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International Council for the  
Exploration of the Sea

C.M.1982/E:3  
Marine Environmental  
Quality Committee

REPORT OF THE EIGHTH MEETING  
OF THE WORKING GROUP ON MARINE  
POLLUTION BASELINE AND MONITORING STUDIES  
IN THE NORTH ATLANTIC

Göteborg, 26-29 January 1982

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<sup>3E</sup>General Secretary  
ICES  
Palægade 2-4  
1261 Copenhagen K, Denmark



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1. OPENING OF MEETING

The Chairman, Dr M. Parker, opened the meeting at 9.30 hrs on 26 January 1982 and welcomed the members. Dr B.I. Dybern, Acting Director of the Institute of Marine Research of the Fisheries Board of Sweden, welcomed the participants on behalf of the host, the Fisheries Board of Sweden. Dr Dybern briefly described the work of the Fisheries Board and emphasized the interest in Sweden in environmental issues and programmes for the monitoring of pollution in the marine environment.

2. ADOPTION OF AGENDA

The draft agenda was adopted without change. It was noted that issues concerning the ADP handling of marine pollution data would be considered under Agenda Item 6.4. For Agenda Item 9, Any Other Business, there were two papers on algal blooms/low dissolved oxygen occurrences and an overview paper on lead in the marine environment. The agenda is attached as Annex I and the list of participants is attached as Annex 2. The ICES Environment Officer served as Rapporteur.

3. ACTIONS OF COUNCIL, ACMP, AND OTHER RELATED ICES ACTIVITIES

3.1 The Chairman drew attention to a list of relevant resolutions taken at the 1981 Statutory Meeting which had been circulated prior to the Working Group meeting.

3.2 Regarding the activities of the Advisory Committee on Marine Pollution (ACMP), there were several questions on the ACMP request that the Working Group develop a format and proposals for the conduct of regional assessments of the health of the marine environment. It was felt that details of this request should be handled under Agenda Item 7.

4. GENERAL CONSIDERATION OF OTHER RELATED INTERNATIONAL ACTIVITIES

4.1 GESAMP - Dr McIntyre presented information on the main items in his paper on GESAMP activities in 1981 (Doc. WGMPNA 1982/4/2), noting in particular the extensive amount of work conducted on a review of the health of the oceans. He further reported that GESAMP was discussing possible alterations to its definition of marine pollution.

4.2 JMG - The Chairman provided information on the outcome of the January 1982 meeting of the Joint Monitoring Group (JMG) of the Oslo and Paris Commissions (Doc. WGMPNA 1982/4/3). Among the items mentioned was the endorsement by the JMG, subject to approval by the Commissions, of the conclusions of a meeting between representatives of ICES and the JMG/Oslo and Paris Commissions that, inter alia, (a) a joint ADP-compatible format for reporting and exchange of ICES and JMG data on contaminants in biota (and possibly water and sediments) will be

developed; (b) the data on contaminants in organisms will be compiled by ICES using its computer facilities and possibly processed (e.g., statistical analysis) as requested by JMG; (c) JMG and ICES will assess the data independently; and (d) laboratories participating in the ICES Coordinated Monitoring Programme will be invited to submit their 1981 data using the JMG reporting format (attached as Annex 3). The JMG also agreed, subject to endorsement by the Commissions, to adopt the new sampling protocols contained in the "Six-year Review of the ICES Coordinated Monitoring Programme" starting in 1982.

4.3 It was further noted that the JMG had considered the work programme for ICES and had proposed, subject to approval by the Commissions, the addition of three items to the programme for 1983. These additions are:

- (i) To examine, in cooperation with JMG, the automatic processing of marine pollution data and to prepare an ADP-compatible data reporting and exchange format;
- (ii) To prepare a general rationale for intercalibration exercises and their frequency, including an examination of the use of standard reference materials;
- (iii) To provide further advice on the effects of the dumping of  $TiO_2$  wastes at sea.

4.4 GIPME - Dr Portmann informed the Working Group about the outcome of the meeting of the Working Committee for GIPME (Global Investigation of Pollution in the Marine Environment) in January 1982 (Doc. WGMPNA 1982/4/4). He noted that the meeting had recognized the contribution made by ICES in the study of marine pollution. In this connection, Dr Bewers mentioned some of the activities of the Inter-governmental Oceanographic Commission (IOC) within the GIPME Pilot Project (Doc. WGMPNA 1982/4/1). Under the Group of Experts on Methods, Standards, and Intercalibration (GEMSI), an IOC/UNEP/WMO Sampling Intercalibration had been carried out on Bermuda in January 1980 (PANCAL-80). This exercise had benefited greatly from the series of ICES intercalibrations on trace metal analyses in sea water which had already been carried out, as well as from the plans developed for the future ICES Fifth Round Intercalibration. Dr Bewers also reported that IOC is developing plans for a baseline survey of trace metals in the open waters of the North Atlantic Ocean. A series of stations on various major water masses would be occupied and trace metal concentrations would be determined with the aim of establishing whether there are differences in trace metal compositions between water masses and improving estimates of advective fluxes of metals in the North Atlantic.

4.5 EEC COST-47 PROJECT - The Chairman gave a brief summary of the aims of and progress in the COST-47 project under the EEC (Doc. WGMPNA 1982/4/5). This project aims to establish a manageable "baseline" study of benthic communities on the Northeast Atlantic/North Sea coasts, including a determination of natural variability on wide geographical and long-term temporal bases and an understanding of the causes of biological change and the structure of community dynamics.

5. BIOLOGICAL EFFECTS MONITORING

5.1 National Reports on Methods Currently in Use

- 5.1.1 The Chairman noted that reports on programmes utilizing biological effects monitoring techniques from Canada, Sweden, UK-England/Wales and Scotland (Doc. WGMPNA 1982/5.1/1) and the USA (Doc. WGMPNA 1982/5.2/2) had been circulated prior to the meeting and that reports were now available from Norway (Doc. WGMPNA 1982/5.1/4) and UK-Northern Ireland (Doc. WGMPNA 1982/5.1/5). Apart from pathobiological studies which are covered under Agenda Item 5.2, these reports showed that studies were being conducted in most of the fields identified for biological effects monitoring: (1) in terms of biochemical effects, a number of countries were studying enzyme induction or inhibition; (2) several countries were developing bioassay techniques; (3) scope for growth was being tested as a physiological parameter; and (4) in the area of ecology, primary production and benthos studies were being conducted.
- 5.1.2 In the discussion, it was pointed out that these reports showed a large diversity of aims and techniques for biological effects monitoring, indicating the difficulties of international cooperation on such a complex subject. However, it was also felt that as long as studies are in a developmental phase, it would be premature to attempt to organize any form of coordinated activity. Only when techniques have been identified as useful monitoring tools is there a possibility for international coordination.
- 5.1.3 The Working Group then turned to a consideration of specific techniques for biological effects monitoring. Considerable discussion arose on the value of primary production measurements in the context of monitoring the biological effects of pollution. Several members reported that they have obtained useful results from the measurement of primary production indices in long-term studies. Examples mentioned were the Danish Belt Project, in which primary production had been measured over a period of seven years, and Norwegian studies in fjords, coastal areas and at offshore oil fields, whereby over ten years of experience in the use of primary production indices under carefully defined conditions has permitted the detection of environmental changes. Other members, however, felt that there were still serious problems in terms of methodology which need to be solved before measurements could be considered comparable from one area to another. The long time series of measurements often needed before the effects of pollution can be detected was also considered a drawback.
- 5.1.4 In terms of methodology, it was noted that the ICES Working Group on Primary Production Methodology has recommended guidelines for the measurement of primary production which are intended to reduce the variability in measurements made by different laboratories. This Working Group had also recommended that primary production indices be considered for use in environmental quality assessment programmes. A Workshop on Intercomparison of Techniques in Measurements of Primary Production is planned for 1983 to refine the details of the method given in the guidelines.

- 5.1.5 Dr Jensen mentioned that, in the context of work under the Helsinki Commission, Denmark will host a biological intercalibration workshop in August 1982 which will include an intercalibration of primary production methods.
- 5.1.6 The Working Group expressed interest in primary production studies and agreed that further information should be collected. All members were therefore requested to report on the use of primary production measurements in environmental studies for the next meeting (see para. 5.1.12).
- 5.1.7 Mr Hill described an oyster embryo bioassay technique which has been developed for coastal water quality surveys in England and Wales (Doc. WGMPNA 1982/5.1/2). In this technique, the survival rate of oyster embryos in the test water sample is compared with their survival rate in a control sample of water. As oyster embryos (in fact, larvae) are sensitive to the effects of a wide variety of pollutants to varying degrees, the test can only be used to assess good or bad water quality. Mr Hill reported that the technique gives a fair measure of water quality within a survey, but good comparisons cannot be obtained between surveys. He further stated that the technique is simple and reproducible and that it is good for field surveys because it is easily carried out on board ship at the sampling site.
- 5.1.8 The Working Group felt that this was an interesting technique for general surveys of water quality and requested that further results on its use be made available at the next meeting.
- 5.1.9 Mr Hill then provided information on a detailed spatial benthic survey used in the UK to study the effects of dumping solids and sewage sludge at sea (Doc. WGMPNA 1982/5.1/3). In these surveys, the distribution of macrobenthos is determined over a fairly wide area in association with a dumping ground and this is then related to hydrographic and sedimentological characteristics. Mr Hill stated that experience has shown that better results are obtained by conducting periodic intensive spatial surveys rather than by monitoring annually at fixed stations, as the latter can create problems in interpreting the data.
- 5.1.10 In the discussion of this report, several members agreed with the conclusion that intensive spatial surveys are of greater value than annual monitoring at selected sites. However, several problems were mentioned in terms of benthic surveys. It was agreed that a major problem in benthic studies concerns the difficulty in distinguishing between natural long-term climatic changes and anthropogenically induced changes. It was also suggested that the bottom-type within the area under study will influence the type of benthic community found and that this must be taken into account when looking for changes. Finally, it was suggested that, to obtain a more complete picture of the effects of dumping, meio- and micro-fauna should be studied in addition to macrobenthos.
- 5.1.11 Deciding that this issue should be considered again next year, Working Group members agreed to collect papers and other information on studies of benthos in dumping grounds and other areas receiving significant inputs.



5.1.12 In drawing the overall discussion on techniques for biological effects monitoring to a close, the Working Group agreed that for the next meeting members should prepare short reports on the use in their institutes or countries of the biological effects monitoring techniques recommended in the report of the ICES Workshop on Biological Effects Monitoring (Rapp. P.-V. Réun. No.179 (1980)) and the GESAMP Reports and Studies No.12. In these reports members should provide an evaluation of the usefulness of the technique in a monitoring context. In addition to reporting on techniques already (or soon to be) used in monitoring, members were encouraged to report on techniques which are being developed for possible use in biological effects monitoring. As agreed above, specific reports on the use of primary production measurements in environmental studies (see para. 5.1.6) and the use of benthic studies in dumping grounds and other areas receiving significant inputs (see para. 5.1.11) should also be prepared. To allow adequate time for compilation and circulation prior to the next meeting of the Working Group, the reports should be sent to the ICES Environment Officer to arrive no later than 15 November 1982.

5.1.13 As one contribution to these reports, Dr Lange offered to ask Dr John Gray of the University of Oslo to prepare a paper on the techniques he uses in studies of hard-bottom benthos and their value in terms of a biological effects monitoring programme.

## 5.2 Results of Cooperative Pathobiology Monitoring Studies

5.2.1 Reports on the results of studies of the incidence of fish disease had been submitted by members from Canada, Sweden, the UK (England/Wales and Scotland) (Doc. WGMPNA 1982/5.2/1), the USA (Doc. WGMPNA 1982/5.2/2), Ireland (Doc. WGMPNA 1982/5.2/3), and Norway (Doc. WGMPNA 1982/5.1/4).

5.2.2 After considering these reports, the Working Group felt that at this stage there were not yet sufficient data for it to be able to draw conclusions regarding any relationship between disease incidence and pollution. Rather, taking note of C.Res. 1981/4:6 and the earlier C. Res. 1977/4:11 (which called for the collection of data on disease incidence in fish and shellfish in relation to pollution), the Working Group urged the conduct of studies of fish disease incidence by ICES member countries and the reporting of the results to ICES.

5.2.3 In collecting data on fish diseases, the Working Group considered that information should also be given on the size, sex, total gutted weight (excluding gonads), liver weight and fat weight of the fish, so that the relationship of disease incidence to the condition of the fish could be investigated. When reporting on fish pathology, all observed diseases and parasitic infestations should be recorded as far as possible. Where relevant, data on seasonal variability of the diseases and the migratory behavior of the fish should be included. The Working Group considered that it was unnecessary to collect body burden data at present, except in cases where the incidence of disease is particularly high.

- 5.2.4 Given these additional reporting requirements, the Working Group felt that it might be advisable to make modifications to the ICES Fish Pathology Data Sheets, on which data are to be reported in 1982 on a trial basis. It was further noted that the USA has developed an ADP-compatible reporting format for fish disease data and it might be desirable for ICES to explore whether an ADP-compatible reporting format could be useful in the collection of fish disease data by ICES. The Working Group felt that the ACMP, as the initial recipient of the Fish Pathology Data Sheets, may wish to consider whether modifications should be made to the present trial Data Sheets to include the types of information mentioned in para. 5.2.3.
- 5.2.5 Bearing in mind the common interests of WGPMPNA and the Working Group on Pathology and Disease of Marine Organisms (WGPDMO), it was agreed that this section of the report should be made available to the WGPDMO for consideration at its next meeting. It was further agreed that information should be requested from the WGPDMO on the geographical distribution of fish diseases and, in particular, on the relationship of disease incidence to environmental variables, including pollution as well as natural sources. With this information, the WGPMPNA considered that it would be in a better position to investigate the use of pathobiology in pollution monitoring programmes.
- 5.2.6 In considering areas to be covered in surveys for fish diseases, the WGPMPNA urged the WGPDMO to include areas identified as "hot spots" of pollution in addition to "normal", i.e., unpolluted, areas in any general surveys they may coordinate relative to the geographical occurrence of fish diseases. Furthermore, noting that data on fish diseases may be available in laboratories other than those which normally report data to ICES (e.g., universities), the WGPMPNA recommended that these sources of information be examined by the WGPDMO. Finally, it was recommended that the Chairman of WGPMPNA make contact with the Chairman of WGPDMO before the 1982 Statutory Meeting in order to promote the coordination of relevant activities of the two Working Groups.
- 5.2.7 The Working Group then noted that, as a result of Dr Dethlefsen's invitation to WGPMPNA members at the last meeting, scientists from Norway, France and the UK had participated in a fish diseases cruise organized by the Federal Republic of Germany in the summer of 1981. This had proved useful to the participants as a means of inter-calibrating the gross diagnosis of diseases. It was further noted that a similar cruise had been organized by ISTPM, Nantes, with participation by a number of visiting scientists. Dr Dethlefsen extended a new invitation to members of the Working Group to join a fish disease cruise in June 1982. The Working Group noted this offer with gratitude.
- 5.3 Development of Protocols for Biological Effects Monitoring
- 5.3.1 The Working Group considered this item in the context of its second term of reference for the meeting, i.e., "to consider (ii).... preparation of a protocol for a biological effects monitoring programme" (C.Res.1981/2:15). The Chairman interpreted this term of reference to refer to the development of an overall strategy for the implementation of a biological effects monitoring programme rather than to the definition of individual protocols for particular techniques.

- 5.3.2 Dr McIntyre called the attention of the Working Group to a part of the GESAMP Report on Monitoring Biological Variables in relation to Marine Pollution (GESAMP Reports and Studies No.12) dealing with the overall strategy for the implementation of biological effects monitoring programmes. This report had been prepared in a global context, so as to be of relevance to developing as well as developed countries. The report spelled out a three-phase approach to the use of biological techniques: (1) the identification of "hot spots", (2) the quantification of effects, and (3) the analysis of their causation. It was assumed that when this strategy is actually implemented, the elements appropriate to local needs and concerns would be extracted and applied. Dr McIntyre drew particular attention to three points in this strategy: firstly, specific reference was made to the appropriate chemical and/or physical analyses essential to each phase of biological monitoring; secondly, it was stressed that no one technique could be adequate, but rather that a multidisciplinary suite of techniques should be applied; thirdly, biological observations could be used for two purposes, either indication of the presence of contaminants (as in the use of, e.g., "mussel watch" or bioassay techniques) or, more crucially, for evaluation of the effects of contaminants. It is in this latter area that biological studies are essential, bearing in mind that, according to the GESAMP and other international usages of the term "pollution" (which define pollution in terms of its effects), the ultimate determination of whether or not an area is polluted cannot be carried out without an assessment of biological effects.
- 5.3.3 The Working Group then discussed whether it should adopt the GESAMP strategy in its own work. It was felt that the GESAMP strategy represented the best currently available conceptual framework for a biological effects monitoring programme, but that a number of comments, clarifications, and caveats should be made concerning the application of the strategy. Firstly, the GESAMP strategy uses the term "phase" when describing the three aspects of a biological monitoring programme. The Working Group considered that these three "phases" were the structural elements of a programme and need not necessarily be followed consecutively. For example, the phases could be telescoped, or parts from more than one phase could be studied simultaneously, or, in certain circumstances, the phases could usefully be applied in reverse order. It was stressed that in applying any one element of such a programme, economic and logistic prudence would suggest that sufficient data be collected to enable proper evaluation of other segments to be conducted at a later stage.
- 5.3.4 Secondly, the Working Group felt that the first aspect listed in the GESAMP strategy (identification) required clarification. The purpose at this stage was to identify any biological variation, be it natural or artificially induced. Once such a variation has been identified, further observations, using a different suite of techniques, would be required to analyze the course of the change. It was stressed that at present it is often very difficult to distinguish between natural variations and artificially induced changes, although this should be the eventual aim. To reduce the problems of variability when contaminant concentrations in biota are used to identify "hot spots",

care must be taken that all samples are as biologically equivalent as possible, i.e., that samples are taken within narrow biological, temporal and local (spatial) limits.

- 5.3.5 Thirdly, while at present there are many techniques still in the process of being developed for use in a biological effects monitoring programme, there are a number of techniques which are already being used successfully by specific laboratories with access to the appropriate expertise. Nonetheless, the Working Group felt that it was not yet possible to propose specific techniques for routine use in coordinated, international monitoring programmes. Accordingly, the Working Group agreed that it could not recommend the immediate implementation of a biological effects monitoring programme on an internationally coordinated basis.
- 5.3.6 Concerning the ultimate selection of specific techniques, it was recalled that the report of the ICES Workshop on Biological Effects Monitoring and the GESAMP report had identified seven main areas of techniques and around 50 actual methods which showed promise in terms of biological effects monitoring. A number of these techniques were being studied in ICES member countries and reports on some of them had been presented at this meeting (cf. sections 5.1 and 5.2). As such reports on techniques and experiences in using them are valuable aids to the Working Group in its evaluation of suitable techniques for eventual inclusion in a biological effects monitoring programme, the Working Group reiterated the importance of all members preparing reports on techniques in use or under development, including an evaluation of the usefulness of these techniques for biological effects monitoring, as was agreed in paragraph 5.1.12, above.
- 5.3.7 The Working Group agreed that, in the context of these comments, it would annex pages 13-16 of the GESAMP report, with minor amendments, to its own report as representing the overall strategy of the Working Group for the development of a programme to monitor the biological effects of marine pollution (Annex 4). It was further agreed that, in preparing reports on techniques (cf. paras. 5.1.12 and 5.3.6) members should assess each technique in relation to the three elements identified in the strategy and indicate the most suitable application of the technique in question.
6. POLLUTANT MONITORING
- 6.1 1980 Coordinated Monitoring Report
- 6.1.1 The Environment Officer presented the draft report on the 1980 results of the Coordinated Monitoring Programme. Data had been submitted by Belgium, Denmark, England/Wales, the Federal Republic of Germany, Ireland and the Netherlands. Data had also been reported from Spain, but the laboratories conducting the analyses had not participated in an intercalibration exercise. The amount of data received, both in terms of number of species studied and number of samples taken, was similar to that received in 1979 but less than in years previous to that. However, as a result of the decision of the Joint Monitoring Group at its meeting in early January 1982, the Environment Officer would add relevant data from the JMG Joint Monitoring Programme into the ICES Coordinated Monitoring Report beginning with the 1980 results.

- 6.1.2 Several comments and suggestions were made on the report. The Working Group then agreed that after the appropriate additional data have been inserted, the report should be transmitted to ACMP.

6.2 Intercalibration Exercises

- 6.2.1 The Chairman noted that during the past three years the discussion of this subject had been based upon the decisions of the Marine Chemistry Working Group (MCWG) meeting the preceding week; however, as this year the order of the meetings was reversed, the WGMFNA could bring up some ideas for consideration by the MCWG.
- 6.2.2 Dr Uthe presented information on intersessional work he had been co-ordinating on PCB analyses as a follow-up to the Fourth Intercalibration Exercise on Organochlorines in Biological Materials. In this work, three samples (an oil, an oil spiked with Aroclor 1254, and Aroclor 1254 alone) were distributed to a small number of laboratories which analyzed the sample for individual PCB components. Dr Uthe reported that these detailed analyses still did not result in good agreement among laboratories (not even for Aroclor 1254) because, among other problems, laboratories are analyzing for different isomers.
- 6.2.3 As approved by Council in C.Res. 1981/4:2, Dr Uthe stated that he will conduct a Fifth Intercalibration Exercise in which samples of unspiked and spiked fish oil and small quantities of individual isomers would be distributed. Analysts will be requested to identify and quantify each isomer. Dr Uthe stated that each analyst requesting samples must write directly to him on letterhead stationery and indicate the method of analysis to be used. Preference in distribution of the samples will be given to laboratories using capillary column gas chromatography with individual isomer analysis.
- 6.2.4 The Working Group noted this information with interest and agreed that this was the correct approach to take. Given the many problems with the analysis of PCBs, the Working Group felt that this intercalibration exercise would help solve some of these problems. The Working Group expressed its appreciation to Dr Uthe and his institute for coordinating the exercise.
- 6.2.5 The Chairman then asked the Working Group to consider the issue of an overall rationale for the conduct of intercalibration exercises. This issue had been raised at the recent meeting of the JMG because several laboratories which had not participated in the initial intercalibration exercises for the JMG were now interested in contributing data to the Joint Monitoring Programme. The question was whether they must wait until new intercalibration exercises are organized, or whether they can participate in a bi-lateral intercalibration exercise with a laboratory which is already "intercalibrated", or whether they can analyze reference standards and report the results with their monitoring data.
- 6.2.6 It was felt that there were several objectives in the conduct of intercalibration exercises. First, intercalibration exercises are needed to provide a continuing assurance of the quality of analysis of individual laboratories and the comparability of results between laboratories. Secondly, based on the results of the intercalibrations, the information

obtained on the actual accuracy and precision of the analyses for the various contaminants is needed for use in interpreting the monitoring data. Moreover, it was felt that intercalibrations should be organized in such a way that specific questions on analytical issues can be answered with the aim of obtaining an overall improvement in the ability to analyze the substance of question in the matrix of interest.

- 6.2.7 On the issue of matrices, it was noted that previous intercalibrations concerning organochlorine residues have only studied the analysis of these substances in fish oil. It was felt that there is also a need for intercalibrations to include the extraction procedures for organochlorines from fatty tissues, especially fish muscle tissue and the fatty tissues of marine mammals.
- 6.2.8 The Working Group briefly discussed reference standards and agreed that, in terms of participation in internationally coordinated monitoring programmes, the use of reference standards could not substitute for taking part in an intercalibration exercise where the concentrations of contaminants in the samples are unknown.
- 6.2.9 On the subject of the frequency at which intercalibration exercises should be conducted, it was felt that it was difficult to set down general rules, but the Working Group agreed that at a minimum intercalibration exercises on the analysis of contaminants in biota should be conducted before each five-year baseline survey. However, this minimum frequency of every five years should only pertain to the easily analyzed contaminants, i.e., mercury, copper, zinc, and DDT, and not to the contaminants for which work needs to be done to improve analytical methods. These latter contaminants will require more frequent intercalibrations until the problems are solved. Although it was recognized that the frequency of conduct of intercalibration exercises will not always be optimal in terms of catering for new laboratories which wish to join an international monitoring programme, it was felt that the high cost of conducting large intercalibration exercises dictated against more frequent intercalibrations.
- 6.2.10 Finally, it was suggested that the Marine Chemistry Working Group should look at the results of the previous intercalibration exercises for each contaminant studied in each matrix and indicate the general accuracy and precision of analysis and the criteria for excluding outlying data, so that the results of monitoring programmes for contaminants in biota can be better evaluated.

### 6.3 Review of National Priorities in the Choice of Contaminants for Monitoring

- 6.3.1 The Chairman reminded the Group that the purpose of considering this topic was to determine what are the most important contaminants to be studied in the marine environment and decide whether they are being studied adequately. Reports on priority substances had been submitted for precirculation by members from Canada, Ireland, the Netherlands, Sweden, and the UK (England/Wales and Scotland) (Doc.WGMFNA 1982/6.3.1). A report from the USA was available at the meeting (Doc.WGMFNA 1982/6.3) and members from other countries reported orally on their national priorities in terms of contaminants to be studied.

6.3.2 Based on this information, the Working Group concluded that the contaminants presently studied in the Coordinated Monitoring Programme (i.e., mercury, cadmium, lead, copper, zinc, dieldrin, DDT isomers and PCBs) are still of sufficient importance that monitoring of them should continue. In addition, several other substances were mentioned as priorities in some countries, so the Working Group discussed how it should decide which substances were of general enough concern to merit consideration in ICES cooperative programmes. It was decided that, to aid in making these decisions, short review papers (4-5) pages should be prepared on the substances identified as a priority in two or more countries. Each paper should provide a succinct summary of the information available, emphasizing the problems of the contaminant on a general, international basis and providing an assessment of whether the problems are great enough for WGMFNA interest both in terms of quantity and geographical scope of contamination.

6.3.3 It was agreed that for the next meeting papers would be prepared by the following members:

<u>Subject</u>	<u>Member</u>
Polynuclear Aromatic Hydrocarbons	Dr Uthe, Dr Piuze
Petroleum Hydrocarbons	Dr Portmann, Dr McIntyre
Nutrients	Dr Parker, Dr Jensen, Dr Dethlefsen, Dr Folkard (Lowestoft)
Zinc	Dr Bowers
HCB	Dr Kerkhoff
Toxaphene	Dr Uthe, Dr Reutergårdh

These papers should be sent to the ICES Environment Officer to arrive by 15 November 1982 for circulation well in advance of the next Working Group Meeting. Recalling the discussion in the joint meeting with the ICES/SCOR Working Group on the Study of the Pollution of the Baltic, it was noted that the paper on toxaphene would be coordinated with and reviewed by that Working Group also (see C.M. 1982/E:4, para.5.2).

6.3.4 While the substances mentioned in the preceding paragraph were already of concern in at least several countries, the Working Group agreed that it was interested, on an on-going basis, in considering the need for attention to additional environmental contaminants within the ICES forum, either for coordinated monitoring, multi-national review or for increased research activity. One mechanism by which attention can be drawn to "new" or additional contaminants is through the submission of papers by members describing which additional contaminants are of concern in their countries together with a brief explanation of the reason for this concern. This notification procedure should be carried out as a way of identifying particular contaminants that may be of interest to other countries. However, it is important that any discussion on inclusion of a new pollutant in multi-national programme should be based on proposals that argue the need for such work within ICES coordinated programmes on the basis of broad, regional concerns. The Working Group was therefore interested in soliciting proposals for greater attention to new contaminants that provide justification from an ICES-wide perspective.

6.4 Implementation of Cooperative Monitoring Studies of Contaminants in Biota

- 6.4.1 The Working Group recalled its discussion of the baseline survey of contaminants in organisms which had been held during the Joint Meeting with the ICES/SCOR Working Group on the Study of the Pollution of the Baltic on 27 January 1982 (reported in ICES Doc. C.M. 1982/E:4). As this baseline survey will be conducted to meet the second aim of the new Cooperative Monitoring Studies programme, namely, broad geographical coverage, the ICES/SCOR Working Group had been invited to participate to further extend the geographical coverage of the study. The ICES/SCOR Working Group had indicated that it would be interested in joining the study, but felt that 1983, as originally proposed, would be too soon to carry out the work in the Baltic Sea and that, in order to obtain maximum involvement of laboratories in the countries around the Baltic Sea, the support of the Helsinki Commission should be sought for such a survey.
- 6.4.2 For logistical reasons, therefore, the WGMFNA decided that it would be advisable to postpone the geographical baseline survey of contaminant levels in fish and shellfish, originally planned for 1983, until 1985. Recognizing the interest of the members of the ICES/SCOR Working Group on the Study of the Pollution of the Baltic in the conduct of a similar baseline survey in 1984 or 1985, the WGMFNA recommended that the study be conducted as a unified exercise covering the Baltic Sea and the North Atlantic in 1985 (see Recommendation 1 (Annex 7) ). The General Secretary of ICES was asked to convey information on the postponement of the baseline survey to the Oslo and Paris Commissions.
- 6.4.3 In order to carry out some planning for the baseline survey and to obtain agreement on the species to be sampled and how sampling areas should be divided up among participants, the Working Group set up a small sub-group to consider these matters interessionally. The sub-group consists of Dr Portmann as Coordinator, Dr Pearce, and Dr Jensen, who should also serve as an interface with the ICES/SCOR Working Group. It was agreed that the sub-group should write to all members for their suggestions on the plans for the baseline survey. Draft plans should be ready by early June 1982 so that they can be distributed to all members for review and comment. In this way, fairly firm proposals can be available for consideration at the next meetings of WGMFNA and the ICES/SCOR Working Group.
- 6.4.4 Turning to a consideration of the statistical aspects of trend monitoring, Mr Lassen summarized the results of further intersessional work which had been undertaken by the former ad hoc group of statisticians. Mr Lassen stated that the results of this work had shown that the length of the fish was a very important parameter and, thus, the samples should be composed based on length stratification. The former ad hoc group had decided that stratification should be based on a log-linear relationship, with the individual fish sampled spread over the longest length interval practicable. The length range should be divided into at least 5 length intervals of equal size (after log transformation) and the length intervals should be no less than 2-3 cm. Once the length stratification has been developed for a particular species and area, this stratification should be adhered to strictly. Finally, Mr Lassen stated that the former ad hoc group had felt that the number of fish in a sample could be set at 25, although this figure is at the low end of the optimum range for an adequate statistical analysis for trends. The report of the statisticians is attached as Annex 5.



- 6.4.5 Mr Lassen further stated that this work on the statistical aspects of trend monitoring had shown that the software in different computer packages can give different results, so he would coordinate an intercalibration of computer software packages. He invited all persons involved in computer analysis to take part in this exercise. Interested persons should write to Mr Lassen directly.
- 6.4.6 The Working Group thanked Mr Lassen and his colleagues for their valuable work. Noting that the statisticians had recommended that certain changes be made in the Guidelines for trend monitoring in the ICES Cooperative Monitoring Studies programme, the Working Group considered these changes and adopted them with some amendments. The changes are given in the Appendix to the statisticians' report in Annex 5.
- 6.4.7 In terms of the implementation of these guidelines in the development of temporal trend monitoring programmes, the Working Group felt that it would be advisable to have all detailed plans on trend monitoring work submitted to one central person who could review them to ensure that the sampling scheme, statistical basis, etc., were appropriate. This would not only provide assurance that the individual programmes were well designed but would also permit an overview of all such programmes so that as wide a coverage as possible of species, contaminants and areas can be achieved. It would further provide a means by which all participants could share in the experience gained. Mr Hill agreed to act as the central reviewer of this work and all ICES participants in this programme were requested to send him their detailed plans for trend monitoring.
- 6.4.8 Dr Munk Hansen then presented a paper on the results of his work on Greenland to study the factors influencing the concentrations of trace elements in three species of brown algae and in the blue mussel. He reported that an analysis of variances had demonstrated that elemental concentrations in three species of brown algae are generally different and that, for a single locality, the concentrations in one of the species cannot be computed from those in another of the species. Nonetheless, the two species of Fucus studied were rather similar in terms of the concentrations of several elements determined. For the blue mussel (Mytilus edulis), he reported that analysis of variance of elemental concentrations showed a significant relationship between locality and size of the mussels, regardless of whether size was expressed as shell length or freeze-dried weight of soft parts. He stated that this complicates the comparison of studies at different localities because size effects on elemental concentrations cannot be eliminated.
- 6.4.9 The Working Group found this paper to be very interesting. In the discussion, it was noted that the results show that great care must be taken when using mussels in trend monitoring studies in terms of ensuring that the same population is sampled from year to year and that the samples are composed in the same way.

- 6.4.10 Dr Vyncke then presented a paper in which Belgian monitoring data on trace metals in fish and shrimps from 1972-1978 were analyzed in an effort to determine trends in concentrations and possible relationships with biological parameters. He stated that no trends could be found in the concentrations over the seven-year period, nor was there any clear relationship between the concentrations of any of the metals studied in the organisms monitored and the biological parameters considered.
- 6.4.11 The Working Group then considered the issue of the ADP processing and exchange of data on contaminant levels in organisms by ICES. It was recalled that, in C. Res. 1981/4:5, the Council had approved the establishment of a pollution data bank in ICES and had indicated that an appropriate data exchange format should be developed in this connection. The Environment Officer reported that the establishment of a data bank for contaminants in organisms had been discussed by the ICES Marine Data Management Working Group (MDMWG) at its meeting on 3 October 1981 and a sub-group of three persons had been set up to assist in this project. The Environment Officer further reported that, as the JMG had agreed that ICES should handle the initial processing of JMG monitoring data on contaminants in organisms, an informal group within JMG had discussed the format requirements, from the JMG standpoint, for ADP processing of pollution data. The report on this informal discussion was available as Doc. WGMPNA 1982/6.4.
- 6.4.12 The Working Group decided that the Marine Data Management Working Group should be requested to determine what type of ADP system should be used for the archival and processing of pollution data by ICES, given the systems already available to ICES and other relevant systems. Realizing that the system to be chosen depends on the output products which will be required, the Working Group agreed that it must develop a statement of requirements to be used as the basis for the work of MDMWG. One requirement which could be stated immediately was the need for a multi-linear regression analysis package.
- 6.4.13 Dr Portmann and Dr Bewers agreed to assist in defining the requirements of the system from a user standpoint. It was agreed that it would be necessary to define what types of data should be put into the system and what types of products one should be able to get out of the system and in what order. The revised Guidelines for Cooperative Monitoring Studies should be sent to MDMWG as a statement of the types of data which would be entered into the system.
- 6.4.14 To further assist the MDMWG, it was agreed that all members with access to an ADP system for processing their pollution data should send a description of their system to the Environment Officer by 1 May 1982.
- 6.5 Sediments
- 6.5.1 In beginning its consideration of this topic, the Working Group recalled the discussions in the Joint Session with the ICES/SCOR Working Group on the Study of the Pollution of the Baltic on 27 January and confirmed the conclusions agreed at that session (as reported in Doc. ICES C.M.1982/E:4).

- 6.5.2 The Working Group then noted that it had been requested by the Working Group on Marine Sediments in Relation to Pollution (WGMS) to consider the decision trees for sediment monitoring contained in the first WGMS report (Doc. ICES C.M.1981/E:34) and provide advice on the values which should be inserted in these decision trees. In deciding that WGMS was in a better position to determine these values, the Working Group took note of and supported the two pilot projects planned under WGMS to establish the nature of natural and anthropogenic signals in sedimentary columns. The Working Group felt that the information which will result from these projects will be required in order to put values into the decision trees developed to select sedimentary criteria that are useful for contamination (or pollution) assessment. The Working Group recommended that every advantage be taken of radionuclide/geochronological measurements in the elucidation of natural and anthropogenically influenced conditions in coastal marine sediments.
- 6.5.3 In closing the discussion on sediments, the Working Group agreed that the WGMS was making a very promising beginning in its work. However, the Working Group requested WGMS to consider whether it could include other contaminants than trace metals in its future work.
- 6.6 Water
- 6.6.1 Dr Bewers provided further details on IOC activities within the GIPME Pilot Project (Doc. WGMFNA 1982/4/1; see also para.4.4 this report). In particular, he stated that the planned IOC baseline survey of trace metals in open ocean waters of the North Atlantic would probably be delayed until 1985 in order to permit the participation of additional laboratories in the programme and to be able to add organochlorines to the substances to be studied.
- 6.6.2 Dr Bewers, as Chairman of the Marine Chemistry Working Group, further reported that the ICES Fifth Round Intercalibration on Trace Metals in Sea Water has been scheduled to take place from 5-18 September 1982 using the vessel "M/V Holland" and ISTEPM, Nantes as the land-based laboratory. This exercise will concentrate on the problems of nearshore sampling and sample preparation procedures.
- 6.6.3 The Working Group noted these two developments with interest. Recalling that it has been a long-term objective of the Working Group to coordinate a baseline survey of trace metals in sea water, especially in the coastal zone, the Group proposed that, if the Fifth Round Intercalibration is successful, a baseline survey of trace metals in the coastal zone should be planned. It was felt that such a baseline survey was a logical and necessary progression in the work of the Working Group. This baseline survey should take place in 1985 so that it can interface with the IOC baseline survey in open ocean waters.

6.6.4 In order to begin planning for the baseline survey, the Working Group decided to draw the attention of the MCWG to the interest of WGMFNA in this project and to ask the MCWG to assist in planning the baseline survey of trace metals in coastal waters, taking into account the results of the 5th Round Inter-calibration and the desire to interface with the IOC baseline survey of trace metals in open ocean waters, including the need to obtain intercomparable measurements between the two programmes. It was felt that planning could best progress if a sub-group were set up consisting of 2 or 3 members of WGMFNA and 2 or 3 members of MCWG. This sub-group should begin to develop plans immediately after the conduct of the 5th Round Inter-calibration in September 1982. The plans should take into account the results of the annual monitoring of contaminant levels in organisms and also river input data, where available. The Planning Group was requested to develop the plans well enough in advance so that ship time can be obtained for the study. Dr Jensen and Dr Portmann agreed to serve as the WGMFNA members of the Planning Group.

6.6.5 In order to ensure that plans for the baseline study can be developed as soon as practicable, the Working Group felt that it should seek approval in principle from the Council at the next Statutory Meeting, and adopted a recommendation accordingly (Recommendation 2).

#### 6.7 Inputs

6.7.1 Input study report - Recalling that the Working Group had requested that further data be collected and evaluated to complete the study of pollutant inputs to the Oslo Commission Area (Coop.Res.Rep.No.77 (1978)) and extend the study to the Northwest Atlantic, the Environment Officer presented Doc. WGMFNA 1982/6.7/1 in which new data from Canada, France, and Greenland had been provided. Additionally, there were a number of reports containing data on inputs from the Northeastern United States, but the results had yet not been compiled into one report.

6.7.2 The Working Group took note of the information contained in the document and thanked the members who had contributed data for it. Further noting the information from Dr Pearce that the United States will publish an overall report on pollutant inputs from the Northeast USA in late 1982, the Working Group felt that its work on the compilation of input data was now complete. It wished, however, to re-emphasize the great importance it attached to the quantification of contaminant inputs from all sources - rivers, atmosphere, direct discharges, land runoff, and dumping - as this information is essential to the development of mass balances.

#### 6.7.3 Report on riverine input assessment

Dr Bowers introduced the report "Methods of Assessing Gross Riverine Discharges of Trace Metals and Organohalogenes to the Ocean" (Doc. WGMFNA 1982/6.7/Rev.1) which he and Dr J.C. Duinker had prepared. He stated that the methods described in this paper apply only to the measurement of gross fluxes of trace constituents within a river discharge. Information on net fluxes of these constituents out of the estuary is also very important, but net fluxes are considerably more difficult to determine and thus should be the subject of a future document. When applying these methods for measurement of gross fluxes, Dr Bowers emphasized that one must first have a good understanding of the hydrology of the river in question.

- 6.7.4 Noting that this document will be reviewed in greater detail by MCWG, the Working Group endorsed this approach to the measurement of gross river fluxes of contaminants. The Working Group further emphasized that there is a great need for such measurements to be conducted because there is a large gap in knowledge concerning riverine inputs. However, noting that no intercalibrations have been conducted on the analysis of trace constituents in river water, the Working Group felt that there was a need for such an intercalibration exercise to check the comparability of analytical results among laboratories carrying out river monitoring programmes. To stimulate such measurements, the Group passed Recommendation 3.

## 7. REGIONAL ASSESSMENT

- 7.1 The Chairman reported that the ACMP, at its meeting during the 1981 Statutory Meeting, had considered the issue of whether and how ICES should conduct assessments of the health of the marine environment on a regional basis. Taking note of two major international assessment projects (the UNEP review of regional seas activities and the GESAMP review of the health of the oceans) and the extensive assessment of the health of the Baltic Sea carried out under the Helsinki Commission with assistance from ICES, the ACMP had felt that it was important that assessments be carried out in the ICES area on a regional basis. The ACMP had, therefore, requested WGMFNA to consider the issue of assessments and (1) to develop a general format for the assessment of the state of health of the marine environment of an area using existing information, and (2) to consider the best way to carry out such regional assessments and prepare practical recommendations for the work.
- 7.2 The Working Group, having considered this request, agreed that the conduct of regional assessments of the health of the marine environment was a logical progression from the monitoring programmes with which it has been concerned and would thus be very valuable. It was felt, however, that before discussing details of such assessments, the audience should be determined. The Working Group agreed that, in the first instance, the audience for such assessments was the Working Group itself and the ACMP; at a later stage, summaries or synopses of the reports might be useful for other audiences, such as pollution regulatory commissions or the general public.
- 7.3 The Working Group felt that, in the first instance, a relatively brief review of published data (especially of previous assessments, where available) was required in the near future rather than a large-scale data gathering exercise which might take several years. These reviews should, therefore, be broadly descriptive rather than highly detailed. These preliminary assessments might then form the basis for more detailed studies at a later stage.
- 7.4 The Working Group then discussed the general guidelines for the preparation of the assessments. It was agreed that all regional assessments should follow a generally similar approach so that comparisons could be drawn between regions. The assessments should include a succinct description of the physical, chemical and biological conditions of the region and any changes which may be occurring due to natural causes. The anthropogenic influences on the region should then be described, including not only contaminant inputs and their effects but also modifications of a physical nature (e.g., regulation of freshwater flow) and fishing activities. The magnitude, significance and trends

of these anthropogenic impacts on the physical, chemical or biological regimes of the region should be described, where possible. Some evaluation of the accuracy, precision, and comparability of the data used in developing the assessment should also be made. Finally, the gaps in knowledge, both of natural conditions and of anthropogenic influences on them, should be identified.

- 7.5 The Working Group then considered the approach used in the assessment of the Baltic Sea, as described in ICES Doc. C.M.1981/E:29. The Guidelines to authors described in that paper were felt to be more appropriate to the type of highly detailed, multi-authored assessment which had been carried out for the Baltic Sea, but these questions did provide a series of considerations to be borne in mind when preparing the preliminary assessments of the type the Working Group advocated.
- 7.6 It was decided that, in order to finalize these guidelines and decide on the emphasis to be placed on particular aspects, intersessional work should be carried out by a small group (working by correspondence). The final draft guidelines should be presented in a paper to the relevant Standing Committees and to ACMP at the 1982 Statutory Meeting.
- 7.7 The Working Group felt that the appropriate means of producing these assessments would be to have small steering groups formed, consisting of members from the relevant countries in each region. Each steering group would coordinate the preparation of an assessment of the health of its region according to the guidelines. Where necessary, the steering groups should draw upon the expertise of scientists from outside the Working Group.
- 7.8 Concerning the question of which regions should be chosen for the conduct of preliminary assessments, the Working Group decided that the initial criteria for choice should be that (a) the region is a reasonably natural hydrographic entity, (b) there is reason to believe that anthropogenic activities have an effect on the marine environment of the region, and (c) published information on the region is readily available. It was noted that assessments have recently been carried out for the Baltic Sea, the Skagerrak/Kattegat area, and the German Bight of the North Sea under the auspices of various regional or national authorities. Furthermore, work was in progress or had been completed for several areas off the east coast of the United States, including the New York Bight. While the North Sea as a whole was considered to be too large an area to serve as the subject of an assessment at the present time, the Southern Bight region of the North Sea was considered to be a good candidate for an assessment of the health of the marine environment. Other areas identified as possible candidates for regional assessments were: the Irish Sea, the English Channel, the Gulf of St. Lawrence, and the Bay of Biscay. It was further suggested that the Skagerrak/Kattegat study could possibly be extended to include the Norwegian Coastal Current body of water. The final choice of regions would depend on the willingness of the ICES member states bordering these areas to commit time to this work.

7.9 Given that at this meeting preliminary discussions had taken place on the method of approach to regional assessments, the guidelines for the contents and format of the preliminary assessments, and the regions that might be considered suitable for assessment in the near future owing to the availability of published information, the Working Group envisaged the following time schedule:

1. On the basis of these discussions, a small group, consisting of the Chairman Dr Parker, Dr Bewers, Dr Jensen, Dr McIntyre, Dr Pearce, Dr Portmann and the ICES Environment Officer, will work by correspondence to prepare a draft set of guidelines for the carrying out of preliminary assessments.
2. Bearing in mind the regions discussed by the Working Group, members agreed to approach their national authorities with a view to obtaining a commitment to the conduct of a preliminary assessment in any of the areas mentioned. As appropriate, contacts should also be sought for bi- or multi-lateral projects among countries bordering the same sea region.
3. In addition to the Working Group report, the paper prepared by the group described in paragraph 1, above, giving the guidelines for the development of preliminary assessments, should be presented to the Marine Environmental Quality Committee, the Biological Oceanography Committee, and the Hydrography Committee, as well as to ACMP, for consideration at the 1982 Statutory Meeting.
4. Assuming the acceptance of the proposal for the development of regional assessments by the ICES authorities, the WGMPNA will decide on the basis of national commitments which regions are likely to receive adequate enough coverage for work to begin. For each region so selected, experts will be identified to act as coordinators or members of a coordinating group for the assessment project.
5. The preliminary assessments will then be prepared inter-sessionally for presentation to WGMPNA.
6. As these first assessments will be of a preliminary nature, they will identify what is known about an area as well as items on which further information is needed. This may lead to a further, more detailed assessment of the area concerned. It may possibly also result in proposals for research programmes or workshops/seminars to gather additional information.

7.10 In closing the discussion on this subject, the Working Group agreed that a recommendation would be needed on this subject and accordingly passed Recommendation 4 (Annex 7).

8. FUTURE WORK

- 8.1 It was noted that a good deal of work had already been agreed to be carried out in the coming year. As this will result in the preparation of a number of papers for consideration at future meetings, it was strongly urged that these papers be prepared and precirculated in adequate time before the meeting to allow members to discuss the papers with their national colleagues. It was noted that at the present meeting a large number of papers had been delivered during the meeting; this situation should be avoided in the future because adequate consideration cannot be given to such papers. The Environment Officer renewed her standing offer to circulate papers for the meeting and reminded members that, owing to postal conditions, the deadlines should be adhered to strictly.

9. ANY OTHER BUSINESS

- 9.1 Dr Dethlefsen reported on the occurrence of low oxygen concentrations in near-bottom waters in an area of the German Bight northwest of Helgoland during late summer 1981 (Doc. WGMPNA 1982/9/1). Catches of fish were much lower in this area and some diseased and dead fish were found. There were no plankton blooms in the areas where the low bottom-water oxygen concentrations were observed, but heavy blooms of Ceratium furca were present in an area some miles to the north.
- 9.2 Dr Portmann then reported that in September 1981 during a routine Groundfish Survey cruise a UK research vessel had noted that unusually low numbers of fish were caught in an area west of Jutland (Doc. WGMPNA 1982/9). Furthermore, in this area some dead fish and a substantial number of dead benthic animals were found in the nets. Investigations of oil in water samples did not reveal anything unusual and it was ultimately felt that the incident may have been associated with the one reported by Dr Dethlefsen which had occurred in an area to the south of this area.
- 9.3 The Working Group discussed the question of the possible association between low concentrations of dissolved oxygen and the occurrence of unusual plankton blooms. Although low dissolved oxygen concentrations have been observed in several areas where plankton blooms have occurred, the connection between the two observations is not certain. Furthermore, in terms of the conditions which promote the occurrence of unusual plankton blooms, the role of nutrients is uncertain although hydrographic conditions appear to be important. Noting that the subject of "plankton blooms, their causes and effects on fisheries and ecosystems" would be the theme of a Joint Session between the Marine Environmental Quality Committee and the Biological Oceanography Committee at the 1982 Statutory Meeting, the Working Group agreed to await the outcome of this session before deciding whether it should carry out any work on the subject.
- 9.4 Dr Bowers gave a brief presentation of the paper "Lead in the Marine Environment: An Overview" by Dr M. Waldichuk, Dept. of Fisheries and Oceans, West Vancouver, Canada (Doc. WGMPNA 1982/9/3). He stated that this overview would be considered in detail by the Marine Chemistry Working Group the following week.
- 9.5 Members made the following comments on the paper: (1) On page 5, in the second paragraph the statement concerning bioaccumulation is too broad; (2) On page 6, the last sentence in para. 2 must refer to human consumers; (3) the degree of bioaccumulation is very variable between



organisms - filter feeders are the most important organisms in terms of lead bioaccumulation, other organisms accumulate it to a lesser degree; (4) in certain areas, e.g., on Greenland, there can be unusual cases in which particulate lead is taken up by bivalves; (5) in some coastal areas, e.g., the New York Bight, >50% of the lead is associated with organic material. Dr Bowers agreed to convey these comments to Dr Waldichuk for his consideration.

- 9.6 In concluding the discussion on this paper, the Working Group agreed that this was an excellent review paper on lead and asked Dr Bowers to thank Dr Waldichuk for his very good work in preparing the paper.

10. RECOMMENDATIONS

- 10.1 The Working Group reviewed and adopted the recommendations which had been agreed during the course of the meeting and endorsed a recommendation for the next meeting of the Group. The Recommendations are given in Annex 7.

11. ACTION LIST

- 11.1 The Working Group reviewed and accepted the Action List for intersessional work as attached as Annex 6.

12. CLOSURE OF MEETING

- 12.1 On behalf of the Group, the Chairman thanked the Swedish hosts, the National Board of Fisheries, and, especially, Dr Stig Carlberg and Ms Eva-Gun Thelén for their excellent meeting arrangements and assistance. The Chairman closed the meeting at 12.30 hrs on 29 January 1982.

ANNEX 1

ICES WORKING GROUP ON MARINE POLLUTION BASELINE AND MONITORING  
STUDIES IN THE NORTH ATLANTIC

Göteborg, 26-29 January 1982

AGENDA

1. Opening of Meeting
2. Adoption of Agenda
3. Actions of Council and ACMP, and other Related ICES Activities
4. General Consideration of other Related International Activities
5. BIOLOGICAL EFFECTS MONITORING
  - 5.1 National Reports on Methods Currently in Use
  - 5.2 Results of Co-operative Pathobiology Monitoring Studies
  - 5.3 Development of Protocols for Biological Effects Monitoring
6. POLLUTANT MONITORING
  - 6.1 1980 Co-ordinated Monitoring Report
  - 6.2 Intercalibration Exercises
  - 6.3 Review of National Priorities in the Choice of Contaminants for Monitoring
  - 6.4 Implementation of Co-operative Monitoring Studies of Contaminants in Biota
  - 6.5 Sediments
  - 6.6 Water
  - 6.7 Inputs
7. REGIONAL ASSESSMENT
8. Future Work
9. Any other business
10. Recommendations
11. Action List
12. Closure of Meeting

ANNEX 2

PARTICIPANTS LIST

<u>Name</u>	<u>Address</u>
Dr. G. Berge	Institute of Marine Research P.O.Box 1870 N-5011 Bergen Nordnes NORWAY
Dr. J. M. Bewers	Bedford Institute of Oceanography P.O.Box 1006 Dartmouth, Nova Scotia B2Y 4A2 CANADA
Dr. Stig Carlberg	National Board of Fisheries Institute of Hydrographic Research P.O.Box 2566 S-403 17 G8teborg SWEDEN
Dr. V. Dethlefsen	Institut für Küsten-und Binnenfischerei Toxikologisches Labor. Niedersachsenstrasse, 219 Cuxhaven FEDERAL REPUBLIC OF GERMANY
Mr. Ingemar Gustavsson	National Swedish Environment Protection Board Coastal Research Laboratory P.O.Box 8043 S-750 08 Uppsala SWEDEN
Mr. M. Munk Hansen	Grønlands Fiskeriundersøgelser Tagensvej 135 2200 Copenhagen Ø DENMARK
Mr. H. W. Hill	Directorate of Fisheries Research Fisheries Laboratory Lowestoft, Suffolk NR33 0HT UNITED KINGDOM
Dr. Arne Jensen	National Agency of Environmental Protect. Marine Pollution Laboratory Kavalergaarden 6 2920 Charlottenlund DENMARK

<u>Name</u>	<u>Address</u>
Dr. (Ms) Mia Kerkhoff	Netherlands Institute for Fishery Investigations Postbus 68 1970 AB IJmuiden NETHERLANDS
Prof. R. Lange	F.O.H./NAVS Munthesgate 29 Oslo 2 NORWAY
Mr. Hans Lassen	Danmarks Fiskeri- og Havunder- søgelser Charlottenlund Slot 2920 Charlottenlund DENMARK
Ms. C. Lima	Inst. Nacional de Investigaçã das Pescas Av. Brasilia 4 1400 Lisbon 3 PORTUGAL
Dr. A. D. McIntyre	Marine Laboratory P.O.Box 101, Victoria Road Aberdeen AB9 8DB SCOTLAND
Dr (Ms) M. O'Sullivan	Dept. of Fisheries and Forestry Fisheries Research Centre Abbotstown, Castleknock Co. Dublin IRELAND
Dr. K. H. Palmork	Institute of Marine Research P.O.Box 1870-72 N-5011 Bergen-Nordnes NORWAY
Dr. M. Parker, <u>Chairman</u>	Fisheries Research Center Dept. of Fisheries and Forestry Abbotstown Castleknock Co. Dublin IRELAND
Dr. (Ms) J. Pawlak, <u>Rapporteur</u>	International Council for the Exploration of the Sea Palægade 2 1261 Copenhagen K DENMARK

<u>Name</u>	<u>Address</u>
Dr. J. Pearce	Sandy Hook Laboratory NMFS/NOAA P.O.Box 428 Highlands, N.J. 07732 U.S.A.
Dr. J. Piuze	Fisheries and Oceans P.O.Box 15500 901 Cap Diamant Quebec, P.Q. G1K 7Y7 CANADA
Dr. J. E. Portmann	Fisheries Laboratory Remembrance Avenue Burnham-on-Crouch Essex, CMO 8HA ENGLAND
Dr L Reutergårdh	National Swedish Environment Protection Board Special Analytical Lab. S-106 91 Stockholm SWEDEN
Mr. G.N.M. Stokman	Rijksinstituut voor Zuivering in Afvalwater P.O. Box 17 8200 AA Lelystad NETHERLANDS
Ms Eva-Gun Thelén	National Board of Fisheries Inst. of Hydrographic Research P.O.Box 2566 403 17 Göteborg SWEDEN
Dr. J. F. Uthe	Resource Branch Fisheries and Oceans P.O.Box 550 Halifax, N.S. B3J 2S7 CANADA
Dr. W. Vyncke	Station de Pêche maritime Ankerstraat 1 8400 Oostende BELGIUM

OSLO COMMISSION - PARIS COMMISSION

JOINT MONITORING PROGRAMME

Form to be used for reporting the concentration of mercury, cadmium and PCBs in fish and shellfish

To be submitted to the ICES Secretariat by 30 June 1982

- (a) JMG area .....  
 (b) species .....  
 (c) size (range and mean) .....  
 (d) catching date ..... (g) no. of individuals in sample .....  
 (e) parameter ..... (h) method of analysis .....  
 (inc. extraction procedure and detection limit).  
 (f) name of laboratory ..... (j) objective.....  
 (k) date of analysis .....

ANNEX 3

<u>Results</u>	average	range	standard deviation	aggregate sample*	duplicate*
<u>muscle tissue</u>					
mg/kg wet weight					
mg/kg dry weight					
mg/kg fat					
<u>liver</u>					
mg/kg wet weight					
mg/kg dry weight					
mg/kg fat					
<u>percentage fat in organism**</u>					

NOTES : The procedures to be followed for the sampling and preparation of fish and shellfish are those contained in Annex II to the 1978 Report of the ICES Advisory Committee on Marine Pollution to the Oslo Commission, the Interim Helsinki Commission and the Paris Commission.

\* These columns to be used if it is not practicable to analyse each individual separately.

\*\* If information is not given on the basis of muscle tissue and liver.

#### ANNEX 4

### STRATEGY FOR MONITORING THE BIOLOGICAL EFFECTS OF POLLUTION<sup>\*</sup>

There are several possible monitoring objectives: for input control; the protection of human health; the determination of spatial and temporal trends in contamination and its effects on the ecosystem; the provision of environmental management data. Constraints of time and resources often make it necessary that a single monitoring exercise subserve several requirements, but the programme, whether single or multi-purpose, may usefully be built up according to a consistent strategy that will enable the requirements of different objectives to be identified and appropriate techniques used.

In developing such a strategy, the Working Group recognized three phases:

- Phase I      identification: detecting a change in time and/or space;
- Phase II     quantification: establishing the degree or extent of the change;
- Phase III    causation: determining the cause of the observed change.

The recognition of these phases is important because techniques appropriate to one phase will usually be less appropriate to another. For example, it has been pointed out that many of the readily observable biological changes can be produced by a wide variety of causes, not all related to pollution, but by selecting a suite of non-specific biological effects measurements, changes from the normal state, however caused, can be quickly identified and quantified. On the other hand, the measurement of biological effects specific to one particular pollutant will not identify effects produced by other pollutants.

These phases may be regarded as a temporal sequence of discrete investigations for monitoring biological effects of pollution. It should be noted that in many cases (for example, when hot-spots are already known) phase I, which concentrates on chemistry and involves biology largely to detect a signal, may have been accomplished before the start of the investigation. It is then possible to begin with phase II. At each phase, techniques could be used to increase the precision or sensitivity before the next phase was entered into. Furthermore, at any point within this strategy, an evaluation of the situation based on scientific or economic considerations could indicate that further investigation is unwarranted.

#### Implementing the strategy

We may now examine how the variables evaluated in the earlier sections can be drawn into this framework to produce practical guidelines for a monitoring programme. It is useful for descriptive purposes to consider spatial and temporal aspects separately, although the components of both are essentially the same.

Phase I. In the context of spatial variability, the identification phase is concerned with mapping potential or actual effects and thus pinpointing "hot-spots" of pollution. This allows the effort in the later phases to be concentrated at those sites where biological effects are most likely to occur.

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\* Taken from:

IMCO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). 1980 Monitoring biological variables related to marine pollution. REP. Stud. GESAMP (12), pp.13-16.

Potential "hot-spots" of effects can be inferred from the distribution of contaminating inputs and from areas with elevated levels of contaminants in water, sediment and biota. Increased resolution may be achieved using chemical analysis of sessile suspension feeders of wide geographical distribution (such as Mytilus); mobile species (such as fish) may also be used but they provide poorer resolution. Spatial discrimination by these methods can be very high.

Biological variables in phase I must be sensitive and precise. That is, they should be responsive to very slight changes in the chemical composition of their environment but, at the same time, they should be capable of precise measurement and discrimination against normal variability - they should have a high "signal to noise" ratio. Also, to be useful on a wide scale, they should be cheap and generally applicable. The incidence of abnormal morphological and pathobiological conditions in fish, as defined earlier, appears to be highly suitable for broad-scale discrimination and over long time periods. Bioassays of sea water samples, although probably subject to greater temporal variability, fulfil all other requirements, and resolution can be increased merely by increasing the intensity of the sampling grid. Observations on lysosomal stability of the bioassay organisms can also be a useful additional technique.

Phase II. The demonstration of a "hot-spot" by the above-mentioned procedures does not of itself indicate biological damage. Confirmation and quantification is then required, and this constitutes phase II, which relies on the examination of more ecologically significant variables. Since one purpose of biological monitoring is to ascertain the health of the ecosystem, gross measurements at community level are important. This approach would have been advocated in phase I but for its relatively high cost, for its insensitivity, and for the problems of interpretation. The Working Group endorsed the conclusion reached by the Ecological Panel of the ICES Workshop on Pollution Effects Monitoring, that analysis of the benthic and epibenthic communities, including littoral communities, is likely to be more cost-effective than plankton work. As indicated earlier, however, the case for detailed analysis of benthic communities in a monitoring role is not yet proven, and the Working Group recommends that only gross measures such as total abundance, total biomass, etc., be done initially. To obtain increased sensitivity, it is recommended that general physiological measurements, such as scope for growth and biochemical measurements, be made.

Phase III. At this stage it may be possible to ascribe the causes (where these are not already known) of any effects using circumstantial evidence, and this can be enhanced by increased chemical sampling, with specific analyses using advanced techniques. It may be noted that phase III requires a rather different type of chemistry from that likely to be used in phase I. The later phases are concerned with quantification and with understanding dose/response relationships so that knowledge of the speciation of chemicals and of their partition in different biological compartments is needed. Bioassays on seawater samples modified in specific ways to alter their chemical quality is a relevant biological approach, and it is at this stage that the extensive use of laboratory experiments on the effects of substances (i.e., retrospective testing) becomes particularly useful.

For a limited number of substances, or types of substances, specific biological effects can be sought, but it should be noted that effects will often be produced by the interactions of numerous contaminants rather than by single substances acting alone.

The essential aspects of the strategy are set out in the following Table.



## ELEMENTS IN STUDYING THE DISTRIBUTION OF BIOLOGICAL EFFECTS

- Phase I      Identification:      Distribution of known inputs:
- chemical analyses of water, sediment and biota;
  - selected bioassay of organisms (e.g., estimates of lysosomal fragility);
  - elevated incidence of morphological/pathological abnormalities in fish populations;
  - bioassay of surface/deep water with oyster/echinoderm larvae, hydroids.
- Phase II      Quantification:      To be implemented on detection of spatial variability of any phase I determinations. In order:
- survey of benthic community structure;
  - survey of benthic population parameters;
  - physiological indices (e.g., scope for growth) in selected widespread species (e.g., Crassostrea, Mytilus);
  - biochemical indices in above-mentioned species.
- Phase III      Causation:      To be implemented on confirmation of significant effect assessed by the above-mentioned procedures:
- by specific chemical analyses of water, sediment, biota for suspected contaminants;
  - bioassay, with specific chemical modifications to water samples.
  - biochemical techniques specific to chemicals or chemical classes.

Temporal aspects. Study of changes in intensity with time is concerned with establishing trends. This can be done: (i) in conjunction with a spatial mapping exercise to demonstrate changes in geographical distribution, one spatial survey identifying the distribution being repeated on an appropriate time sequence; or (ii) by repeated observations at the same site to demonstrate station-specific trends. The approach can clearly be applied over various time scales, depending on the nature of the contaminant inputs.

The strategy for determining temporal changes is similar to that for spatial changes as set out in Table 2, except that the objectives become the identification of changing inputs, changing levels of chemicals in the environment, changing incidences of morphological modifications in fish, and changing size and frequency of hot-spots. The use of bioassays provides a good basis for measuring changes in water quality, as long as a suitable baseline such as synthetic sea water can be established. In such work, variations in water quality due to seasonal influence, blooms, changes in coastal run-off, etc., must be taken into account. An adequate trend-monitoring study will require a suite of biological procedures covering, in particular, sensitivity, causation and ecological relevance, drawn from the possibilities listed under phases II and III of the spatial study.

### Geographical scales

Application of the strategy will vary, depending on the geographical scale, and in general three ranges may usefully be recognized. First, at the local level, one can think in terms of point-source pollution from individual discharges or of localized hot-spots on dumping grounds or around industrial terminals, where the details of the input may be known and the strategy may therefore be more finely focused. The Working Group discussed this aspect, but in view of its terms of reference, concentrated on the second level: the regional, which will encompass the sum of the effects of the local-scale pollution and include diffuse inputs from land and river run-off and from the atmosphere.

At the third level, the global scale, the Working Group concluded that there was sufficient reason to modify its strategy with respect to open oceans.

There is increasing evidence that the division between estuarine and shelf waters, on the one hand, and the open oceans, on the other, is surprisingly firm in that "leakage" of pollutants between the two is slight. Since most of the inputs of contaminants are to shelf waters (by main rivers, land run-off, direct discharge), it is to be expected that biological effects will occur in these regions more quickly than in the open oceans. Accordingly, the greater proportion of monitoring effort should be concentrated on these shelf waters.

ANNEX 5

STATISTICAL CONSIDERATIONS FOR TIME TREND  
MONITORING WITHIN THE ICES COOPERATIVE  
MONITORING STUDIES PROGRAMME

The members of the former ad hoc group of statisticians who were present at the WGMFNA meeting gathered for several hours on Wednesday, 27 January 1982 to discuss further developments in the statistical considerations for trend monitoring.

The following persons were present: Mr H. Hill (UK), Dr A Jensen (Denmark), Mr H Lassen (Denmark), Dr M Munk Hansen (Denmark) and Dr J Uthe (Canada).

The objective of the discussion was to review the guidelines laid down in the "Six-Year Review of the ICES Coordinated Monitoring Programme in the North Atlantic" and possibly amend and extend them. Furthermore, the "state-of-the-art" was discussed and some minor future tasks were agreed upon.

In its discussions, the group bore in mind that its concern was time trend monitoring - objective 3 of the ICES Cooperative Monitoring Studies Programme. After reviewing the guidelines in the "Six-Year Review.....", the group proposed the extensions and clarifications as given in the appendix to this report.

The group identified two gaps in the guidelines which the WGMFNA was asked to discuss and possibly fill. The guidelines should include

- (1) A minimum list of biological variables which should be collected when sampling for time trend monitoring, e.g.:
  - total length
  - total weight
  - liver weight (when contaminants in liver are determined)
  - sex (when applicable)
  - age
  - % extractable lipid

Furthermore, the group would prefer to see as many additional variables as possible recorded.

- (2) A list of contaminants and the relevant tissue(s) which should be analysed for each contaminant.

The group recommended that WGMFNA discuss the issue of which institutes are planning to do what work, with which species and from where the fish and mussels are to be sampled.

### Length Stratification

The main finding from the statistical analyses presented to WGMPNA and the Council Meetings (MEQC) over recent years is the gain in precision which can be obtained from stratification using biological variables. These relevant stratification variables have been identified from multiple linear regression analysis. Although several biological parameters have been shown to be significant as stratification variables in different materials, length appears to be the only parameter which is simple to apply at sea and which shows up as being significant in most analyses. The group therefore suggests that length stratification be adopted and implemented throughout the ICES Cooperative Monitoring Studies Programme when sampling fish for time trend analysis.

Much discussion has been devoted to whether simple linear or log-linear (multiplicative) models give the better fit. Analyses presented and general experience with some data sets suggest little preference within the current "state-of-the-art" for one or the other model. General experience with other fish and other types of data may indicate preference for the log-normal model and the group suggests that the log-normal model be adopted until data are available to disprove this assumption. As the length dependence of the contaminant level is not well understood, sampling should keep the length-contaminant relationship under constant surveillance, i.e., the entire length range should be covered evenly. The length range should be defined from practical considerations, the lower bound ensuring that enough tissue is available for chemical analysis and the upper bound such that at least 5 fish in the largest length interval can readily be found. The length stratification should be determined in such a way that it can be maintained over many years. The length interval should be at least 2-3 cm in size.

The group suggests that the length range be split into 5 length intervals which are of equal size after log transformation. For example, if the length range is 20-70 cm, then the interval boundaries could be (rounded to 0.5 cm) as follows:

<u>cm</u>	<u>No.of fish</u>	<u>Log upper - log lower</u>
20.0 - 25.5	5	.243
25.5 - 33.0	5	.258
33.0 - 42.5	5	.253
42.5 - 54.5	5	.249
54.5 - 70.0	5	.250
<hr/>	<hr/>	<hr/>
total	25	

The group suggests that care be taken that samples are not unduly clustered within each stratum (length interval). One should be aware that more length intervals could be used and that the test of the hypothesized contaminant-length relationship becomes stronger if the lengths are evenly distributed. But the item of major importance is to keep the length stratification identical from one year to the next.

Intercalibration of Computer Program Packages for Statistical Analysis (1.round)

It has been observed that results obtained with different software on different computers sometimes differ. In most cases, these differences are of minor importance, but the accuracy and resolution of the packages need investigation. The group therefore suggests that individual laboratories carry out multiple regression analysis on the Canadian Cod data previously distributed using the software available. The results should be sent to Hans Lassen, Danish Institute for Fisheries and Marine Research, Charlottenlund Slot, DK-2920 Charlottenlund, Denmark, who will summarize these results for the Statistics Committee session at the 1982 Council Meeting.

The models to be run are:

$$\begin{aligned} 1. \log_e(\text{contaminant}) = & \beta_0 + \beta_1 \times (\text{year} - 1978) \\ & + \beta_2 \times \text{age} \\ & + \beta_3 \times \log_e(\text{length}) \\ & + \beta_4 \times \log_e(\text{total weight}) \\ & + \beta_5 \times \log_e(\text{liver weight}) \\ & + \beta_6 \times \log_e(\% \text{ extractable muscle fat}) \\ & + \beta_7 \times \log_e(\% \text{ extractable liver fat}) \end{aligned}$$

$$\begin{aligned} 2. \log_e(\text{contaminant}) = & \text{model 1} + \\ & (\text{year} - 1978) \times \left[ \beta_{12} \times \text{age} \right. \\ & + \beta_{13} \times \log_e(\text{length}) \\ & + \beta_{14} \times \log_e(\text{total weight}) \\ & + \beta_{15} \times \log_e(\text{liver weight}) \\ & + \beta_{16} \times \log_e(\% \text{ extractable muscle fat}) \\ & \left. + \beta_{17} \times \log_e(\% \text{ extractable liver fat}) \right] \end{aligned}$$

All data elements should be included (i.e., do not delete outliers).

## APPENDIX

The following sentences should be included in the "Six-Year Review of the ICES Coordinated Monitoring Programme in the North Atlantic".

### Appendix I SAMPLING

Samples to meet objective 3.

- (a) The paragraph stands as it is with the following addition:

The stratification should be based upon an equidistant logged length interval, i.e., the log (upper bound) minus log (lower bound) should be equal for each length interval. The length range of the entire sample should be selected so that the individuals in the lower bound yield sufficient tissue for the chemical analyses, while the upper bound should be selected such that at least 5 fish can readily be found in the sampled catch. The length range should be divided into 5 (or more) length intervals of equal size (after log transformation). Once the length stratification for a particular species and area has been agreed this stratification should be strictly adhered to for a number of years. No length interval should be less than 2-3 cm. If the length range is smaller than 2-3 cm, the species is not ideally suited for the proposed analysis.

- (c) Replace "site" by "areas and from the same stock" in line 1.

Add new paragraph

- (e) The species of interest can only be selected in the light of information on fish stock composition and history and the known or perceived problems which define national priorities. It is preferable to use a species which continues to grow throughout its life. Species which are of particular interest in an ICES context are

Cod or Hake  
Plaice  
Flounder  
Mackerel (Scomber scombrus)  
Mussels  
Shrimps

but data relating to other species are also required.

### Storage and Pretreatment of Samples Prior to Analysis

Amend (a) to read:

The following biological variables should always be recorded when sampling for time-trend analysis purposes:

Age

Total weight

Total length

Liver weight when contaminants in liver are determined. (If  
another fatty organ is used the weight should  
be recorded)

Sex

)

Degree of sexual maturation

)

where applicable

ANNEX 6

ACTION LIST

The following activities were agreed by the Working Group members listed. For items for which all members are requested to send information, null reports should be sent by members who have no information. Unless otherwise indicated, all written reports should be sent to the ICES Environment Officer to arrive no later than 15 November 1982 so that they may be circulated in good time before the next meeting.

1. All members utilizing primary production measurements in environmental programmes should report on their results and on the usefulness of the technique in biological effects monitoring (Para. 5.1.6).
2. All members should ask colleagues for papers and information on studies using benthos to monitor dumping grounds and other areas receiving significant inputs; an evaluation of the usefulness of these techniques should also be made (Para. 5.1.11).
3. All members should request colleagues to prepare brief, succinct reports on the results of the use in their countries of biological monitoring techniques described in the Beaufort and GESAMP reports, providing an evaluation of the usefulness of the technique in relation to the three elements of the GESAMP strategy (Para. 5.1.12 and 5.3.7).
4. All members should submit data on the incidence of fish and shellfish diseases and parasites in their area to the ICES Secretariat by 1 December 1982 (Para. 5.2.2 and C.Res. 1981/4:6).
5. The Chairman should make contact with the Chairman of the Working Group on Pathology and Diseases of Marine Organisms to ensure co-ordination between the two Working Groups on matters related to pollution and disease incidence (Para. 5.2.6).
6. Members with additional data for the 1980 Coordinated Monitoring Report must submit them by 15 March 1982 and members with comments on the draft report must submit them by 28 March 1982 to the Environment Officer (Sec.6.1).
7. All members wishing to participate in the next intercalibration exercise on the analysis of PCBs should write to Dr J Uthe by 1 April 1982 (Para. 6.2.3).



8. Review papers on specific contaminants in the marine environment of the North Atlantic should be prepared as follows:

Dr Uthe. Dr Piuze	= Polynuclear aromatic hydrocarbons
Dr Portmann, Dr McIntyre	= Petroleum hydrocarbons
Dr Parker, Dr Jensen, Dr Dethlefsen, Dr Folkard (Lowestoft)	= Nutrients
Dr Bewers	= Zinc
Dr Kerkhoff	= HCB
Dr Uthe, Dr Reutergårdh	= Toxaphene

(Paras. 6.3.2 and 6.3.3)

9. Members with information on a "new" contaminant of concern to their country should submit a short report on this contaminant describing why it is a matter of concern to national authorities (Para. 6.3.4).
10. All members should submit their 1981 data for the Coordinated Monitoring Report to the ICES Environment Officer by 30 June 1982 using the form in Annex 3, if so desired (Sec.6.4).
11. Dr Portmann (Coordinator), Dr Jensen and Dr Pearce should draft plans for the baseline survey on contaminant levels in organisms and send the plans to all members for comment. Final proposals should be ready by 15 November 1982 (Para. 6.4.3).
12. All members devising schemes (or knowing of colleagues devising schemes) for trend monitoring using fish should send the detailed plans on this work to Mr H Hill for review and comment (Para. 6.4.7).
13. Dr Portmann, Dr Bewers and Mr Lassen should assist the ICES Environment Officer in defining the requirements of an ADP system within ICES to archive and process data on contaminants in biota. This information should be available by early May 1982 for consideration at the meeting of the Marine Data Management Working Group (Para. 6.4.12 and 6.4.13).
14. All members with access to an ADP system for processing pollution data should send a description of this system to the Environment Officer by 1 May 1982 (Para. 6.4.14).
15. Dr Jensen and Dr Portmann should serve as WGMPNA members of a planning group with MCWG to develop plans for a baseline study of trace metal concentrations in coastal and shelf waters in the North Atlantic (Para. 6.6.4).
16. Members from Norway have promised to send an English translation of the conclusions of the Skagerrak/Kattegat assessment report (cf. Para. 7.8).
17. Dr Parker, Dr Bewers, Dr Jensen, Dr McIntyre, Dr Pearce, Dr Portmann and the Environment Officer should prepare a draft set of guidelines for the development of preliminary regional assessments by 1 August 1982 for consideration at C.M. 1982 (Para. 7.9).

## ANNEX 7

### RECOMMENDATIONS

#### Recommendation 1

Taking into account the interest of the ICES/SCOR Working Group on the Study of the Pollution of the Baltic in the conduct of a similar baseline survey, the Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic recommends that a geographical baseline study of contaminant concentrations in fish and shellfish be conducted as a unified exercise in the Baltic Sea and the North Atlantic in 1985.

#### Recommendation 2

Noting that the outcome of the 5th Round Intercalibration for Trace Metals in Sea Water (5-18 September 1982) is expected to permit the conduct of the baseline study of metals in the coastal and shelf waters of the North Atlantic area and further noting the possibility of interfacing with the IOC Open Ocean Baseline Study which is expected to take place in 1985, the Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic recommends that approval in principle be given to the conduct of a baseline study for metals in coastal and shelf sea waters in 1985 and that detailed planning to implement this study commence as soon as practicable.

#### Recommendation 3

The Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic recommends that ICES member countries be encouraged to commence the assessment of gross river inputs of trace metals and organo-chlorine compounds to the marine environment according to the agreed guidelines taking particular account of quality control procedures and to report the results to ICES.

#### Recommendation 4

Noting that the logical continuation of the marine pollution baseline and monitoring work conducted in the North Atlantic since 1974 is an assessment of the state of health of the marine environment of this area and noting further the example provided by the assessment of the effects of pollution in the Baltic Sea conducted under the Helsinki Commission with the assistance of ICES, the Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic recommends that regional assessments be conducted on the health of various coastal areas of the North Atlantic. It is recognized that to accomplish such assessments, the expertise of physical oceanographers, chemists, and biologists from the countries bordering the various regions of the North Atlantic will be needed and member countries are encouraged to facilitate the participation of such experts in assessment projects.

Recommendation 5

The Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic recommends that the Group meet for four days in 1983 the week after the MCWG meeting to consider

- (a) progress in coordinated monitoring studies, including plans for the baseline survey of contaminant levels in organisms,
- (b) progress in biological effects studies,
- (c) papers on "new" contaminants,
- (d) the implementation of regional assessments of the health of the marine environment.

