) Monitoring has to be performed in coastal areas as well as in open sea areas. In general, the coastal areas are more polluted than the open sea areas, but limiting the monitoring to coastal areas only would provide too limited information to allow full understanding of the observed environmental changes. On the other hand, monitoring only in the open sea areas would provide the answers and even warning signals at a too late a stage.
- c) In designing a monitoring programme one should keep in mind not only known sources of pollution in the area, but also potential pollution that could be imported from neighbouring areas, including that carried via the atmosphere. It is also essential to take into consideration whether fish spend time in the area during their most sensitive stages.
- d) A substantial proportion of most monitoring programmes rely on very sophisticated analytical methods and equipment. As a result, it will take time before they have generated long time series data. In order to assure continuity in time series, it would be a good idea to include simple techniques in the programmes. As an example, Secchi disk observations were mentioned. In either case there is a need for long-term data sets. Care should also be taken not to disregard old data. Because of its duration, it can be relevant.
- e) It was particularly pointed out that a lot could be gained in terms of cost-benefit if monitoring efforts between countries within any geographical area were coordinated and undertaken jointly.



- f) It was noted in relation to the presentation of monitoring results that experience has shown it is difficult for scientists to present data convincingly to decision makers and the public. It was considered important that this be done successfully and this called for joint action between scientists and responsible journalists and illustrators. Only in this way would it prove easy to present reports in simple language with well designed lay-outs and good illustrations rather than the usual tables.

#### 10 PROPOSALS FOR NEW REGIONAL ASSESSMENTS AND THE NEED TO REVISE THE EXISTING GUIDELINES

It was agreed that before proposing new regional assessments it would be wise first to consider whether the Guidelines needed to be revised. The Chairman urged members to reflect accordingly on the three reports to which they had had access at the meeting, namely, the Irish Sea Review, the Assessment of Environmental Conditions in the Skagerrak and Kattegat, and the Quality Status Report on the North Sea. It was suggested that it might be appropriate to examine what the Working Group understood by an assessment. To this end, Mr Bannink made a number of proposals which in essence were accepted by the Working Group.

Mr Bannink explained that he saw an assessment as being the process of collecting data and from this producing information for the benefit of society via policy makers. Thus, he envisaged a relational scheme between the natural system, society's uses of the system and interests in it, and the policy makers' management of the system (Annex 4). It is for the scientists to produce the information for the policy makers to use. In this context, relevant information included uses made of an area, conditions of the system, impacts upon it both actual and potential as a result of uses, processes occurring inside the system and relations between the different components. Monitoring is a tool which provides access to conditions and impacts, but is unlikely to assist with information on processes and relationships. Thus, an assessment requires monitoring data but also reviews of other information. The resulting assessments might be expected to have a feedback effect on monitoring requirements and on the management of the natural system and the uses and impacts on it.

In the discussion which followed, it was agreed that the existing guidelines catered for this concept of an assessment, although it would be worth elaborating certain sections to clarify them. It was also agreed that the definition of monitoring suggested in the discussion paper (WGEAMS 1987/4) could, with only minor modification, cover all necessary environmental parameters. It was recognized that the three documents referring to regions were very different and that only the Kattegat and Skagerrak report broadly followed the Regional Assessments Guidelines concept. However, all three in their own way were useful.

Discussion as to the underlying reasons for this, suggested that the three documents addressed different parts of the process. The Irish Sea Status Report was perhaps best regarded as the first step or Review of available information, the Skagerrak/Kattegat

report was the final product and as such lacked the supporting review, whereas the North Sea report sought to combine the entire process, although following a somewhat different approach. This suggested that the documents might be aimed at different audiences and perhaps should involve different expertise. On this last point it was agreed that the implementation of the recommendations implicit in, or stemming from, an assessment would involve policy makers and probably legal experts and engineers as well as scientists, but that scientists alone should carry out the actual review and assessment. However, in presenting the assessment to policy makers and the public, professional journalists and illustrators should be called upon for assistance.

It was agreed that as the existing guidelines inferred, but did not explicitly state, an assessment should be considered a two-step process. The first involves production of a complete status report or review with no limitations on the fields of interest covered. The second is the final assessment which should be conducted strictly according to agreed guidelines. The assessment should be able to refer to the review so that readers can cross check, but it was suggested the review need not be published as such (make available on diskette).

In addition to identifying features common to several areas, it was considered that one of the main values of an assessment report is to pinpoint gaps in environmental knowledge. This latter purpose is not fully apparent in the existing guidelines. Gaps in this context include both identification of a need for new information and areas of uncertainty. The Group thus concluded that the guidelines needed to be revised in a number of respects and that until this had been achieved it would be premature to suggest new areas to be studied. It was hoped that both matters would be resolved at a future meeting. As a guiding principle, it was felt that ICES statistical divisions might provide a useful basis as these reflect fishing effort and to some extent biological and physical boundaries. Other aspects which might play a role were considered to include hydrographic features and international interests. In this latter respect, it was suggested that participation in the Working Group of persons familiar with other areas would be useful. The Mediterranean was mentioned particularly in this context.

Finally, the Working Group addressed the question of the need to update or repeat assessments. It was concluded that no hard and fast rule could be drawn up, since the need would depend upon many things, e.g., changes in use or policy, the availability of new information. Nevertheless, it was considered that if the basic reason for the repeat was a result simply of a policy to do so at regular intervals, it is necessary to understand that the process of acquiring new data takes time. Thus, depending on the scale involved, it is unlikely that repeat assessments will be worthwhile more frequently than every five years.

#### 11 FURTHER CONSIDERATION OF STRATEGIC PLAN PROPOSALS

In the light of discussion on agenda items 5 to 10, the Chairman invited further comments on the discussion paper discussed earlier under agenda item 4. Members had in front of them a draft

of the main points raised earlier in the meeting and were also asked to consider whether any of these required amendment. No changes were proposed but some additional points were raised as follows.

More thought should be given to active biological monitoring, as for example a monitoring programme focussed on gathering data on egg-shell thinning. Where a substance is bioaccumulatable, early warning signals can be expected to be found with species higher up the food-chains. Attention should be given to a properly set up programme carefully aimed at properties and characteristics of the contaminant under consideration. It was noted that "mussel watch" programmes proved themselves valuable only when carefully planned and executed. Since data from such programmes produce relative values only, there should be a reference location included and great care should be taken in choosing these locations. In addition to body burdens of contaminants, other useful data which can be produced include scope for growth, mixed function oxidase, lysosomal stability and the determination of metals in organisms in excess of the amount bound by metal binding proteins.

Active biological monitoring programmes should be designed with a clear aim as to the type of information one wants. With respect to indicator species, the following remarks were made:

- When aiming to get information about the situation in different areas, for example around the North Sea, one should use organisms which occur throughout the area of concern.
- When aiming at gradient studies, organisms which remain in one place should be used. Mussels, Fucus sp and Enteromorpha sp were all mentioned as having proved useful in this context. They tend to reflect different phases of the contaminants, for example, Enteromorpha reflects adsorbable metals.
- The species Zoarces viviparus (viviparous blenny) was said to merit particular attention. This is a medium-sized stationary coastal fish which is easy to keep under laboratory conditions. Its great advantage is that the very vulnerable and sensitive larvae are kept within the parent fish body: it is suspected that it acts as an effect-integrating organism.

It was suggested that the Working Group on the Biological Effects of Contaminants might be asked to prepare a summary paper on these kinds of techniques. Prof. Grimås will also provide details of test procedures using Z. viviparus.

Attention was given also to integrating devices such as the 'Sea-star' sampler, which uses ion exchange resins, and of the use of polyurethane foams.

It was recognized that organisms can be used both to assess biological effects, including those which might serve as early warnings, and as an integrator (for metals or other contaminants).

It was suggested that more biologists should join the WGEAMS both to assist in interpreting information and in order to

clarify to the chemists what kind of information is needed in assessments. To this end the Chairman of the Working Group on the Biological Effects of Contaminants should be invited to attend WGEAMS meetings.

It was further noted that, as inputs from point sources are declining in amounts, more attention should be given to diffuse sources and their effects (atmosphere). Care should be given to maintain the continuity of monitoring programmes. Thus, although there is a need to switch attention to contaminants not previously monitored, it is recommended that regular (2 or 3 years) checks should be made of environmental levels of contaminants previously studied (e.g., mercury or nutrients).

#### 12 ANY OTHER BUSINESS

There was no other business.

#### 13 PLANS FOR THE NEXT MEETING

The Working Group concluded that, for an inaugural meeting, progress had been good. However, in view of the need to consider assessment documents and the report of the Baseline Study of Contaminants in Fish and Shellfish, it had not been possible to develop and finalise the monitoring strategy document or the regional assessment guidelines. These topics would be given priority at the next meeting, at which time consideration would also be given to the future format of the existing ICES Cooperative Monitoring Programme. A recommendation to this effect (including proposed dates and venue for the meeting) was drafted and is given in Annex 5.

#### 14 DATE AND VENUE OF THE NEXT MEETING

Dr. Carlberg indicated that his Institute would be happy to provide facilities for the next meeting at its main office in Norrköping from 2 - 5 May 1988. Norrköping is readily accessible by rail from Stockholm or directly by air from Copenhagen. The proposal was accepted by the members. Details will follow after the ICES Statutory Meeting if Council approves the recommendation.

#### 15 CLOSURE OF THE MEETING

The Chairman thanked the members for their active participation and attention and, there being no other business, closed the meeting at 14.50 hrs on 8 May.

## ANNEX 1

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## ANNEX 2

WORKING GROUP ON  
ENVIRONMENTAL ASSESSMENTS AND MONITORING STRATEGIES

Copenhagen, 4 - 7 May 1987

AGENDA

1. Opening.
2. Adoption of Agenda.
3. Report from Statutory Meeting 1986 - consideration of terms of reference and tasks in relation to those of other working groups (Doc. WGEAMS 1987/3).
4. Preliminary consideration of strategic plan proposals - paper to be distributed by the Chairman (Doc. WGEAMS 1987/4).
5. Report of 1985 Baseline Study of Contaminants in Fish and Shellfish. Final amendment and consideration of recommendations and whether original aims were met (Docs. WGEAMS 1987/5, 5.1 and 5.2).
6. Note position in relation to trend monitoring of contaminants in biota, sediments and water (Doc. WGEAMS 1987/6).
7. Note conclusions of preliminary assessment of baseline survey data for trace metals in sea water (Doc. WGEAMS 1987/7).
8. Compilation of Irish Sea Status Report in final format - inclusion of other working groups' comments and Irish contribution (Doc. WGEAMS 1987/8 and 8.1).
9. Consideration of the implications of the outcome of the Skagerrak and Kattegat and Irish Sea Regional Assessments in relation to monitoring strategies (Doc. WGEAMS 1987/9).
10. Proposals for conduct of further Regional Assessments - selection of other areas and consideration of need to revise guidelines (Doc. WGEAMS 1987/10).
11. Further consideration of Strategic Plan proposals and elaboration thereof (Doc. WGEAMS 1987/4).
12. Any Other Business.
13. Plans for next meeting.
14. Proposed date and venue of next meeting.

## ANNEX 3

EXECUTIVE SUMMARY

The 1985 Baseline Study of Contaminants in Fish and Shellfish was conducted to obtain a picture of the distribution and levels of certain contaminants in certain species of fish and shellfish in the North Atlantic and the environment from which they were collected. In the Northeast Atlantic, the Baseline Study was conducted in cooperation with the Oslo and Paris Commissions, while in the Baltic Sea, this study was conducted with the support of the Baltic Marine Environment Protection Commission (Helsinki Commission).

Sixteen countries participated in this Baseline Study, namely, Belgium, Denmark, Finland, France, the German Democratic Republic, the Federal Republic of Germany, Ireland, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, the United Kingdom, the USA, and the USSR.

The contaminants measured in this study included the metals mercury, arsenic, copper, lead, and zinc, and the organochlorine compounds hexachlorocyclohexane (HCH), hexachlorobenzene (HCB), op and pp'DDT, pp'DDE, pp'TDE, Dieldrin and PCBs and individual CBs. The main species studied were cod (Gadus morhua), plaice (Pleuronectes platessa), flounder (Platichthys flesus), dab (Limanda limanda) and blue mussels (Mytilus edulis). Some data were also submitted on herring (Clupea harengus), Mediterranean mussels (Mytilus galloprovincialis), and oysters (Crassostrea gigas).

As far as is known, this Baseline Study was the first attempt to conduct a unified exercise on such a wide geographical scale and with such a large number of participating laboratories (33). A total of 670 samples were collected and more than 10,000 contaminant concentration values were submitted. This demonstrates that, if the plans are sufficiently well thought out and the proposed investigation soundly based and justified, wide-scale participation can be attracted.

The study was a success in many respects; and even where there were failures, they have provided experience from which benefit can be drawn if future similar investigations are contemplated. A major disappointing feature of the results submitted was the fact that, although guidelines had been agreed as to the species that should be sampled and the season for sampling as well as the types of data that should be reported, many participants failed to follow all of these guidelines.

Because some of the data were not comparable, either due to different species being collected or because the laboratory concerned had failed to achieve an adequate standard of analytical accuracy and/or precision, the usable data set is less complete than it might have been. Despite this, an adequate picture has been obtained of the distribution of most of the contaminants which have in the past given rise to concern over potential or



real adverse effects. From this picture it is apparent that, with very few exceptions, the concentrations now being found in edible fish or shellfish tissues are unlikely to present any risk to human health. It is not, however, possible to give such assurances in relation to the effects on marine biota, partly because in a few areas there are clear grounds for suspecting problems, but mainly because little is known about what concentrations of contaminants, either alone or in combination, do or do not cause damage to marine organisms. Nevertheless, it is worth noting that, in most cases, the marine organisms present today have, in population terms, survived the levels of exposure they have suffered up to now. Even allowing for the absence of strict comparability between the data from the 1985 Baseline Study and those from earlier surveys, it is clear that levels of certain contaminants in 1985 were generally lower than previously, and there are now very few areas which exhibit high levels. Thus, if there are problems, they are likely to be less numerous and serious than previously, since it is apparent, at least for the contaminants covered in this study, that levels were higher in the past.

It should be remembered that this study related to a limited number of contaminants. Most of these have been subjected to pollution control measures and, in an era of increasing environmental awareness, it is possible that in the Northern Hemisphere releases of other contaminants have also been restricted. Whether this has occurred, and if so its extent, is unknown as are present environmental levels. It is also worth noting that for some substances, e.g., DDT, increasing use in the Southern Hemisphere may well be resulting in a position where global use remains much as it was before controls were introduced in the Northern Hemisphere.

As was to be expected, some areas do appear to be more contaminated than others, either in a general sense or by a particular contaminant. Full details of the latter can be found in the sections of the report which deal with each contaminant separately and it is inappropriate here to do more than pick out a few of the clearer examples. These include:

For cadmium: Liverpool Bay, Firth of Forth, Gironde Estuary and in the southwestern Baltic Sea (40G5) and the Gulf of Gdansk.

For copper: Liverpool Bay, Humber Estuary, Gironde Estuary, Central North Sea, and in the southern and southeastern areas of the Baltic Sea.

For lead: Southwest coast of England, Northwest coast of England, German Bight, Northeast coast of England, Southern Bight of North Sea.

For zinc: Clyde Estuary, Firth of Forth, Northeast coast of England, Southwest coast of England, Gironde Estuary, Spanish coast around Santander and Navia Estuary, and the southern areas of the Baltic Sea.

For mercury: Oslofjord, Liverpool Bay/Mersey Estuary, Humber Estuary, Spanish coast around Navia Estuary and La Coruña, and in the Gulf of Gdansk in the Baltic Sea.

For arsenic: Belgian and Netherlands coasts, Firth of Forth, German Bight, Central North Sea

For PCBs: Liverpool Bay, Belgian coast, Oslofjord.

For organo-chlorine pesticides: Liverpool Bay, German Bight, Oslofjord, Humber Estuary.

On this basis, the areas which seem to be generally more contaminated than others are:

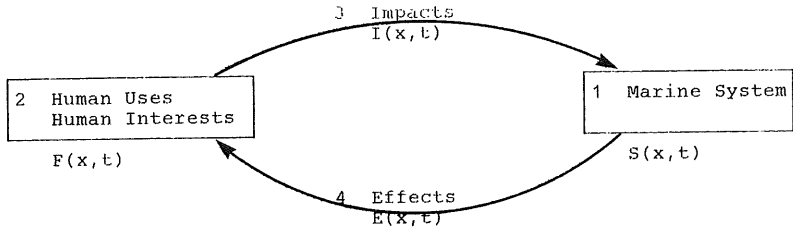
- Belgian and Netherlands coasts
- Oslofjord
- German Bight
- Liverpool Bay
- Northeast coast of UK (Humber to Firth of Forth)
- Gironde Estuary
- Southern areas of the Baltic Sea

None of these findings present any great surprises; most reflect known sources of input of the contaminant in question and, where general contamination is indicated, the areas are ones which are clearly associated with major centres of population and/or industrial activity or are influenced by discharges of major river systems. In short, therefore, the survey tended to confirm what was either already known or suspected and the results give no cause for major reappraisal of requirements in terms of pollution prevention priorities in respect of contaminants covered in this study.

However, this conclusion needs to be interpreted with some caution because of the way in which the samples were collected. In some cases, countries clearly attempted to obtain coverage of their entire coastal areas, e.g., the UK and Denmark via their mussel sampling, whereas other countries sampled more sparsely. Moreover, some countries clearly sought to ensure that the survey adequately covered areas likely to be more contaminated than others, whereas in some instances sampling of such areas was either omitted or was very limited, e.g., Baie de Seine, German Bight. Thus, the results of the survey do not necessarily identify all of the most contaminated areas, although it seems unlikely that major areas of contamination will have been missed although local hot spots may have been, i.e., any contamination of significant geographical scale will have been picked up, even if not clearly identified, by multiple sampling.

The overall success of the study must be judged on the extent to which the basic aims were met. The main aim was to estimate the range of levels of selected contaminants throughout the ICES area and, despite some reservations about the quality of some data sets, there is no doubt that this was achieved, at least for the European part of the area. Although the total picture is not entirely complete because of the uneven distribution of sampling, it is unlikely that any large scale hot spots were missed in the Study. The picture could, however, be improved substantially in the future if the experience gained from this study is fully utilized.

## ANNEX 4

RATIONAL DIAGRAM OF (MARINE) ENVIRONMENTAL ASSESSMENTS

Uses:

$F(x,t)$   
 - fisheries  
 - shipping  
 - sand/gravel mining  
 - oil/gas exploitation  
 - input of materials  
 - recreation

$S(x,t)$   
 - abiotic/biotic  
 - condition/processes

Interests: - conservation of nature

6 Regulations  
 $R(x,t)$

6 Adjustments  
 $A(x,t)$

5 Policy & Management

$P(x,t)$

On the basis of knowledge of  $S(x,t)$ , the present and preferred  $F(x,t)$  with their accompanying  $I(x,t)$  and resulting  $E(x,t)$ , policy formulation, decision making and management of (marine) resources ( $P(x,t)$ ) should result in sensible  $R(x,t)$  and  $A(x,t)$ .

Assessments are condensations of information such that the bare essence of this knowledge (of  $S$ ,  $F$ ,  $I$  and  $E$ ) - including relevant lacks and flaws - is produced for society and its policy makers.

## ANNEX 5

### RECOMMENDATIONS

- 1) The Working Group on Environmental Assessments and Monitoring Strategies (Chairman, Dr. J E Portmann) should meet at SMHI Headquarters, Norrköping, Sweden, preferably the week after the meeting of the Working Group on Statistical Aspects of Trend Monitoring. The preferred dates are from 2 to 5 May 1988. The following should be its main tasks:
  - a) To complete the Strategic Plan for Monitoring;
  - b) To redefine the guidelines for regional assessments and to include in them the criteria for defining a region and the detailed protocol for their development and preparation.
  - c) To review the existing Coordinated Monitoring Programme and consider its future content and conduct.
  - d) To review progress on biological effects monitoring and trend monitoring of contaminant levels in various media, particularly biota.

It is desirable that the chairmen of WGSATP, WGBEC and MCWG attend, since the activities of these three working groups have a close relationship with those of WGEAMS.

