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International Council for the
Exploration of the Sea

C.M.1981/E:33
Marine Environmental
Quality Committee

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

Nantes, 23 - 26 February

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1. OPENING OF MEETING

The Chairman, Dr M. Parker, opened the meeting at 9.30 hrs on 23 February 1981 and welcomed the members. Professor C. Maurin, Director of the Institut Scientifique et Technique des Pêches Maritimes, which hosted the meeting, welcomed the participants to his Institute and provided information about it and the town of Nantes.

2. ADOPTION OF AGENDA

The draft agenda was considered and it was agreed that Agenda Item 6.8 on the use of marine mammals as indicators should be eliminated and the topic considered under Agenda Item 12. With this amendment, the agenda was adopted and is attached as Annex 1. The list of participants is given in Annex 2. The ICES Environment Officer served as Rapporteur.

3. ACTIONS OF COUNCIL AND ACMP

The Working Group took note of the relevant resolutions from the 1980 Statutory Meeting, including (1) the establishment of a new Working Group on Marine Sediments in Relation to Pollution (C. Res. 1980/2:1), (2) the establishment of a new series of leaflet publications,entitled "Techniques in Marine Chemistry", (C. Res. 1980/1:3), and (3) the publication in the Cooperative Research Report series of selected review papers and summaries of other contributions presented to ICES on the Marine Environmental Quality Committee's theme of water quality and transport of materials in coastal and estuarine environments, as edited by Dr J.B. Pearce (C.Res.1980/1:5).

4. GENERAL CONSIDERATIONS OF OTHER RELATED INTERNATIONAL ACTIVITIES

4.1. MEQC

Dr Pearce, the new Chairman of the Marine Environmental Quality Committee, provided information on the types of papers presented and the discussions held at the 1980 meeting of the Committee. He noted that the special theme for the 1981 meeting will be the biological effects of pollution, including the relationships between pollution and diseases in marine organisms. Other important topics will be estuarine studies, habitat improvement and the impact of pollutants on marine mammals.

4.2. MCWG

4.2.1. The Working Group was informed that, in order to implement the decision to publish a series of leaflets on "Techniques in Marine Chemistry", three editorial boards had been established, on the subject of nutrients, trace metals and organic substances. The MCWG hoped to have several leaflets ready for publication before the end of the year.

4.2.2. It was agreed that other relevant issues from the recent meeting of the Marine Chemistry Working Group could best be discussed under later items of the agenda.

4.3. ICES/SCOR Working Group on the Study of the Pollution of the Baltic

The major activities of this Group were noted as follows: (1) a finalisation of the work-up of data from the Baltic Open Sea Experiment (BOSEX), (2) the conduct of studies on patchiness in the distribution of physical, chemical and biological properties in the Baltic Sea, (3) studies on the biogeochemical cycling of substances and related modelling activities, and

(4) studies of the biological effects of pollution, especially pathobiological effects.

5. GENERAL CONSIDERATIONS OF OTHER RELATED INTERNATIONAL ACTIVITIES

5.1. GESAMP

The Group was informed that at its last meeting GESAMP (IMCO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution) approved reports on the interchange of pollutants between the atmosphere and the oceans, on monitoring biological variables related to marine pollution, and on the effects of coastal zone development. The main activity of GESAMP at present is the development of a statement on the health of the oceans, which should be completed next year.

5.2. IOC/GIPME/IGOSS

5.2.1. It was noted that, although GIPME (the Working Committee on the Global Investigation of Pollution in the Marine Environment) has not met since 1979, a sub-group of it, GEMSI (Group of Experts on Methods, Standards and Intercalibration), had been carrying out some work which was very relevant to that of ICES. Dr Bewers briefly summarized the main recent activity under GEMSI, the intercalibration workshop on Bermuda, which had studied the effects of the use of different water samplers and sampling wires on the concentration values obtained for trace elements and PCBs in open ocean waters. He noted that, although ICES had not formally participated in this intercalibration, many laboratories from ICES member countries had taken part and the plans developed by the MCWG for the ICES fifth round intercalibration on trace metals in sea water had been invaluable in developing the programme of the IOC experiment. Dr Bewers reported that as an extension of the Bermuda Workshop, IOC was now developing plans for a baseline survey of trace elements in sea water in the North Atlantic area.

5.2.2. The Working Group was very interested in this proposed baseline study and asked Dr Bewers to prepare a written summary of the plans for the study for distribution in advance of the next meeting.

5.3. Oslo and Paris Commissions (JMG)

5.3.1. The Group was informed that the 1980 report of the Advisory Committee on Marine Pollution had been considered by the Joint Monitoring Group (JMG) of the Oslo and Paris Commissions at its meeting in May 1980. The JMG had expressed its appreciation of the work conducted for it by ICES and had proposed a work programme for ICES for 1981.

5.3.2. The Group was further informed that a meeting had taken place between the Chairmen and Vice-Chairmen of the Oslo and Paris Commissions and the relevant Chairmen of ICES groups to consider possible overlaps in the monitoring programmes of the two organisations. At that meeting it had been concluded that there was little actual overlap between the two programmes, but it could be useful to develop a common data reporting format.

POLLUTION MONITORING

6. THE USE OF BIOLOGICAL INDICATORS/COORDINATED MONITORING PROGRAMME

6.1. Statistical Aspects

6.1.1. Mr. H. Lassen, Chairman of the ad hoc group to consider statistical aspects of the use of biological indicators, reported on the results of the meeting which had been held on 20-21 February 1981. Prior to the meeting, the statisticians had received two sets of monitoring data to analyse: a set of Canadian data on the concentrations of trace metals and organochlorines in length-stratified cod and a set of UK data on organochlorine concentrations in herring. The ad hoc

group meeting began with a discussion of the aims of the coordinated monitoring programme and then focussed in on the determination of trends in the concentrations of contaminants in fish. Mr. Lassen reported that the ad hoc Group had been unable to agree on any one method to be used in the statistical analysis of data for trends, because the form of the relationship between contaminant levels and biological variables (age, length, weight, etc.) is not known, nor is it known whether the dependent variable is normally, log normally or otherwise distributed in specific areas or species. Nonetheless, Mr. Lassen reported that participants using different techniques had all arrived at similar results in terms of the significance of the biological variables for each contaminant. Concerning the type of statistical sampling to be used for the determination of trends, the ad hoc Group recommended that, because the relationships among biological variables (age, length, weight) are reasonably well known, it should only be necessary to take stratified length samples. The length samples should be taken over as large a range as practicable in order to improve the precision of the regression analysis, whichever type is used.

6.1.2. Mr Lassen further reported that, as requested by members of the WG MPNA, the ad hoc group agreed that a graph of the minimal detectable increase plotted against the number of fish sampled for specified sampling programmes would give useful guidance toward an optimal sampling scheme. Thus, the ad hoc group had prepared one illustrative graph, concerning PCB levels in herring muscle, and agreed to produce similar graphs for other contaminants and for other sampling schemes.

6.1.3. Concerning the future of this work, Mr Lassen stated that the ad hoc group felt that it could give further input to WG MPNA and thus proposed that it continue its work by correspondence. It further recommended that a centralised computerized data bank be established at ICES to hold all available data collected under the coordinated monitoring programme. These data should be distributed to interested statisticians for analysis so that future modifications to the monitoring programme may be developed.

6.1.4. The Working Group thanked Mr. Lassen and the other members of the ad hoc group of statisticians for their information and for agreeing to continue their work by correspondence. The Working Group then discussed the recommendations of the ad hoc group and agreed that, for monitoring programmes to determine trends in the concentrations of pollutants, the following sampling criteria should be observed:

(a) a sample of fish should consist of at least 25 individuals and preferably 60 or more, and
(b) the sample of fish should be stratified according to length, with the fish spanning as wide a length range as possible.

These changes should be implemented no later than in 1982. As previously recommended, the fish should be analysed individually and information should be obtained on as many biological parameters as practical, e.g., weight, age, sex, condition factor, liver somatic index.

6.1.5 The Working Group then turned to the sampling requirements for a monitoring programme with the purpose of determining the quality of marine foodstuffs with respect to human health. It was agreed that, since a mean value representing what is normally consumed is all that is necessary to determine whether there is any risk to human health, it is not necessary to analyse the fish on an individual basis. A sample should consist of 25 fish selected so as to represent the size distribution in the commercial catch. The fish should be pooled, with the pool normally consisting of equal amounts of muscle filet from each fish. However, in certain cases it may be considered advantageous to use amounts of muscle filet proportional to the size of the fish instead. When reporting data on pooled samples, the scheme for pooling should be described. The analyses should be done in duplicate on homogenized samples.

6.1.6. The Working Group then discussed the recommendation of the ad hoc group that a data bank be established in ICES to store and exchange data obtained in the coordinated monitoring programme. The Working Group supported the idea of a data bank, noting that it could be used to facilitate the analysis of trends in pollutant concentrations. It could also be used to compare intercalibration data with monitoring data to see how well they fit. Accordingly, the Working Group passed Recommendation 1 (see Annex 4).

6.2. Intercalibration Exercises in Biological Materials

6.2.1. Dr Portmann reported on the discussions of the results of recent intercalibration exercises at the MCWG meeting the previous week. Concerning trace elements, a sixth intercomparison exercise had been held in 1980 which had concentrated on lead and cadmium, the metals which had been shown by previous exercises to cause the most problems to analysts. The results of this exercise have shown that for cadmium at concentrations normally found in shellfish (about 1 µg/g dry weight), reasonably good results were obtained (a coefficient of variation of 17%). For lead, however, even at levels of around 2.5 µg/g, poor agreement was obtained among laboratories (CV 43%). The MCWG had felt that the only way to advance the state-of-the-art of lead analyses was to carry out experiments to identify the problem areas in the determination of lead in biological tissues. Accordingly, a sub-group had been set up to carry out this work.

6.2.2. Dr Portmann further reported that, owing to the poor results of the third intercalibration exercise on organochlorines, a fourth exercise had been held in 1980, concentrating mainly on problems in analysing PCBs. Some improvement had been noted in this exercise, but the MCWG had concluded that there were still severe deficiencies in the determination of PCBs. On the basis of the discussion in MCWG, it strongly advised that gas chromatography employing glass capillary columns be used for PCB analysis. Intersessional work will be conducted to study interlaboratory agreement using this method to quantify individual PCB compounds.

6.2.3. Information was also presented on the results of the first intercomparison exercise on analyses of petroleum hydrocarbons in marine samples. Three samples had been analysed: a slightly weathered crude oil, a contaminated sediment, and a mussel homogenate. The results were reported relative to a standard oil and indicated rather good agreement among laboratories using a UV fluorescence method of analysis. On the basis of this intercomparison exercise, the MCWG developed a recommendation to conduct a second intercomparison exercise and also outlined problems for intersessional study.

6.2.4. The MCWG had also discussed Doc. C.M. 1980/E:45 by Dr Topping and Mr. A. V. Holden, which summarized the results of the series of ICES intercalibration exercises which they had conducted and gave their personal evaluation of the present state of interlaboratory comparability of analytical results, namely, that the agreement among laboratories on the results of the analysis of single samples did not warrant the compilation and comparison of data from numerous laboratories. This paper had received much discussion in MCWG, which had ultimately agreed to transmit to WG MPNA tables giving information on what coefficient of variation (CV) has been obtained for what metal or organochlorine at what concentration. The MCWG was not happy with the CVs given in this table, but they felt that they needed guidance from WG MPNA on what concentrations of what substances must be analysed accurately for the monitoring programme and what standards are applicable.

6.2.5 The WG MPNA thanked Dr Portmann for this very useful information from the MCWG meeting. In the discussion, many members of WG MPNA expressed their dissatisfaction with the present level of accuracy of analytical data, noting in particular that in order to be able to compare data from area to area, the data need to be more accurate. It was pointed out as an example that, with a CV of $\pm$ 40%, results can be reported from 0.1 to 0.9 ppm. Thus, in comparing levels between areas

analytical (and sampling) differences can be responsible for apparent differences observed.

6.2.6. However, turning to the question posed by the MCWG concerning the concentration levels for each substance at which accurate data are needed, the WG MPNA felt that in terms of human health and probably also environmental protection the analytical results for copper, zinc, and mercury are reasonably good because the levels at which they can now be measured are below the levels of concern. For cadmium, the concentration levels in shellfish can now be measured reasonably accurately and there is probably no need to measure at lower concentrations for human health risk monitoring. Concerning lead, the situation is quite different and further work is needed to permit accurate measurements at low concentrations.

6.2.7. In summing up, the Chairman stated that, although the Working Group was not satisfied with the present level of accuracy of analytical data, the available techniques would continue to be used and a new intercalibration exercise should be held in several years' time to see whether better results can be obtained owing to improvements in methodology.

6.2.8. Regarding organochlorines, the Working Group noted that at present it must accept a coefficient of variation of $\pm$ 30% for PCBs and higher CVs for some of the other organochlorine compounds. The Working Group further noted that work is continuing to find ways to improve the accuracy of PCB analyses, especially by the use of glass capillary column gas chromatography to identify individual PCB compounds. The Group expressed its support for these studies and realized its own obligation to contribute to this work by encouraging studies on the toxicity of individual PCB isomers. The Group also requested the assistance of the Marine Environmental Quality Committee in stimulating studies on this subject.

6.2.9. Finally, the Working Group agreed that the results of the first intercalibration exercise on petroleum hydrocarbon analyses had shown that further work needs to be done before results can readily be compared between laboratories.

6.3. Review of National and International Programmes

6.3.1. The Chairman reminded the Group that at the last meeting it had been agreed that each member should prepare a short paper giving information on which pollutants are regularly monitored in which species (including which tissue) and in which areas. This was to have been sent to the ICES Environment Officer for compilation and distribution prior to this meeting. Information had been received before the meeting concerning programmes in Belgium, the Federal Republic of Germany, Ireland, the Netherlands, and the United States.

6.3.2. During the meeting, short information papers were given on the monitoring programmes in France, Northern Ireland, Portugal and Sweden and oral presentations were given on the programmes in Canada, Denmark, England/Wales, Greenland, Iceland, Norway, Scotland and Spain. Information was also provided on the Joint Monitoring Programme of the Oslo and Paris Commissions.

6.3.3. Having taken note of this information, the Working Group agreed that what was really needed was information on the priority substances for each country -- what are the problem substances of particular concern to each country? It was agreed that each member should prepare a short statement of priority substances, which should be sent to the ICES Environment Officer before 15 December 1981 for compilation and distribution prior to the 1982 meeting.

6.4 New Pollutants

6.4.1. Recalling that the Working Group should keep under review possible new pollutants

in the marine environment with a view to determining the need for including them in international cooperative monitoring programmes, the following substances were noted: phthalate esters, polychlorinated terphenyls (PCTs), toxaphene and organosilicons. The Group recommended that information be collected on these substances so that it would be possible to evaluate the necessity of making preparations to include any of them in a monitoring programme. Such preparations would involve the conduct of a bi- or tri-lateral intercalibration exercise on the analysis of an identified substance or class of substances, followed by an overall intercalibration exercise if the Working Group felt that wide-spread monitoring of this substance was warranted.

6.5. Report on the Use of Biological Indicators (Mussel Watch)

6.5.1. The Working Group discussed the use of biological indicators and the fact that it had originally been considered desirable that a critical review should be made of the papers which had been submitted to the 1978 Statutory Meeting. One of the objectives of this review had been the derivation of conclusions and guidelines on which further studies of the "mussel watch" type might be undertaken. Dr Portmann indicated that although a number of the reports, which it had been agreed at the 1980 meeting should be considered, had now been published, it had not been possible for him to make any progress on the review, either alone or with the other volunteers.

6.5.2. It was recognised that a variety of species other than simply mussels might be used in a "mussel watch" type of study and that such studies could now incorporate more than simply chemical measurements. Over the years, a considerable body of experience had been gained within the member countries of ICES in the course of national investigations of this type. A brief review of what had been undertaken in several of the countries represented at the meeting is attached to this report as Annex 3. Most participants indicated that they would derive no significant benefit from a review of the type originally planned. The published reports and their individual experience was sufficient to allow them to proceed with any further studies. Most members also indicated that they did not expect to conduct another large-scale "mussel watch" type survey and that their continuing efforts were being directed towards smaller geographical scale refinements of the study, especially in relation to previously detected "hot-spots". In many cases, the continuing "mussel watch" studies included physiological or biological effects type investigations and a number of members stressed that such studies were at least as important as the chemical observations. Since the on-going national studies are in most cases directed at the examination of particular problems, it was agreed that there was little point in attempting to compare experiences.

6.5.3. The Chairman drew attention to the fact that he had received a letter requesting liaison between ICES and a SCOPE Committee which would be meeting early in March 1981 to plan a second International Mussel Watch meeting, probably in the Far East during 1982. There was a general feeling that ICES could have a comparatively limited role to play in planning such a meeting, but that a brief statement of the ICES position and experience in ICES countries might be useful. It was accordingly agreed that this could be provided in the form of the text of this section of this report plus Annex 3.

6.5.4. As far as the ICES position was concerned, it was agreed that there was no requirement for a wide-scale coordinated mussel watch survey throughout the ICES area. Similarly, it was agreed that although national investigations of hot-spot areas were being undertaken in a number of countries, there was little point in attempting to coordinate these at ICES level. The level of experience now attained within the ICES countries obviates the need for any ICES coordinated critical review of "mussel watch" type studies. In this context, it was pointed out that much of the experience was summarised in the 1980 US National Academy of Sciences publication "The International Mussel Watch" and in the open literature

6.5.5. The Working Group also emphasised that many of the studies being undertaken in the ICES countries include biological effects studies alongside the purely chemical studies and drew attention to the fact that the combination of results provided more valuable information than purely chemical studies.

6.6. Review of First Five Years Data from CMP and the Aims, Objects and Methods for Future Co-ordinated Monitoring

6.6.1. It was recalled that at the previous meeting a first draft had been considered of a review of the experience gained in the first five years of the coordinated monitoring programme. The review had been prepared by Dr Portmann, who had revised it after the meeting for presentation to the 1980 meeting of ACMP. The ACMP had also requested several additions.

6.2. The Working Group reviewed the revised document on a page-by-page basis and made suggestions for amendments as a result of (a) the information from MCWG on the accuracy and precision of analyses of contaminants, (b) the recommendations from the pre-meeting of the ad hoc Group of statisticians, and (c) the results of the discussion on the use of mussels and other organisms as indicators of pollution.

6.6.3. The aims of monitoring stated in the paper were reviewed in detail, in order to reconsider the differences between the wordings used in this paper and those given in the report of the 1979 meeting of the Working Group as well as to ensure clarity in the meaning. The Working Group agreed that monitoring of contaminant levels in biota may be conducted for any of the following three aims:

(1) the provision of a continuing assurance of the quality of marine foodstuffs with respect to human health.

(2) the provision over a wide geographical area of an indication of the health of the marine environment in the entire ICES North Atlantic area.

(3) the provision of an analysis of trends over time in pollutant concentrations in selected areas, e.g., estuaries, coastal waters, especially in relation to the assessment of the efficacy of control measures.

6.6.4. Concerning objective number 2, the Group agreed that what was meant was the establishment of baseline data on a broad geographical basis in order to give a comparative picture of contaminant level differences and to check to make sure that more frequent monitoring is being carried out in the right areas, i.e., "hot-spots". Such geographical baseline studies would only need to be carried out every five years.

6.6.5. In the discussion of the third objective, it was agreed that the general purpose was to determine the trends in pollutant concentrations with time. Practical considerations would require that monitoring would be limited to the study of certain contaminants in certain species in selected areas. Ultimately, it might be useful to look at contaminant levels and their trends on a fish stock basis, but this was not yet possible.

6.6.6. It was agreed that each of the three aims of monitoring identified required a different approach. Thus, a set of methodological guidelines for each aim was developed for inclusion in an appendix to the final draft of the review of the coordinated monitoring programme. This new programme thus outlined should be called Cooperative ICES Monitoring Studies and should begin in 1982.

6.6.7. The Working Group recognised that the cooperative studies will be carried out according to national priorities concerning areas, contaminants and species. As a result, some divergence from the guidelines may be unavoidable. However, it

is believed that the guidelines represent the best procedures that can be recommended at the present time for the objectives identified; the guidelines have been developed drawing on more than five years of experience of ICES monitoring and experimental studies. Accordingly, it is strongly recommended that they should, as far as possible, be followed by all laboratories which contribute to the cooperative programme.

6.6.8. Data from studies carried out under these guidelines should be presented, at the recommended intervals, by each country together with a brief commentary on the significance of the results obtained in the reporting year as compared with previous years. These commentaries are regarded as essential for the data obtained to meet food quality/ public health and hot-spot trend determination aims and optional for the 5-year repeat survey aim.

6.6.9. The ICES Environment Officer will compile these national data sets into separate reports concerning food quality/public health studies, geographical baseline studies and trend monitoring studies and shall make use of the national commentaries to prepare commentaries to each report, adding any overall conclusions which may seem appropriate. These reports will be reviewed first by WG MPNA and thereafter by ACMP and will form the continuation of the series previously described as Coordinated Monitoring Programme Reports.

6.6.10. Data collected nationally using methods other than those recommended in the guidelines for cooperative studies may be reported separately to the WG MPNA in a brief written summary of national pollution baseline and monitoring programmes, in which emphasis should be placed on the criteria and strategy of the study (i.e., why it was done, what is the problem, how is it being handled, what are the implications).

6.6.11. The Working Group then discussed details of the sample which should be taken for objective number one and the means of pooling the tissues. It was agreed that the distribution of sizes of the fish sampled should reflect the size distribution of the commercially exploitable (marketable) portion of the catch of that species within that particular geographical area. This distribution may be determined from previous data or on board the vessel, but once having been established should only be amended if a significant change in the distribution can be demonstrated. In taking samples of fish muscle or liver from the full range of commercially exploited sizes, it is important to ensure that bulking or pooling of the tissues from each fish does not distort the careful selection of individuals representing the tissues consumed by humans. To avoid such distortion it is recommended that a full length fillet or the whole liver be taken from each fish and pooled. If bulking this total amount of fish is impractical, due to the large total amount of tissue obtained, a fixed percentage of each fillet or liver weight should be pooled (e.g., 10%). This sub-sample can be taken from a homogenate of each individual fillet or liver or by taking thin transverse sections distributed over the length of the fillet. When reporting data, analysts were requested to indicate whether they followed these recommendations and, if not, to state briefly the procedures used.

6.6.12. In closing the discussion on this item, the Working Group expressed its gratitude to Dr Portmann for his excellent work on this paper and approved it as amended for transmission to ACMP.

6.7. 1979 Coordinated Monitoring Report

6.7.1 The Environment Officer presented a draft report on the data obtained for the coordinated monitoring programme for 1979. Results had been submitted from Belgium, Canada, England/Wales, the Federal Republic of Germany, Ireland and the Netherlands. In comparison with previous years, the amount of information submitted in 1979 had been small in terms of the number of species sampled and the number of samples analysed for each species as well as in the number of geographical areas covered.

6.7.2 Mr Alzieu promised to send data on organochlorines in organisms from French coastal areas and Dr Jensen promised to send Danish data for samples from the Kattegat and parts of the North Sea. Dr. Carlberg agreed to check on whether appropriate Swedish data were available and Dr Gonzalez would check on Spanish data.

6.7.3. The Working Group agreed that all appropriate additional data should be added to the report. After suggesting several amendments, it approved the report for transmission to ACMP.

6.7.4. Concerning the future of these reports, the Group agreed that they should continue in the same format and under the same name for the 1980 and 1981 data. Beginning in 1982, however, the name and format should be altered to reflect the changes in the monitoring programme agreed in Section 6.6.

7. MONITORING IN SEDIMENTS AND WATER

7.1. The Uses of Sediment monitoring

7.1.1. The Chairman read the terms of reference of the new Working Group on Marine Sediments in Relation to Pollution (WG MS). He noted that this new group will have the responsibility to develop the techniques needed to monitor contaminant levels in sediments, but the actual establishment of a monitoring programme would be under the WG MPNA.

7.1.2. As the new WGMS was requested to work in close collaboration with the WG MPNA, among others, the Group considered what suggestions could be given to the WGMS on the development of its work programme. The WG MPNA felt that the WGMS should deal with practical matters rather than academic issues and should begin by concentrating on studies directly relevant to the possible use of sediments in monitoring marine pollution so that the question can be answered of how we can use sediments in international monitoring programmes. Additional types of investigations which are relevant include studies of sediment processes and behaviour in estuarine areas and studies of sediments in accumulation areas.

7.1.3. The Working Group then approved the following statement for transmission to the WGMS:

> The Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic recommends to the Working Group on Marine Sediments in Relation to Pollution that, as far as the second term of reference of this latter group is concerned, the first priority should be to identify those sedimentological research areas which are particularly relevant to monitoring the pathways and effects of pollutants in the marine environment. The Working Group on Marine Sediments is also requested to bear in mind particularly the questions outlined in para. 4.3.8. of the 1980 Marine Chemistry Working Group Report (Doc. C.M.1980/C:1). It is further recommended that the Working Group on Marine Sediments give some consideration at a future stage to problems of intercalibration of sediment analyses for metals, PCBs, etc., when required for the conduct of effective monitoring programmes.

7.1.4. It was noted that the Joint Monitoring Group of the Oslo and Paris Commissions is very interested in pollution monitoring of sediments and that an intercalibration exercise on sediment analyses has been conducted among some JMG laboratories. Thus, the WG MPNA asked the WGMS to take into consideration also the interests of the JMG on this subject and how ICES may assist JMG when the WGMS develops its own programme.

7.2. Intercalibration Exercises in Water

7.2.1. Dr. Portmann reported that this subject had been considered by the Marine Chemistry Working Group at its meeting the previous week but that no progress had yet been made on the fifth round intercalibration for trace elements in sea water owing to the lack of an offer for ship time to conduct the exercise.

7.2.2. The WG MPNA took note of the restated plans for this exercise and reiterated its strong support that this programme be carried out, so that important issues associated with sampling in shallow, nearshore waters may be resolved. The Working Group expressed its appreciation to the ISTPM for the offer of land-based laboratory facilities for this exercise and hoped that an offer for ship facilities would be forthcoming in the near future.

7.2.3. The Working Group noted that issues concerning sampling in open ocean waters were being studied by IOC and that laboratories in ICES member countries were making a valuable contribution to this work. However, the IOC work will not consider questions peculiar to nearshore zones and estuarine waters and thus there is a great need to conduct the ICES fifth round intercalibration exercise to resolve these important issues.

7.3. Aims and Objects of Water Quality Monitoring

The Chairman drew attention to C.Res. 1980/4:8, which encouraged the conduct of ad hoc intercalibrations of nutrient analyses on a regional basis, especially before beginning a multi-ship project. The results of such intercalibrations should be sent to ICES.

8. INPUTS AND COASTAL PROCESSES

8.1. Input Study

8.1.1. The Working Group was informed that no progress had been made on this subject since last year's meeting. It was agreed that the project should be carried out as had been agreed at last year's meeting using the same persons who had accepted last year to carry out this work (see ICES Doc.C.M.1980/E:4, Section 3).

8.2. Assessments of River Inputs

8.2.1. Recalling that the MCWG had been requested to prepare a paper on methodology for sampling gross inputs to the marine environment from rivers, the WG MPNA was informed that this project was not yet completed. The Working Group looked forward to seeing this paper at its next meeting.

8.3. Coastal Processes/Overviews

8.3.1. Representing the Marine Chemistry Working Group, Dr Portmann reported that two overviews on the distribution, behaviour and transport of substances in the marine environment had been considered and approved: one on PCBs and the other on cadmium. He stated that MCWG was quite willing to have other Working Groups review these overviews, but they were requested to state their comments in such a way that the origin of the comments was clear.

8.3.2. Dr Portmann then provided a summary of the PCB overview which he had prepared and its conclusions. The paper reviewed the structure and form of PCBs, their production and use, and the pathways by which they enter the marine environment. Based on PCB concentrations in the North Atlantic, overall concentration ranges were given for PCBs in the various compartments of the marine environment. In concluding his summary, Dr Portmann stated that the overviews are only intended to provide a quick view of the subject as they are aimed at administrators rather than scientists.

8.3.3. Dr Bewers briefly summarised the overview on cadmium in the marine environment, which he had prepared. This paper provided information mainly on the physical and chemical processes affecting the transport and cycling of cadmium in the marine environment; very little mention had been made of biological processes affecting cadmium.

8.3.4. Dr Jensen then informed the Group about the results of two Danish studies concerning cadmium. One study investigated the total use of cadmium in Denmark and its effects on human health and concluded that it was necessary to reduce the exposure of humans to cadmium. The other investigation concerned the ecotoxicity of cadmium in fresh and marine waters and concluded that cadmium presents less of a problem in marine waters than in fresh water ecosystems.

8.3.5. The Working Group expressed its great appreciation to Dr Portmann, Dr Bewers, Dr Jensen and the MCWG for the preparation of these overviews, which contained very useful information. It was hoped that overviews could be prepared on other substances, e.g., lead.

8.3.6. The Working Group then took note of a paper providing an extended summary of the 1980 Mini-Symposium on Transport Processes in Estuarine and Near-Shore Zones and was informed that, under C. Res. 1980/2:17, the Convener, Professor Kullenberg, had been asked to develop proposals for an expanded symposium or a special meeting on this subject in 1983 or 1984. The Working Group expressed its support for the proposal for a symposium on coastal zone processes, as made by Professor Kullenberg, and advocated that the symposium be as multi-disciplinary as possible. Processes of sediment transport, estuarine mixing, biological transport and uptake should be included in addition to the chemical aspects of estuarine transport and mixing.

8.4. Atmospheric Inputs

8.4.1. Dr. McIntyre informed the group that he had prepared a paper on this subject for the 1980 Statutory Meeting ("A note on the input of contaminants from the atmosphere to the sea", C.M.1980/E:47) in order to stimulate more interest in this subject, which has been recognised by ICES as very important (e.g., in C. Res. 1978/4:20). Since the Statutory Meeting, GESAMP Reports and Studies No. 13, "Interchange of Pollutants between the Atmosphere and the Oceans," has been published, which contains an extensive review of the subject along with guidelines for a measurement programme to determine air-sea fluxes. He noted that GESAMP is continuing its work on this subject.

8.4.2. In the discussion, the Working Group recognised the importance of the atmospheric deposition of pollutants to the sea as a route of input, especially in the open ocean. The Group thus reaffirmed the call for a response to C. Res. 1978/4:20 encouraging ICES member countries to develop methods for studying atmospheric deposition and report the results of these studies to ICES.

EFFECTS MONITORING

OUTCOME OF SPECIAL MEETING ON DISEASES OF COMMERCIALLY IMPORTANT FISH AND SHELLFISH

9.1 Professor Maurin informed the Working Group about the background of the Special Meeting, which resulted from the work of the Working Group on Pathology and Diseases of Marine Organisms, of which he is Chairman. The Special Meeting had two major aims: (1) to make an objective inventory of diseases of fish and shellfish and their possible causes, including pollution, and (2) to try to make a quantitative evaluation of the effects of disease on the stocks. A half-day session had been devoted to the subject of the relationship between pollution and disease. Papers were presented on the effects of oil in relation to disease and on necroses and vertebral deformities which were associated with pollution.

9.2. Professor Maurin then provided information on some relevant work in the Working Group on Pathology and Diseases of Marine Organisms (WG PDMO) and noted its interest in the pathological studies associated with certain Mussel Watch programmes.

9.3. In the discussion, the WG MPNA agreed that a multi-disciplinary approach is

needed to determine relationships between pollutants and diseases of marine organisms because both histopathological studies as well as analyses of pollutant body burdens in the diseased organisms are needed. Noting further that the WG PDMO has been preparing a series of leaflets to be used in the identification of diseases of fish and shellfish, the WG MPNA expressed its support for the publication of these leaflets as they will be very useful in biological effects studies.

9.4. The Working Group thanked Professor Maurin for his very useful contribution to the discussion.

10. REVIEW OF NATIONAL STUDIES AND OTHER INTERNATIONAL ACTIVITIES

10.1. GESAMP

10.1.1. Dr McIntyre summarised the GESAMP work on biological effects monitoring, as reported in GESAMP Reports and Studies No. 12, "Monitoring biological variables related to marine pollution." He stated that this work had built upon the results of the ICES Workshop on Monitoring the Biological Effects of Pollution in the Sea, taking many of the 50 techniques identified there and evaluating their suitability for inclusion in a pollution monitoring programme according to a set of 13 criteria. The report then went on to outline a strategy for a biological effects monitoring programme in three phases: (1) identification of an effect, i.e., detecting a change in time and/or space, (2) quantifying the degree or extent of the change or effect, and (3) determining the cause of the observed change or effect. Dr McIntyre noted that each phase requires the use of different types of monitoring techniques, so that a package of techniques is needed to carry out the entire programme.

10.1.2. The Working Group felt that this report provided a very valuable approach to the subject, giving a useful set of criteria for the evaluation of techniques and a good strategy to implement an effects monitoring programme. It was agreed that the Group would return to the report for a more detailed consideration of the table providing an evaluation of the various techniques considered when the Group discussed future work on this subject under Agenda Item 11.

10.2. EEC COST 47

10.2.1. The Chairman informed the Group about COST 47, an international project coordinated by the European Economic Community to study the influence of climatic variability on natural cycles using benthic communities. For this programme, the intertidal and sub-littoral benthic communities on both hard rocky bottoms and soft bottoms are being investigated.

10.3. Biological Work in the Baltic Sea

10.3.1. An information paper on this subject prepared by Dr G. Ærtebjerg Nielsen was presented, which concerned the biological parameters which are being monitored in the Baltic Monitoring Programme under the Helsinki Commission. The parameters studied are all ecological and most are pelagic. They include the measurement of phytoplankton primary production and the determination of species composition and biomass for phytoplankton, meso-zooplankton and soft-bottom macrozoobenthos. A series of intercalibration exercises is being held in connection with these studies.

10.3.2. It was also noted that work on biological effects monitoring was being conducted by the ICES/SCOR Working Group on the Study of the Pollution of the Baltic. This work was mainly concerned with the pathobiological effects of pollution.

10.4. National reports

10.4.1. It was recalled that at the previous Working Group meeting, all members had agreed to prepare a short paper on which biological effects monitoring techniques were being tested in their countries, the types of situations in which they are being used and, if possible, an evaluation of the utility of these techniques in relation to the information desired. Contributions had been received before the meeting from Dr Uthe for Canada, Dr J Derenbach for the Federal Republic of Germany, the Chairman Dr Parker for Ireland, and Dr Pearce and Dr Thurberg for the United States. Written papers were presented at the meeting from Dr J Parker for Northern Ireland and Dr Carlberg for Sweden. The other members presented their information orally.

10.4.2. From the description given, it was obvious that a wide variety of biological techniques were being used and most were still in an experimental stage. A number of the programmes used ecological investigations and pathobiological observations, but a few used biochemical and physiological techniques.

10.4.3. As a case study, Dr Dethlefsen presented the results of two investigations in which he had been participating. In the first, an attempt had been made to combine laboratory methods with environmental studies. Running ripe Baltic Sea flounder had been caught. The eggs had been artificially inseminated and incubated and the percent viable hatch had been determined. Ovary and liver samples of the female parent fish had been analysed for chlorinated hydrocarbons and heavy metals. The results showed that viable hatch was significantly affected at PCB concentrations in the ovary of 120 ng/g and above. Dr Dethlefsen felt that this method was a promising tool for the assessment of the effects of pollution on marine biota and indicated that he planned to extend its use to studies in other areas and on other species.

10.4.4. The results of this paper were discussed and a number of points were mentioned, including the large variability in hatching success and survival of larvae in vivo and the effects of handling in the laboratory. It was noted that many unknown factors are involved in such studies, e.g., the presence of other contaminants which have not been measured, the individual differences in certain fish which create conditions for markedly higher accumulation of PCBs in their tissues, etc.

10.4.5 Dr. Dethlefsen then provided information on the extensive monitoring programme for fish diseases which is being conducted in the southern North Sea, some of the results of which were given in Paper No. 8 at the Special Meeting on Diseases of Commercial Fish and Shellfish. This paper gave the results of studies of epidermal papilloma in dab, which was found to occur at a much higher percentage in fish caught near a waste dumping site. He stated that this work was continuing and a new cruise was scheduled for this summer.

11. CONSIDERATION OF AIMS AND APPLICATION OF BIOLOGICAL TECHNIQUES

11.1 Having considered the on-going programmes at the national level and the work of GESAMP on this subject, the Working Group agreed that the best way to progress on this issue was to begin to collect reports on the results of biological effects studies and compile them together, perhaps on an annual basis.

11.2 Thus, the Group agreed that members from countries which have on-going programmes utilizing biological effects techniques described in the report of the ICES Workshop on Monitoring the Biological Effects of Marine Pollution (Rapp.P.-v-Réun. Cons.int.Explor.Mer. No.179) and the GESAMP report (Reps. and Studies No. 12) should provide a paper containing details of the techniques used and the results obtained, together with an evaluation of the effectiveness of the technique for monitoring, to the Environment Officer by 1 December 1981. She will compile the papers into a report for consideration

at the next meeting of the Group. In addition, it was agreed that members should provide details of biological monitoring techniques other than those covered in the ICES and GESAMP reports.

11.3 The Working Group further agreed that, as a first step in cooperative biological effects monitoring, countries should where possible undertake observations on pathobiology (e.g., tumours, fin rot, skeletal abnormalities) in relation to pollution and report the results to the ICES Secretariat by 1 December 1981 (see Recommendation 2). In order to facilitate this reporting, the Environment Officer agreed to circulate a draft reporting format by 31 August 1981. The data so collected would be collated by the Environment Officer for consideration at the next meeting. It was agreed that an offer should be extended to the ICES/SCOR Working Group on the Study of the Pollution of the Baltic that data from its programme could also be included so that a joint report could be prepared.

11.4 Finally, the Group noted with appreciation an offer by Dr. Dethlefsen of places on forthcoming cruises for scientists wishing to gain training in the identification of pathobiological features in fish. The Group expressed the hope that other specialists might make similar offers to demonstrate their techniques and considered that workshops on selected techniques would be a useful means of providing training.

12. EFFECTS OF POLLUTION ON MARINE MAMMALS

12.1 Several members provided information on national programmes in which contaminant levels in marine mammals are studied. Dr. McIntyre informed the Group that a discussion had been held at the Joint Session of the Marine Environmental Quality Committee and the Marine Mammals Committee at the 1980 Statutory Meeting concerning whether marine mammals could be used as monitoring objects. It had generally been felt that they were not useful on a local basis, but perhaps on a larger basis (e.g., on Greenland) there could be some value in using marine mammals to monitor pollution. Another joint session would be held at the 1981 Statutory Meeting to consider further the issues of the effects of contaminant body burdens on marine mammals and the use of marine mammals in monitoring marine pollution.

12.2 The Working Group decided to postpone further discussion of this subject until the results of the discussions at the 1981 Statutory Meeting are available. It was felt, however, that studies should be encouraged on the concentrations of contaminants in living seals to avoid the problems which are now encountered in the study of dead or dying animals, i.e., that true "sampling" cannot be done and that elevated body burdens are suspected to be the cause of death of the animals.

FUTURE ARRANGEMENTS

13. RELATIONS WITH OTHER WORKING GROUPS

13.1 The Group considered its relations with other ICES Working Groups, including the ICES/SCOR Working Group on the Study of the Pollution of the Baltic, the Marine Chemistry Working Group, the Working Group on Marine Sediments in Relation to Pollution, the Working Group on Pathology and Diseases of Marine Organisms, the Working Group on Primary Production Methodology and the Working Group on Shelf Seas Hydrography. The Group discussed the advantages of meeting on a back-to-back basis with others of these groups than the MCWG. It was agreed that the ultimate decisions on these matters should be taken at the Council Meeting each year when the terms of reference for the next meeting of each group were available for comparison of the points of common interest.

14. FUTURE WORK OF WG MPNA/REVIEW OF TERMS OF REFERENCE

14.1 The Working Group reviewed its terms of reference, which dated back to 1974, and discussed whether new overall terms of reference should be recommended. Although there was some support for this idea, it was finally agreed that there was no real need for new general terms of reference as the MEQC via the Consultative Committee provided terms of reference for each meeting that was recommended to take place.

14.2 There was considerable support to shorten the name of the Group to "Working Group on Marine Pollution in the North Atlantic," but it was decided not to recommend this change to the Council Meeting.

14.3 The Group then discussed its future work. Noting that the agenda for this meeting had been very long, it was agreed that for Agenda Items 3 and 4 concerning ICES activities, the Environment Officer should prepare a written summary for distribution prior to the meeting. For the activities of other international organizations, the Chairman would contact the appropriate persons to prepare reports on the activities of these organizations, for distribution prior to the meeting. Most members were also interested in obtaining information about the monitoring programmes in other countries. As extensive information had already been given at this meeting, it was agreed that each member who has new information should submit it to the ICES Environment Officer no later than two months before the next meeting, for compilation and distribution. It would be presumed that members not submitting information were working on the same projects as last year.

14.4 The Group then discussed whether the meetings should be held so that the two main topics - chemical contamination and biological effects - could be discussed in sub-groups meeting at the same time. There was both support for and opposition to this proposal. It was agreed that it should be the Chairman who will decide on the structure of the meeting when he draws up the agenda, so that when the agenda is circulated the items will be marked for which it might be advisable to break up into sub-groups. It was also agreed that when the agenda is circulated, the Chairman will indicate the areas for which the expertise of certain types of scientists (e.g., biologists, oceanographers, statisticians, geochemists) is needed.

15. RECOMMENDATIONS

The recommendations were reviewed and Recommendation 3 on the next meeting of the Group was passed. These are attached as Annex 4.

16. ANY OTHER BUSINESS

16.1 Dr. Topping reported that he will present a paper giving a summary of the results of the ICES intercalibration exercises on the analyses of trace metals in biota at a NATO meeting this spring.

16.2 The Action List for intersessional activities and deadlines was agreed and is attached as Annex 5.

17. CLOSURE OF MEETING

17.1 The Chairman, on behalf of the Group, expressed appreciation to the host Institute for the excellent meeting arrangements and especially thanked Mlle. Lebouvier, Professor Maurin's secretary, for her assistance.

17.2 The Chairman closed the meeting at 12.30 hrs. on 26 February.

ANNEX 1

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

Institut Scientifique et Technique des Pêches Maritimes
Nantes, 9.30 hrs. 23-26 February 1981

DRAFT AGENDA

PRE-MEETING (20-21 February): Statistical aspects of the use of biological indicators in pollutant monitoring

- o - o - o -

1. Opening of Meeting

2. Adoption of Agenda

3. Actions of Council and ACMP

4. General considerations of other related ICES activities

   4.1 MEQC

   4.2 MCWG

   4.3 ICES/SCOR Working Group on the Study of the Pollution of the Baltic

5. General considerations of other related international activities

   5.1 GESAMP

   5.2 IOC/GIPME/IGOSS

   5.3 Oslo and Paris Commissions (JMG)

POLLUTION MONITORING

6. The use of biological indicators/Co-ordinated Monitoring Programme

   6.1 Statistical aspects - report of the pre-meeting session

   6.2 Intercalibration excercises in biological tissues - reports from MCWG

   6.3 Review of national and international programmes

   6.4 New pollutants

   6.5 Report on the use of biological indicators (Mussel watch)

   6.6 Review of first five years data from CMP and the aims, objects and methods for future co-ordinated monitoring

Draft agenda (continued) ..

6.7 1979 Coordinated Monitoring Report

7. Monitoring in sediments and water

7.1 The uses of sediment monitoring

7.2 Intercalibration excercises in water - reports from MCWG

7.3 Aims and objects of water quality monitoring

8. Inputs and coastal processes

8.1 Input study

8.2 Assessment of river inputs - report from MCWG

8.3 Coastal processes/overviews - reports from MCWG

8.4 Atmospheric inputs

EFFECTS MONITORING

9. Outcome of Special Meeting on Diseases of Commercially Important Fish and Shellfish

10. Review of national studies and other international activities

10.1 GESAMP

10.2 EEC COST 47

10.3 Biological work in the Baltic Sea

10.4 National reports

11. Consideration of aims and application of biological techniques

12. Effects of pollution on marine mammals

FUTURE ARRANGEMENTS

13. Relations with other Working Groups

14. Future Work of WGMPNA/Review of terms of reference

15. Recommendations

16. Any other business

17. Closure of Meeting

ANNEX 2

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ANNEX 3

BRIEF DETAILS OF SOME NATIONAL MUSSEL WATCH INVESTIGATIONS

Canada

A number of surveys have been conducted using mussels and other marine organisms as indicators. An example of such a study was conducted in 1977 along the St Lawrence Estuary and Gulf of St Lawrence. This used mussels and the samples were analysed for a range of metals plus PCBs and benzo 3,4, pyrene. In many cases the pattern of distribution observed seems to reflect natural input sources. Current interest is focussed on hot-spot and potential hot-spot areas as identified in baseline studies and use a range of bivalve and crustacean species. Samples are analysed, as individual or pooled animals, for toxic elements, organochlorine compounds and PAHs. Histopathological investigations are also conducted.

USA

Mussels (Mytilus edulis) have been used as indicator organisms in the US section of the "mussel watch program". In southern waters of the US, the program used oysters and other bivalve species. Mussels are used in the USEPA Coastal Environmetal Assessment Study (CEAS) program; this program operated along a gradient of pollution in Narragansett, R.I. and involved "Scope-for-Growth" and other physiological and biochemical measurements. More recently the US Corps of Engineers has been using mussels to integrate and thus monitor the release of various trace metals and organic contaminants from highly polluted dredged materials being dumped in the New York Bight.

A range of other invertebrate and teleost species are used by numerous investigators and programs (ie PRIMA and Ocean Pulse) to assess and monitor the effects of various contaminants on marine organisms, populations and communities.

United Kingdom

Surveys have been carried out using mussels as an indicator in Scotland, England and Wales and are currently in progress in Northern Ireland. Samples were analysed for trace metals, organochlorine compounds including PCBs, "total" petroleum hydrocarbons and specific compounds which may be petroleum derived, including PAHs. The results of these surveys in the main confirmed what was previously suspected about pollution hot-spots but also identified a few previously unsuspected possible hot-spots. A detailed examination of the role 'mussel-watch' studies may play in nationally coordinated monitoring in the UK has just been completed. Mussels are only one of a number of species which are recommended for possible further studies. Emphasis is to be placed on hot-spot area studies and encouragement is given to the concurrent use of a number of biological and histopathological tests. No repeat large scale studies are recommended for at least 5 years.

Netherlands

A number of laboratory and field studies are in progress which are designed to study the possibility of using deposit feeding organisms such as Macoma balthica and Scrobicularia plana especially in relation to pollution of sediments. In the identification of hot-spots surveys are carried out using a variety of species. Although mussels are utilised in such studies others, eg eels in the study of organochlorines, are used as appropriate in this type of survey.

On an ongoing basis mussels are only used to meet obligations to international organisations, eg the Joint Monitoring Programme of Oslo and Paris Commissions. Some investigations have been carried out in this context, using transplanted mussels, in areas where mussels are not naturally present.

Sweden

A number of local studies use different species of mussels, although the most common is Mytilus edulis. A coordinated National Monitoring Programme requires samples of Mytilus edulis and Pontoporeia affinis to be sampled every fifth year from about 20 sites. These sites represent both polluted and relatively clean areas along the Swedish coast. Much of the collected material is simply stored without analysis in the Environment Specimen Bank.

Denmark

No routine monitoring programme is underway using mussels but a number of investigations are in progress on the possible role of mussels in regulatory monitoring. These include:-

(i) Collection of Mytilus edulis from 40 stations.
(ii) Measurement of length, shell weight, wet and dry meat weights and analysis for several metals, % nitrogen, % carbohydrates and % fat.
(iii) Transplanting of mussels in cages and examination of uptake of metals and growth.
(iv) Specific investigations in the laboratory on the effect of cadmium on a number of physiological functions, eg respiration and growth.

Greenland

Mussel watch type studies in Greenland in areas unaffected by local inputs of pollutants have shown that not enough is known about the blue mussel to allow it or other marine organisms to be used to monitor environmental quality parameters. In an effort to expand experience in this context a 5 year programme was initiated in 1980. Samples of Mytilus edulis, Ascophyllum nodosum, Fucus vesiculosus and Fucus distichus are being collected once a year at four stations in an area unaffected by local inputs of pollutants. The samples are analysed for a suite of elements by both AAS and N/A.

Iceland

In 1978 samples of Mytilus edulis were collected from 48 sites in southwest Iceland and during 1979 and 1979 samples of caged mussels were collected at intervals at Hvalfjörrdur, southwest Iceland. For each sample the length distribution and condition factor were determined and the following metals analysed by AAS: Hg, Cd, Pb, Cu, Zn, Fe, Mn.

ANNEX 4

RECOMMENDATIONS

Recommendation 1

The Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic recommends that, in order to facilitate the analysis of trends in pollutant concentrations, a data bank should be established within ICES to store and exchange data resulting from cooperative investigations of the concentrations of pollutants in marine biological samples from the ICES area. A data exchange format should be prepared in connection with the establishment of this bank.

Recommendation 2

The Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic recommends that, as a first step in cooperative biological effects monitoring, ICES member countries should where possible undertake observations on pathobiology (e.g., tumors, fin rot, skeletal abnormalities) in relation to pollution and report the results to the ICES Secretariat by 1 December of each year, beginning in 1981.

Recommendation 3

The Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic recommends that the Group meet for 3 or 4 days in February 1982 at ICES Headquarters to consider the following subjects:-

1) progress in the development of statistical sampling methods for trend monitoring,

2) progress in programmes of biological effects monitoring, and

3) the draft report on 1980 results under the Coordinated Monitoring Programme and progress in other relevant national monitoring programmes.

ANNEX 5

ACTION LIST

1. Dr. Bewers should prepare a written summary of the plans for the proposed IOC baseline survey of trace elements in sea water of the North Atlantic and send it to the ICES Environment Officer by 15 December 1981 (Section 5.2.).

2. All members should prepare a short statement of priority substances for monitoring and send it to the ICES Environment Officer before 15 December 1981 (Section 6.3.).

3. Dr. Bewers, Dr. Johansen, Dr. Pearce, and Mr. Alzieu should act as contact persons in the critical evaluation of their respective data on the input of pollutants to the North Atlantic. Such critical reviews should be sent to the Environment Officer by 31 October 1981. (Section 8 and 1980 WG MPNA Report, Para 3.2).

4. Members from countries which have on-going programmes utilizing biological effects monitoring techniques should provide a paper containing details of the techniques used and the results obtained, together with an evaluation of the effectiveness of the technique for monitoring, to the Environment Officer by 1 December 1981 (Section 11.).

5. Members with results of observations on pathological effects (e.g., tumors, fin rot, skeletal anomalies) in relation to pollution should report the results to the ICES Environment Officer by 1 December 1981 (Para 11.3.).

6. The Environment Officer should prepare a written summary of the actions of the ACMP and the Council and other related activities in ICES for distribution prior to each meeting of the Working Group (Para 14.3.).

7. All members with new information about monitoring programmes in their countries should submit it to the Environment Officer no later than two months before the next meeting (Para 14.3.).

International Council for the
Exploration of the Sea

C.M.1981/E:33
Appendix
Marine Environmental
Quality Committee

REPORT ON THE AD-HOC STATISTICAL GROUP TO ADVISE ON TREND MONITORING

Nantes, 20-21 February 1981

This document is a report of a Working Group of the International Council for the Exploration of the Sea and does not necessarily represent the views of the Council. Therefore, it should not be quoted without consultation with the General Secretary.

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x) General Secretary
ICES
Palægade 2-4
DK-1261 Copenhagen K
Denmark

1. Introduction

The ad-hoc group of statisticians met in Nantes on Friday 2o Feb. and Saturday 21 Feb. 1981. On the afternoon of 2o Feb., they were joined by members of the Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic (WG MPNA) and Marine Chemistry Working Group (MCWG).

Participants

H. Lassen (Chairman)	Denmark
A. Jensen	Denmark
T. Neppelberg	Norway
J. F. Uthe	Canada
D. P. Scott	Canada
H. W. Hill	United Kingdom
M. M. Parker (Chairman of WG MPNA)	Ireland

2. Terms of reference

The terms of reference were (C. Res. 198o/2:14 (c)):
to supply guidance on the statistically most satisfactory method of sampling to be used to meet the objectives of Marine Pollution Monitoring Programmes especially trend analysis.

3. The ICES Coordinated Monitoring programme, which is the one for which advice on statistical analysis is required, was explained by Dr Pawlak as follows:

   The history of the programme and the areas in which samples should be taken are described in paragraphs 2, 3 and 4 of the Introduction to the draft report on 1979 data received for this programme.

   The sampling procedures are revised from time to time. The most recent procedures are contained in Annex II to the 1978

Report of the Advisory Committee on Marine Pollution, Coop. Res. Rep. No 84 (1979). For fish, a sample should consist of 2o specimens. For each specimen the age, length, weight, sex, condition factor, and liver somatic index should be given. For the sample as a whole, the area of catch (according to ICES statistical rectangles) and the month should be specified. Additionally, certain procedures are specified for the sampling and handling of shellfish.

Prior to the meeting, two sets of data originating from this programme were distributed among the participants. These data originate from Canada and U.K. The Canadian data were a length stratified sample of cod taken from the Gulf of St Lawrence in 1977-79. Some of these data have been published and analysed in C.M. 1978/E:16. In this programme, both the metals Cu, As, Zn, Hg, Cd, Se, Pb and the hydrocarbons PCB, DDT, HCH, HCB were measured. The U.K. data was a sample previously analysed under an OECD programme (ENV/Che/77. dated 14 Oct. 1979). In this data set, herring above 2o cm were sampled west of Scotland. The hydrocarbons PCB, DDT, DDE, TDE, ODE were measured.

Dr Uthe made a brief presentation of the background to the problem, in which he identified four different types of pollution studies which were of interest to the WG MPNA, viz

(i) Determination of areas of chemical pollution occurrence (of the type investigated in the "Mussel Watch" programme)

(ii) Determination of general trends in pollutant levels in biota in the oceans and particularly in shelf sea areas

(iii) Determination of food safety levels for pollutants in marine fishery products and

(iv) Determination of the effects of amelioration or clean-up procedures on the quality of certain harbours, estuaries etc.

The Group concentrated on the general trend problem and each of the participants presented his analysis of the sample sets of data which had been circulated.

Dr Scott reported that thirteen contaminants in 122 Canadian cod, taken in 1977, 1978 and 1979 were analysed by multiple linear regression analyses for time trends, after compensation for age, size and fat fractions. Eleven of thirteen showed significant positive (6) or negative (5) trends over the three sample years. By contrast, in 89 North Sea herring (OECD data), of the five organochlorine contaminants analysed, four showed very highly significant negative time trends after compensation for age and fat fraction, while the fifth, dieldrin, showed a very highly significant negative trend after compensation for age only.

In all analyses, all variables except age and year were log-transformed. Dr Scott's general experience with statistical analysis of allometric and contaminant variables is that these transformations are of wide applicability and are hence applied in this study. His MLR analysis included length, weight, age and fat fraction as the independent biological variables.

He concluded that there could be little a priori decision making on the types of analysis and sampling regimes; rather, preliminary sampling has to be done and a statistical protocol worked out on the basis of the preliminary results.

Mr Hill presented an analysis by Mr Woolner in which he had calculated for the Canadian cod data (Cu, Hg and Zn only) and the herring data the simple linear, log linear and log log regressions and compared the level of correlation which could be obtained. For some parameters, the contaminant appeared to be normally distributed over the range sampled and a linear regression gave the best fit (e.g. Hg against weight or length in 1977 explaining 41% of variation as against 29% for log linear) whereas in other cases a log linear relationship gave higher correlations. (Cu against weight/length in 1978 explaining 37% of the variation as against 34% for the linear model).

A stepwise multi-variable regression analysis provided a better estimate in some cases, improving the variances explained by the

model e.g. from 59% to 66% in the case of Hg in 1978 (by inclusion of both age and weight), but in other cases did not produce any significant improvement. MLR using both weight and age for Zn in 1978 produced a weak correlation (14% of the total variation) whereas all three simple models did not detect significance.

Mr Woolner's conclusion was that fitting the simplest model which provided the best regression fit of either raw or transformed data, depending on each individual data set, was the best statistical approach with the present quality of data.

Mr Lassen reported on a preliminary analysis of the PCB levels in the herring data submitted. Analysis of variance with year as class variable and log linear regression for the relationship between the age, weight and fat content were mixed and the variance of the residuals was calculated. From this information assuming a log normal distribution of the contaminant level, the minimal increase from one sample time to the next which could be found with given probability using a prespecified significance level could be calculated as a function of the number of fish sampled.

Mr Lassen stressed the importance he puts on prior biological information on the contaminant-biological variable relationships as this reduces the chance of being misled by spurious correlations in the data.

Mr Neppelberg reported that he had analysed the Canadian data with standard multi-linear regression (MLR) and obtained mostly the same results as presented by Dr Scott. His intention is to analyse these data on a classification program package called ARTHUR (from the Laboratory for Chemometrics, University of Georgia). He also wishes to use PLS-1 (Path Modelling, Infometrix, Seattle) which allows the user to specify directional relationships among blocks of variables, each block being a set of measures derived from a distinct source. Path Modelling overcomes the problem of discarded variables by stepwise regression when a high degree of co-linearity is present in the original variable mix. His own data will be analysed with both these methods.

4. After discussion of these presentations the ad-hoc Group was unable to agree on a simple most useful statistical analysis for trend data, since we do not yet know the form of the relationship between contaminant levels and the biological variables (age, length, weight) nor between the contaminant levels and time. Neither do we know whether the dependent variable is normally, log normally or otherwise distributed in specific areas and species. However, it emerged from the various presentations that the participants using different techniques had produced similar results in terms of the significance of the biological variables for each contaminant. This was found independently of whether a multi-linear regression model or the simplest regression model for each individual contaminant was employed bearing in mind the quality of the presently available data sets. As far as the type of statistical sampling for the establishment of trends was concerned, the Group recommended that, since relationships among the biological variables (age, length, weight) were reasonably well known, it should only be necessary to take stratified length samples. The length samples should be taken over as large a range as practicable, in order to improve the precision of the regression analysis, whatever type is used. An added practical advantage of using length as the paramount biological variable was the ease of measurement and the need to carry out the stratification on the vessel. Such sampling would enable further improvements in our understanding of the length (and hence other independent variables) contaminant relationships providing a better fit to that trend relationship as well as allowing trend analysis of the contaminant versus time. It will probably be necessary to continue such sampling over a number of years in order to identify these relationships with sufficient precision, to enable a smaller window to be used.

During the afternoon session on 2o February the required sample size to find a specified trend was discussed. It was noted that variance due to the analytical chemical method used may be of significant magnitude, and that this variance increases with decreasing contaminant level. The analytical method variance

should be isolated from the residual variance since for low contaminant levels this could be the major error and improvement could not be expected without better analytical techniques.

Consequent upon a request from members of the WG MPNA/MCWG, it was agreed that a graph of the minimal detectable increase against the number of fish sampled for specified sampling programmes would give useful guidance towards an optimal sampling scheme. For illustrative purposes only, one example derived from the submitted herring data utilizing all 3 years data showing the sample size needed to detect significant increases in level of PCB is given in Fig. 1. The Group agreed to produce similar graphs for other contaminants and for other sampling schemes.

These graphs will be directly applicable to the herring data only, but may be used as a guideline to the sample sizes required for other areas and species.

5. Future work

The ad-hoc Statistical Group feels that the data collected under the ICES Coordinated Monitoring Program could give a sound basis for advising on sampling procedure modifications. However, the Group is also concerned that the present scheme should not undergo any major amendments at this stage apart from increasing the sample size to preserve continuity. The Group also has recommended the application of length stratification.

It is felt that the Group could give some further input to the WG MPNA and it is therefore proposed that the ad-hoc Group should continue its work by correspondance. The ad-hoc Group has however recommended the use of length stratification, within the samples collected

- that a centralized computerized databank at ICES to hold all available data collected under the coordinated monitoring-program should be established

- that these data should be distributed among the statisticians on computer readable media so that the members may present their individual analyses at future meetings of the WG MPNA
- that the ad-hoc Group together with the WG MPNA summarize these analyses and recommend future modifications of the coordinated monitoring program
- that one or more nations carry out studies of a selected stock of a species living in a selected sampling area utilizing length stratified sampling techniques. Consideration should also be given to the necessity to sample before and after the identified annual sampling period, and to sampling at known geographical distances from the sampling site selected, to identify the likelihood of time and space effects upon the primary sample.

The time scale these tasks may require is probably 2-3 years.

Herring Pitlochry 1973 - 1975 data

sample size = 80 herring

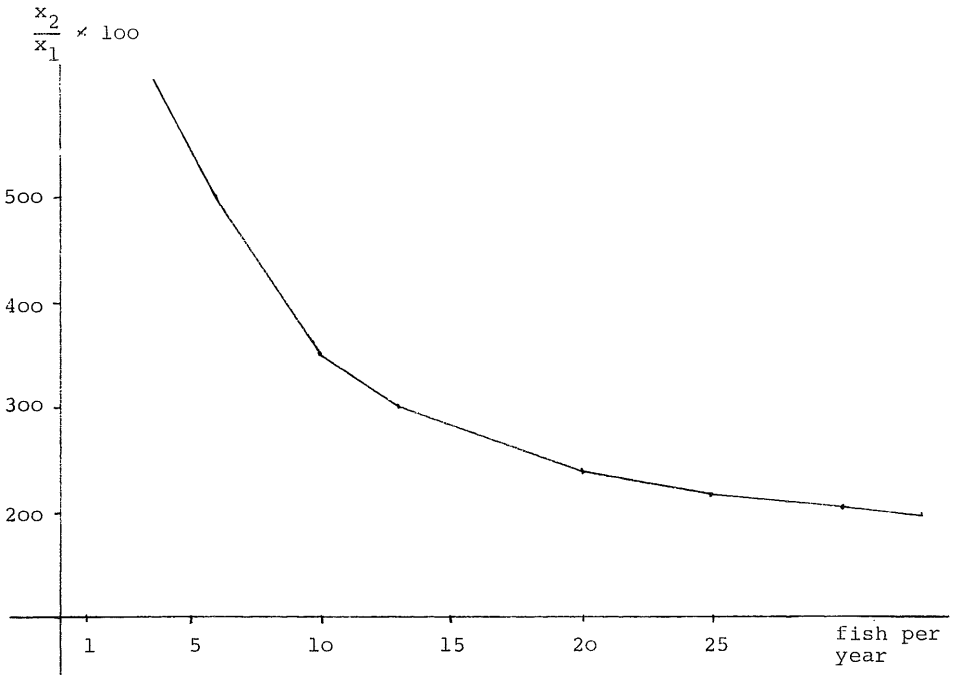

Fig. 1 Minimal detectable increase $\frac{x_2}{x_1}$ in PCB Muscle Herring, based on the sampling scheme applied in the Pitlochry herring data, as function of the annual no. of fish sampled. The calculations are based upon a log-log relationship

$$\log_e \text{PCB} = \alpha_y + \beta \log_e \frac{\text{age}}{\text{weight}}$$

where α_y is the overall level in y = 1973, 1974 and 1975.

The significance level has been adopted to 0.95 and the power of the test is 0.90.