COOPERATIVE RESEARCH REPORT
No. 84

REPORT OF THE ICES ADVISORY COMMITTEE ON MARINE POLLUTION, 1978

https://doi.org/10.17895/ices.pub.7708

ISBN 978-87-7482-569-2

ISSN 2707-7144

International Council for the Exploration of the Sea
Charlottenlund Slot, DK-2920 Charlottenlund
Denmark

January, 1979

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued) Page

- o - o -

REPORT OF THE ADVISORY COMMITTEE ON MARINE POLLUTION, 1978

List of Members

Mr G Berge	Chairman
Dr A D McIntyre	Chairman, Marine Environmental Quality Committee
Mr H W Hill	Chairman, Hydrography Committee
Prof. G Hempel	Chairman, Biological Oceanography Committee

Coopted Members

Dr (Ms) M C de Barros
Dr R Cook
Prof. G Kullenberg
Mr A Preston
Dr E D Schneider
Ms F Soudan
Dr L Zmudziński
Mr L Thorell
Prof. A Voipio
Dr G Weichart

Dr (Ms) Janet Pawlak, ICES Environment Officer, Secretary to the Advisory Committee on Marine Pollution

REPORT OF THE ADVISORY COMMITTEE ON MARINE POLLUTION, 1978

INTRODUCTION

1. The Advisory Committee on Marine Pollution has been established by the International Council for the Exploration of the Sea with the task to formulate on behalf of the Council scientific advice on marine pollution and its effects on living resources to Member Governments and to regulatory Commissions. It is a firm procedure within the Council that reports of other subsidiary bodies must pass the Advisory Committee on Marine Pollution.

2. The Advisory Committee on Marine Pollution consists of a number of scientists acting - when they meet as a committee - in their personal capacity as scientists, responsible only to the Council. The membership of the Committee is such that it covers a wide range of expertise related to studies of marine pollution. The members are not national representatives. The present membership of the Committee is found on Page 1.

3. In the present report, the Advisory Committee on Marine Pollution has prepared one overall report in anticipation that most of the material, even when prepared specifically for one Commission, will be of interest to all three regional Commissions. Thus, information both of a general nature as well as in response to specific requests is contained herein.

GENERAL APPROACHES TO MONITORING THE MARINE ENVIRONMENT

4. The Advisory Committee considered a draft discussion paper prepared by a small ad hoc group of the Committee which dealt with "Monitoring in Relation to Pollution of the Marine Environment". The paper dealt, as requested, with the philosophy of monitoring and the present state of the art, and the Committee concurred with the general principles and arguments presented in the paper, which is attached as Annex I to this report. In discussing the present role of ICES in relation both to its own baseline and coordinated monitoring activities and in respect of the advice the Council is called upon to give to the various pollution Commissions, the Committee felt that the Council's baseline studies in the North Atlantic and jointly with SCOR in the Baltic had provided a broad brush picture, of varying quality, for selected pollutants in some species, especially in a human health context. However, little has yet been done on pollutant distribution in the water mass, though a start has been made on metals in sea water in relation to inter-calibration requirements and validation of sampling and analytical techniques. Proposals are also underway to examine the problems related to sediment monitoring (see also Coop.Res.Rep., No.76(1977)).

5. The question now remained as to how to proceed

   a) in relation to evaluation of the data already acquired and, in particular, how far any valid comparisons could be made as to the state of the Baltic and North Atlantic for the media and pollutants examined; and

   b) whether to extend this general type of activity to other pollutants and media, or to

   c) contract the effort to the areas closer inshore where the major inputs and effects were occurring, with the emphasis on

chemical residue monitoring backed by toxicity tests using fish or invertebrate bioassay systems; such effort would primarily be a move towards target monitoring and the immediate hazards to human health and aquatic resources; and/or

d) keep a watching brief on the wider geographical areas, in the light of what is found inshore, by conducting a trend monitoring survey every five years or so and integrating these with the more intensive near-shore monitoring in an attempt to estimate the fate of pollutants released and to develop pollution mass balance models.

6. Such an outline approach, i.e., broad brush trend monitoring offshore, supplemented by more intensive target-type monitoring efforts in selected inshore areas, might well be correct for most of the North Atlantic area but is perhaps not entirely so appropriate for the Baltic because of the relative scale of the sea areas involved and the higher likelihood of wide-scale effects in the Baltic. The Committee therefore considered that in the case of the Baltic no clear distinction should be made between inshore and offshore monitoring and the sea area should probably be considered as one entity, especially when estimating mass balances.

7. If this were an acceptable approach, how far should the broad brush baseline effort be supplemented with observations on the water mass and, if so, for what pollutants? The present biological baseline sampling protocols would also need adapting along the lines already suggested for fish and shellfish by the Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic in order to provide a better basis for trend monitoring.

8. A careful selection of areas, media and pollutants would need to be made for the inshore situation with, where possible, emphasis on target monitoring, and the national authorities and regional organisations concerned would need to cooperate in the sampling and measurement of these parameters. Inshore conditions were considered generally very variable, with large year-to-year fluctuations generated by purely natural processes, and especial care would have to be exercised when designing sampling programmes for the water mass. If the inshore effort were to be effective, it would also demand a more closely controlled effort to monitor inputs of the selected pollutants in at least some of the areas revealed as important by the environmental monitoring effort. This type of regulatory monitoring was very close to those elements of monitoring which the various pollution Commissions were concerned to have coordinated.

9. The Committee felt, however, that ICES could not neglect its own responsibilities for the assessment of the state of the marine environment, particularly aspects of harm, or potential harm, to fishery and other living resources. There was in any case an obvious ICES role in relation to the pollution Commissions to advise on pollutant and species selection, sampling and analytical protocols.

10. The Committee also considered that a logical further step in its consideration of the basic scientific principles underlying various regulatory activities in relation to marine environmental quality would be to consider the principles involved in deriving and setting standards and applying them to environmental situations. It therefore set up a further ad hoc group to consider these matters and to prepare by correspondence a report for the Committee at its next mid-term meeting.

11. The Committee noted that in order to make the most of the monitoring programmes being set up, more knowledge in several fields is necessary. In particular, there is a need for a better understanding of:

a) processes influencing the distribution of pollutants once introduced in the marine environment, and their retention and partition between the water column, suspended material and sediments;

b) biodegradability of chemicals reaching the marine environment and of their metabolites and degradation products;

c) possible effects of pollutants at levels actually found in the environment on human health or that of living resources or on other aspects of environmental quality;

d) identification of pollutants other than those being currently studied.

Having considered these needs, the Committee recommended that the Working Groups concerned with pollution take them into consideration in planning their future activities.

GUIDELINES ON METHODS FOR SAMPLING AND ANALYSIS OF CONTAMINANT LEVELS IN BALTIC BIOTA

12. The Committee considered the request of the Interim Baltic Marine Environment Protection Commission for ICES to prepare a manual setting forth sampling procedures and analytical techniques for the determination of the levels of certain contaminants in selected Baltic biota. In response to this request, the document "Guidelines for Sampling Procedures and Sample Preparation Methods for the Analysis of Contaminant Levels in Baltic Biota" had been prepared. This document had been drafted and reviewed by a number of scientists actively working in relevant programmes in the Baltic Sea Area and also by several scientists conducting similar programmes in the North Atlantic. The ICES/SCOR Working Group on the Study of Pollution of the Baltic had also reviewed the previous draft and had suggested a reorganisation of the document into what is now the existing format. The Committee noted the contents of the document which are as follows:

INTRODUCTION

GUIDELINES FOR SAMPLING, SAMPLE PREPARATION, ANALYTICAL STANDARDS AND REPORTING PROCEDURES FOR TREND MONITORING OF CONTAMINANT LEVELS IN BIOTA FROM THE OPEN BALTIC

ANNEX I - Analytical procedures for the determination of copper, zinc, cadmium, lead and total mercury in organic material, by Dr Uwe Harms, National Fishery Research Laboratory, Hamburg.

ANNEX II - Analysis of some chlorinated hydrocarbons in biological material, by S Jensen and L Reutergårdh, National Swedish Environment Protection Board, Special Analytical Laboratory, Stockholm.

ANNEX III - Suggestions for using certain species of marine organisms for trend assessment in coastal waters.

13. The introduction gives the background to the document and explains its organisation. The "Guidelines for trend monitoring of contaminant levels in biota from the open Baltic" is the core of the document. It sets forth the general guidelines and recommendations concerning what procedures should be used to provide, as much as possible, for comparable results in monitoring the trends in levels of contaminants in Baltic biota.

14. The Guidelines contain recommendations for certain sampling procedures for the three species of biota (cod, herring and Macoma baltica) which are being considered by the Interim Commission for inclusion in the Baltic monitoring programme. The sampling procedures for the fish specify the age and sex of the specimens to be sampled and, for all three species, the recommended time of the year for sampling is given. Sample preparation techniques are recommended, including an indication of which tissue should be analysed for each contaminant to be studied in the programme. There are no recommendations on analytical procedures, but the use of certain reference standards and the method of preparation of working standard solutions have been suggested. Finally, to provide for common ways of reporting the results, these procedures have been specified. These Guidelines represent a relatively wide concensus of the persons who had contributed to the document.

15. The Committee agreed that no recommendations should be given for analytical techniques because standardisation of techniques was neither necessary nor advisable. The only requirement which should be made is that the laboratories carrying out analyses for the monitoring programme participate regularly in international intercalibration exercises. It was also felt that each laboratory should send a detailed description of their analytical procedures to the Interim Commission so that this information would be available in evaluating the results of the monitoring programme. Realising, however, that there are some laboratories who are just beginning to conduct analytical determinations on contaminant levels in biota, the Committee agreed to include annexes to the Guidelines setting forth detailed analytical procedures followed by two individual laboratories to serve as an example for interested laboratories.

16. Finally, recognising that the three species considered for the Baltic joint monitoring programme are mainly representative of the open sea and that supplementary national monitoring programmes in coastal waters are considered necessary to an overall assessment of the state of the marine environment, the Committee felt that the material contained in Annex III may assist coastal monitoring programmes in the Baltic conducted on the national level. Although the Committee recognised that this information was not specifically requested by the Interim Commission, a number of the species covered are also being considered as possible additional species for later inclusion in the coordinated Baltic monitoring programme and are presently the subject of coastal monitoring programmes in several Baltic countries.

17. After a discussion of the aims of this document, details concerning its organisation and certain specific points covered in it, the Committee approved the document for transmission to the Interim Baltic Marine Environment Protection Commission. The Committee also expressed its great appreciation to the many scientists who had contributed to the preparation of the document and its completion in such a short time frame. The Committee anticipated that the document would be published in the Cooperative Research Report series in due course.

PROCEDURES TO BE FOLLOWED FOR SAMPLING AND PREPARATION OF FISH AND SHELLFISH TO BE USED IN MONITORING PROGRAMMES IN THE NORTH ATLANTIC AREA

18. The Committee noted that a request for ICES to prepare a manual on the sampling of living organisms for monitoring to determine risk to human health and trends in the levels of pollutants had been received from the Joint Monitoring Group of the Oslo and Paris Commissions. A response to this request had been prepared by the Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic. This document was based on three sources: (a) the procedures for the Coordinated Monitoring Programme agreed in 1977, (b) the sample preparation procedures used in the corresponding guidelines for the Baltic monitoring programme, and (c) the conclusions which could be drawn from the multiple regression analysis programme at its present state of progress.

19. In considering the procedures to be used in the North Atlantic and comparing them with the recommended guidelines for use in the Baltic, the Committee agreed that identical sample preparation procedures should be specified for both areas. However, the situation was seen to be somewhat different for the two areas regarding specification of sampling procedures for biota to be used for trend assessment monitoring. For the Baltic, such sampling procedures could be recommended on the basis of existing knowledge of the biology of the organisms involved and also because the Baltic is a relatively smaller, semi-enclosed sea. On the other hand, in the North Atlantic such uniform specification is not possible. Various reasons for this can be postulated, including the wider geographical area and the greater diversity in environmental conditions, fish stocks and species. Thus, the Procedures for this region recommend that a thorough investigation be made using multiple regression techniques to determine the importance of physiological variables on contaminant levels in fish. On this basis, the critical variables should be determined, probably separately, for each species, pollutant, and area to be studied and the results should provide a basis for standardised sampling procedures in each case.

20. Having considered these issues, the Committee accepted the Procedures for transmission to the Joint Monitoring Group. As these guidelines are general for monitoring in the North Atlantic, they are also to be used for the ICES Coordinated Monitoring Programme; thus, several footnotes have been included giving guidelines specific to this programme. The recommended Procedures are attached to this report as Annex II.

RESULTS OF THE REGRESSION ANALYSIS PROGRAMME

21. At its 1977 session, the Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic had suggested that investigations be carried out concerning the physiological factors which affect the concentrations of particular pollutants in marine organisms and had recommended that a multiple regression analysis be performed on the data obtained. The results of several of these studies were now available and the Advisory Committee took note of and agreed with the Working Group's conclusions based on the work conducted to date. In particular, it was concluded that it is not yet possible to make generalisations as to what physiological factors are important or unimportant in affecting the concentration of any particular pollutant in any particular species or area. It was also realised that the use of marine organisms in the assessment of risk to human health and for trend analysis represent two different objectives which require two somewhat different approaches.

22. In the conduct of monitoring programmes primarily for human health purposes, representative fish species used for human consumption should be selected. The samples should preferably be analysed on an individual organism basis, but in some cases the analysis of homogenates may be adequate. From this type of programme it should be possible to determine whether there may be any risk to human health in consuming fish and, if so, for which fish from which area. For each specimen sampled and/or analysed the parameters of length, weight and age should be determined, if practicable, for a better identification of the samples taken and to allow for future statistical studies as appropriate.

23. Regarding environmental risk assessment, the Committee recognised that there were greater difficulties in trying to use marine organisms in the determination of trends in the level of pollutants in the marine environment, both regarding provision of comparable samples and the establishment of the influence of physiological parameters in the overall variation of contaminant levels with time. The Committee agreed that it is necessary to conduct thorough investigations of the importance of physiological variables on the levels of each contaminant under study in the species to be monitored, using multiple regression analysis to establish the critical variables. On the evidence available so far, it was concluded that such an analysis will have to be done separately for each contaminant in each species and also according to stock or area, as different variables appear to be significant in different cases. Until the importance of each variable is established, it was recommended that detailed information should be collected for each specimen to be analysed, including length, weight, age, sex, condition factor and liver somatic index.

EXTENDED BASELINE STUDY REPORT

24. At the 1976 meeting of the Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic, certain gaps in the geographical coverage of the Baseline Study of contaminant levels in fish and shellfish in the North Atlantic had been noted and several members had agreed to conduct studies in these areas. Data have now been submitted by Ireland, Portugal, and Canada for a number of the areas for which data had been lacking. The main portion of the Baseline Study (now published as Coop.Res.Rep. No.69(1977)) was carried out in 1975, and the additional information is for samples mainly collected in 1976. Additionally, the United States submitted data on samples of marine organisms collected in 1971 and 1972, many of which were different from the species used in the Baseline Study. This information was considered a very useful contribution and it had been decided to include a selection of the data presented along with the additional report of the extended baseline study.

25. The Advisory Committee noted that this report shows that the levels of contaminants in each of the species studied in the additional areas covered by the Baseline Study are generally very similar to those reported in the main portion of the Baseline Study, although there are a number of small variations depending on area and species. The report will be published in the Cooperative Research Report series in due course.

1977 COORDINATED MONITORING REPORT

26. The Committee noted that data from 1977 for the Coordinated Monitoring Programme have been submitted by the United Kingdom, the Federal Republic of Germany, Ireland, Belgium and Canada. Additionally, the United States submitted data for 1978. These data were received too late to be compiled into a draft report for the Committee to consider, but such a report will be prepared in the near future and presented to the ACMP at its meeting in October 1978. The Committee agreed to this time schedule for the

preparation of the report and noted that this would allow the publication of the report by the end of the year.

ADDITIONAL INFORMATION ON INPUTS OF POLLUTANTS TO THE NORTH ATLANTIC

27. The Committee was informed that during the past year additional information on the input of pollutants to the North Atlantic had been received from France, Canada and the United States. Most of this information had been received very recently and, thus, there had been insufficient time to prepare a draft report on the subject before the Committee meeting. Moreover, it was recently learned that a further report on inputs to the Northwest Atlantic would be presented by the United States at the 1978 Statutory Meeting. The Committee expressed appreciation for the submission of this new input information and looked forward to receiving the completed report.

EVALUATION OF THE ICES STUDY ON INPUTS OF POLLUTANTS TO THE OSLO COMMISSION AREA

28. At the mid-term meeting of the ACMP in June 1977, it was agreed that an attempt should be made to evaluate the meaning, strengths and weaknesses of the results of the ICES study of inputs to the Oslo Commission Area. Among other things, this review was intended to include an examination of the regional distribution of inputs and the relationship, if any, between the input of a pollutant and the concentrations found in the baseline study of environmental contamination of living resources. As it turned out, however, the quality of the input data did not permit the drawing of any such relationships except in the most general manner. The Advisory Committee took note of the preliminary results of this study, which are given in the next paragraphs.

Major experiences

29. When the results of the input study are compared with the results of the baseline study of contaminating substances in living resources of the North Atlantic, a good general relationship can be distinguished, in the sense that the highest levels of contamination in almost all cases occur in samples of fish or shellfish collected from areas subjected to the largest volumes of sewage and industrial effluents. Thus, contaminant levels tend to be lower in areas where inputs in volume terms are low, such as the west coast of Ireland, the north of Scotland, the west coast of Norway, etc., than in areas such as the Southern Bight of the North Sea or the Irish Sea, where the volume of input is large. There are, of course, exceptions to this rule, as evidenced by the relatively high levels of mercury in cod off the northwest coast of Ireland.

30. In the conduct of the input study, in some cases great difficulties had been experienced by the ICES contacts, both in establishing the source of the required information and in obtaining the information once the source had been identified. In this context it is important for countries to understand that although ICES is not a regulatory organisation, it is an organisation with a valid interest and considerable experience in the study of the effects and levels of pollution in the marine environment. In order to understand the causes of these effects and the sources of environmental levels of contamination, it is necessary for the scientists working under the ICES framework to have accurate information on the pollutants which may be present and the size of contribution and source of any such pollutants. It is therefore important that such information be available to them. Thus, in the absence of alternative sources, ICES set out to obtain the information directly. Whether such a procedure need be followed in future can be discussed, but in view of the

strain imposed on lines of communication in some countries, alternative routes now available may prove successful for any future repeat study.

31. All countries responding were able to provide information on the volume of sewage inputs, although in most cases this information was obtained from per capita water usage rather than measured flows of sewage effluents, and as such it is likely to be an under-estimate. Most countries were also able to provide information on the BOD and/or COD loads and on the input of nitrogen, phosphorus and suspended solids. In all cases, these figures were derived from relatively few actual measurements, applied uniformly to all sewage effluents. Some differences are noticeable between the different country per capita values for these parameters. However, the differences are on the whole small and it was possible to calculate a mean figure which could be applied where a country was not able to make the necessary calculation itself. Fewer countries were able to provide data on the input of pollutants such as mercury, cadmium, DDT and PCBs in sewage. The sparse, unevenly distributed measurements on which the estimates of heavy metal inputs were based revealed several marked differences in per capita input. Thus, although estimates were made for all countries where population or flow data allowed, the estimates must be regarded with considerable caution, since it is hardly likely that the heavy metal content of a purely domestic sewage effluent discharge from a town, e.g., in rural Ireland, can be compared with that of an industrial town, e.g., in the Netherlands or England.

32. The same sort of problems were encountered with river inputs, but in this case in addition to the fact that only a very few countries were able to provide reasonable estimates of river flows, even fewer had data on the concentration, and therefore load, of the pollutants of interest. Thus, in some cases it was impossible even to estimate river inputs and, where inputs could be estimated, extreme caution is necessary in using the results.

33. The problems were even more marked when the countries were asked to provide data on industrial inputs. In some cases industrial effluents are discharged via town sewers and it is possible that there was some confusion as to where to report these effluents. In fact, that source should have been included in the input via sewage, whereas this portion of the inputs questionnaire required information on the input of pollutants by directly discharged industrial effluents. For direct industrial effluents, very little information was provided. In most cases this was probably a case of the required information not being available.

34. Finally, in the context of difficulties, it must be recognised that the fate of the different pollutants on entering the marine environment is not known with any degree of certainty. Just how much of the effluent load discharged at the head of an estuary actually reaches the open sea has not been established. This problem was recognised when the questionnaire seeking input information was distributed, but it still remains unanswered. A similar, though perhaps slightly less pronounced, problem relates to input into coastal waters.

35. From the foregoing it will be apparent that, what on first sight was a reasonably comprehensive and comparable input study, does need to be regarded with a considerable degree of caution.

Future work

36. Clearly, the input study was a success in the sense that information was collected where previously none existed. Equally clearly, where data had previously been sought (i.e., for the North Sea area) more comprehensive information was available on the second attempt. Despite all the shortcomings, the study certainly provides the most detailed and accurate picture of inputs to a marine region so far achieved.

37. For future work, the following points should be kept in mind:

a) It is important to achieve contact with the proper organisation in each country.

b) It is important that requirements are clearly stated and that no ambiguities arise in each different country's understanding of the requirements.

c) It is apparent that much can be achieved provided a minimum of accurate information is available. Thus, in relation to sewage and river inputs, provided that flows are accurately established and a few reasonably representative samples are analysed, not necessarily of each effluent or river but of typical analogues, then loads can be calculated. To this end agreed procedures and minimum requirements for measurements need to be established.

d) It is clear that much needs to be done in relation to industrial inputs either to obtain information at a national level on what is being discharged or to release it to the international organisation requesting it or both.

e) Although not mentioned previously, estimates were made of atmospheric inputs, at least for part of the area concerned. These revealed that for certain pollutants this route could be of major importance. Further work is clearly needed.

38. Having discussed these issues raised in the evaluation of the input study, the Advisory Committee stressed the importance of studying transport processes in the nearshore and estuarine marine environments and between the coastal areas and the open sea. An understanding of these processes is necessary to connect input data with observations of concentration loads in the marine environment and to arrive at mass balances.

39. The Committee also wished to draw the attention of the Council and the pollution regulatory Commissions to the importance that must be attached to the regular and systematic collection of data on pollutant inputs and recommended that they take all necessary steps to promote the collection of such data. It is probably, however, more appropriate that such routine compilation of data be undertaken by the regulatory Commissions rather than by the Council.

INPUT OF POLLUTANTS FROM THE ATMOSPHERE

40. The Advisory Committee considered a request from the Interim Baltic Marine Environment Protection Commission for information relating to sample collection, preservation and analysis regarding measurement of the deposition of pollutants into the sea via the atmosphere. The Committee decided that at present the best way it could respond to this request would

be to transmit to the Interim Commission several papers on the subject which had been presented at recent Statutory Meetings. The results of these studies of input of pollutants to the sea via the atmosphere had also been briefly commented on in the last Committee report (Coop.Res.Rep. No.76(1977)).

41. These and comparable studies in other parts of the North Atlantic and Baltic areas have been made at shore-based sampling stations. They may give a first approximation to the knowledge of such inputs, but it is not possible to reach safe conclusions about the magnitude of the total input of pollutants to the sea from the atmosphere, and its importance for the mass balance of these substances, before a capability to measure directly at stations at sea has been developed.

42. The Committee has approached WMO and OECD and sought information about the state of the art of such measurements. WMO has commissioned a study of the current basic research in the fields of sample site selection, collection techniques and analytical techniques. WMO is also the lead agency for the GESAMP Working Group on Interchange of Pollutants between the Atmosphere and Oceans. This Group will study, among other things, the problems regarding atmospheric exchange in semi-enclosed seas.

43. OECD has studied the long-range transport of pollutants through the atmosphere. One result of these studies has been to show the importance of individual weather situations, both for the magnitude of pollutants deposited and for the areas of deposition. It will, therefore, not be easy to select sampling sites which are representative of large areas. The OECD studies will be extended to cover additional substances, but they have not covered sea areas and there are at present no plans to do so.

44. It is clear from the information gathered that, although there is considerable activity in this field under the auspices of competent organisations, there is still much research needed before one can contemplate meaningful routine monitoring.

45. The Committee agreed that one should not duplicate work carried out by other organisations, but it will be necessary for ICES to follow closely the developments in this field. One should also, whenever possible, try to promote the exchange of information about methods and other studies (e.g., the significance of air/sea interchange) among member countries. It was suggested that one way to do this could be for the ICES Marine Environmental Quality Committee to select these problems as a "special theme" for one of its forthcoming meetings. In the somewhat more distant future, one should aim at a mechanism for coordination of the member countries' activities, as far as marine sciences are concerned, possibly in cooperation with other interested organisations. In the meantime, member countries should, in view of the importance of these studies for the understanding of the input, as well as the dispersal and fate, of pollutants in the sea, be urged to support, whenever possible, relevant research activities.

INTERCALIBRATION EXERCISES FOR ANALYSES OF METALS AND ORGANOCHLORINES IN FISH AND SHELLFISH

46. Following the intercalibration exercises on heavy metals and organochlorines in biological material (published in Coop.Res.Rep. No.80,(1978)) a fourth intercomparison exercise covering analyses of cadmium and lead only has taken place. The results showed a greater level of agreement among the laboratories than had occurred in the third programme.

47. The Advisory Committee noted with appreciation that a new intercalibration programme will take place in 1978, both for heavy metals and organochlorines in biological material. The same coordinators had agreed to continue their work and the programme would serve laboratories engaged in the ICES coordinated monitoring programme as well as those that are to take part in the JMG programme. Although for the latter only Hg, Cd and PCBs are required, all participants will be invited to analyse the entire range of metals and organochlorine compounds covered in the exercise. Laboratories will thus be asked to report on Hg, Cd, Pb, Cu and Zn, and on an optional basis on Se, Cr, As, V, Co, Mn, Ni, Ag and Fe. For the organochlorine compounds, laboratories will be asked to analyse for HCB, α-HCH, β-HCH, γHCH, dieldrin, DDE, TDE, DDT and PCBs. Standard solutions for the first group of heavy metals mentioned will also be circulated to allow for a check on standards being used by the different laboratories.

48. The coordinators of the intercalibrations have emphasised that any data submitted after the final deadline, once settled, could not be accepted and thus those laboratories could not be considered as having taken part in the intercalibration.

TRACE ELEMENTS IN SEA WATER: COMPILED NATIONAL RESULTS ON LEVELS OF HEAVY METALS. INTERCALIBRATION OF ANALYSES FOR TRACE METALS AND PCBs IN SEA WATER

49. The Committee considered a report of an ad hoc group of the ICES Sub-Group on Contaminant Levels in Sea Water which had been asked to prepare a compilation of the most recent data on trace metal levels in sea water from the North Atlantic and adjacent shelf waters. This report had already been considered by the ICES Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic, the Sub-Group's parent group, which had expressed considerable interest in it, but had expressed regret that it had not been able to consider trace metal levels in inshore areas at least for comparative purposes. The Committee endorsed the view of the parent group and while it recognised that the shortage and lack of comparability of data presented a significant problem, nevertheless, by a careful consideration and evaluation of all the data available, it should be possible to draw a broad comparison between the levels of trace metals in open ocean waters and those inshore. It was noted with satisfaction that the ad hoc group had concurred with this view and had agreed to extend their compilation to near-shore waters in an attempt to draw such a broad comparison. The report will be published in due course.

50. The Committee went on to recall that the original aim of the intended comparison was to consider whether or not the earlier requirement that the Sub-Group should pursue the establishment of an open ocean baseline for trace metals should be continued or whether effort should rather be concentrated inshore, where the major interests of the Oslo and Paris Commissions are focussed.

51. In this context, the Committee discussed the revised proposals of the Sub-Group for the continuation of the intercalibration exercise on trace metals in sea water. The Committee noted with some concern the increasing complexity and elaboration of this programme, but in view of the advanced nature of the fourth stage of the exercise and the endorsement by the parent Working Group of the recommendation for a fifth stage it decided to support its continuation. This support was extended in part due to the basic scientific interest that would be involved in any open ocean programme that might follow a successful intercalibration programme, but largely because such a fifth stage to the intercalibration was regarded by the Sub-Group and its parent Group as an essential prerequisite to even inshore work.

52. Nevertheless, the Committee felt that it would be appropriate to ask the Sub-Group to confirm whether or not abandonment of the open ocean baseline objective and concentration of any baseline and monitoring effort inshore would simplify the intercalibration requirements. In making this request, the Committee also took note of the IOC/UNEP/WMO potential interest in the ICES trace metal intercalibration work as a prelude to any possible monitoring exercise in open ocean waters. The Committee felt able to support in principle, in concurrence with the parent Working Group, the involvement of ICES in intercalibration exercises of this kind, but only subject to confirmation from the interested U.N. bodies that they wished ICES to play such a role and provided that it could be carried out without extra cost to ICES and did not unduly distort the original aims of the ICES intercalibration work.

53. The Committee then considered the request from the Joint Monitoring Group of the Oslo and Paris Commissions for an intercalibration exercise for mercury and cadmium in sea water. The Committee endorsed the recommendations of the Sub-Group that this request be carried out by means of separate exercises for mercury and cadmium, which would be mounted under different coordinators. Following notification from the Commissions' secretariat of the names of the participating laboratories, the coordinators would finalise the plans and launch the exercise.

54. The Committee also took note of the discussion within the Sub-Group and its parent Group in relation to the further request of the JMG for an intercalibration exercise for PCBs in sea water. It endorsed the view expressed that such analyses would be extremely difficult and few laboratories would be capable of usefully participating. The Committee was aware that the Baltic Intercalibration Workshop (Kiel, March 1977) had attempted such an intercalibration and had concluded that a gradual, stepwise approach must be taken before an overall intercalibration could eventually be conducted. Thus, the Committee was of the opinion that, although it would be possible to conduct the intercalibration exercise requested for PCBs in sea water, the present state of the art counselled against the conduct of such an exercise at this time. The Committee, however, agreed that it would keep the matter under continuous and careful review, especially in relation to the intended activities of IOC/UNEP/WMO in this area in the context of possible intercalibration for open ocean studies, and report back to the JMG when it thought it appropriate to proceed. The Committee understood that the JMG's concern in this matter is to follow trends in pollutant concentrations in the marine environment using sea water, and would, if so requested, be prepared to explore and advise on alternative methods by which such trends might be followed without such stringent and difficult analytical methods being involved.

55. The Committee also took note of, and discussed, the desirability of the JMG's suggestion that only a selected laboratory from each country should participate in the planned intercalibration exercises and then subsequently assume responsibility for intercalibration of other laboratories within that country who should participate in the JMG's monitoring programme. There was some difference of opinion, but the Committee agreed with the expert view of the Working Group on Marine Pollution Baseline and Monitoring Studies in the North Atlantic and its two Sub-Groups on sea water and fish and shellfish analysis that it was highly desirable that every laboratory participating in a monitoring programme should take part in one carefully conceived and executed intercalibration exercise rather than a series of sequentially performed small exercises. It was hoped that the JMG might reconsider its views on this matter.

PROGRESS IN THE STUDIES OF POLLUTION IN THE BALTIC

56. The Committee was informed about the developments with regard to the research programme formulated by the ICES/SCOR Working Group on the Study of the Pollution of the Baltic (contained in Coop.Res.Rep. No.42 (1974)). During the field phase of the most recent project conducted by this Group, the Baltic Open Sea Experiment 1977 (BOSEX 77), 6-24 September, extensive physical and chemical observations were obtained. However, the biological observations were more limited and had some severe gaps, as for instance the diurnal migration and the grazing factors. Even so, the biologists felt that essential parts of the programme had been sufficiently covered. The pollution studies had been much hampered by the weather conditions, and the programme had partially been covered only during limited periods of time. The data would not permit a study of the transfer of pollutants through the food chain or between different components of the ecosystem. The physical processes imposed by the very strong winds during most of the period had clearly dominated the conditions.

57. The Working Group has agreed upon a plan for the further evaluation of the data. A special BOSEX meeting is planned on 9 October 1978 in connection with the forthcoming Statutory Meeting. In order to facilitate the exchange of results, the Working Group has further agreed that a BOSEX Atlas should be generated where preliminary results, brief reports, and papers presented at meetings of the Conferences of Baltic Oceanographers and ICES should be included. The circulation will be organised through ICES Service Hydrographique.

58. The Committee noted with satisfaction these developments. The Committee also took note of the plans for future work, summarised by the ICES/SCOR Working Group as follows:

a) Modelling

A considerable amount of modelling work goes on in the Baltic countries and, in order to obtain an overview of this, it was agreed that a Modelling Bibliography should be generated.

b) Coastal dynamics project

The problem of the exchange between the coastal zone and the open sea is a basic one, and a number of research projects are either in progress or are being planned. However, it is difficult to obtain an overview of these programmes and their results. It was therefore agreed that information statements on ongoing work should be prepared by the Working Group members for the next meeting. This would facilitate a thorough discussion of the scientific aspects of the problem and would also give an overview of the state of the art in the Baltic.

c) Assessment of the marine environment

The discussion of this general problem arose from a consideration of the Basic Research Programme, task 6 (year-round biological observations and experiments designed to optimise monitoring of future changes). This task was in part fulfilled through the preparation in 1977 of the document "Assessment of the Marine Environment of the Baltic Sea Area". However, it was felt that the experiences gained in connection with this and other recent studies should be used to reconsider the basic

scientific principles involved in an assessment. It was agreed that this should be taken up as a separate agenda item at the next meeting under the heading "Scientific principles for assessment and surveillance of the marine environment". The Working Group members were asked to prepare for such a discussion and it was agreed to invite members of the Baltic Marine Biologists to take part in the discussion.

d) Substances recently detected in the Baltic

It was pointed out that phtalate esters and polychlorinated terphenyls (PCTs) had recently been found in the Baltic. Regardless of the origin of such substances, it is important to identify and characterise these and eventually other newly-occurring substances in order to assess their possible harmfulness to the environment.

59. The Committee wished to stress the importance of detailed data on the inputs of possibly harmful substances, particularly in respect to items (c) and (d). The Committee also noted that the Working Group will consider the problem of formulation of criteria and standards and wished to emphasise the importance as well as the difficulty of such attempts. The Committee noted the relevance of its own activities regarding this problem (see Paragraph 10, above).

60. During the discussion, it was pointed out that both the Baltic and the North Atlantic Working Groups were tackling many similar problems, although with different boundary conditions. It was suggested that the Working Groups should, at a suitable time, arrange to have their meetings at the same place and to have the meeting dates overlap to a certain extent. This would facilitate the exchange of views and experiences and would also make it possible to harmonise the work somewhat more. In this connection, reference was made to the common discussion session with participants in large-scale experiments carried out in various parts of the ICES area, which is planned for the 1978 Statutory Meeting. The importance of general exchange of experiences from field studies was stressed.

61. The Committee noted with satisfaction the progress of the work in the Baltic and endorsed the actions and recommendations of the Baltic Working Group.

INTERACTION BETWEEN FISHING AND OFFSHORE OIL AND GAS ACTIVITIES

62. At the 1977 ICES Statutory Meeting, a joint session was held between the Gear and Behaviour Committee and the Fisheries Improvement Committee on this topic. Seventeen papers were presented by six countries. The Advisory Committee noted that these papers outlined existing legal and administrative arrangements in relation to gas/oil activities and fisheries, and discussed a variety of aspects of the interaction between the two industries. A major item was interference to fishing caused by debris resulting from oil exploitation. It was recognised that in some areas this could be a significant problem, but that it appeared to be manageable in terms of good housekeeping and adequate clean-up. A comprehensive report on the session is in preparation and will eventually be considered by the Committee.

ACTIVITIES OF THE MARINE ENVIRONMENTAL QUALITY COMMITTEE

63. In addition to activities covered in other portions of this report, the Advisory Committee's attention was drawn to the following activities of the Marine Environmental Quality Committee:

a) Plans for a session on the use of organisms for the detection and monitoring of pollutants

A session of the Marine Environmental Quality Committee at the 1978 Statutory Meeting will be devoted to discussing and evaluating the approach used in "mussel watch" programmes and other studies of this type.

b) Disease in fish and shellfish as an indicator of pollution

In discussing the monitoring of the biological effects of pollution, the former Fisheries Improvement Committee recognised that the occurrence of fin-rot, tumors, skeletal anomalies, etc., in fish and shellfish might be useful in identifying pollution "black spots" and a resolution was passed at the 65th Statutory Meeting requesting further information on this topic. An identification manual has been prepared to assist in this project.

c) Oil spills and follow-up

i) At a short meeting of those countries which participated in scientific work during and after the Ekofisk oil spill, it was arranged that a meeting should be held in February 1978 in Norway to assemble available data and draft a comprehensive account of the incident. This has been done and the resulting book will be published in due course.

ii) An ad hoc group has been set up to plan the details of the scientific response appropriate to oil spill situations. This group met in Brest in June 1978 and will report to the 66th Statutory Meeting.

RELEVANT ACTIVITIES OF THE HYDROGRAPHY COMMITTEE

64. The Advisory Committee took note of progress on two items of concern from the Hydrography Committee:

a) Study Group on Flushing Times of the North Sea

At the request of the ACMP, the Study Group has now included the Skagerrak as one of the regions for which flushing times should be estimated. Individual members of the Study Group are currently collecting and assessing data to estimate the fluxes into and out of the sub-divisions of the North Sea. A further report is expected at the 1978 Statutory Meeting.

b) Input of pollutants via estuaries to the North Sea

The Hydrography Committee, through various Working Groups, had been considering this problem for several years but had been unable to make substantial progress. Although a number of studies had been carried out in individual estuaries, fjords, etc., neither universally applicable guidelines nor fundamental

principles had been established. Nevertheless, the Hydrography Committee felt that some of the experience which had been gained would be relevant to the proposed Workshop on the role of sediments in the retention and cycling of pollutants to be held late in 1979 and had proposed to include hydrography representation at that Workshop.

65. The Advisory Committee acknowledged this information and reiterated its concern with the topic. It further requested the Hydrography Committee to consider the feasibility of ICES holding a Symposium on transfer processes occurring at or near the salt water interface in estuarine and coastal waters.

ANNEX I

MONITORING IN RELATION TO POLLUTION OF THE MARINE ENVIRONMENT

Monitoring

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

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

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

Ideally, of course, the introduction of any potential pollutant should be preceded by a series of studies designed to assess its likely environmental impact and, as a consequence, its actual introduction should be accompanied by any necessary controls. Assessments of environmental impact which precede the introduction of new materials should begin with estimates of the amount of such material likely to be introduced to the environment, together with some idea of its distribution and general behaviour after release, and its known or potential impact on the environment, including man. These assessments should ideally be conducted in a stepwise fashion. They should include a consideration of (a) chemical and physical data, from which tentative conclusions based on stability, volatility, solubility, etc., might be drawn, (b) probable rates and degrees of absorption, and (c) the extent to which the material will be retained in the marine environment and partitioned between the water column, suspended particulate material, and the sediments. These should be followed where necessary by appropriate toxicological testing. Finally, the biodegradability of the material might be determined under realistic conditions. If the material is not degraded completely but converted to persistent intermediate products, the properties and behaviour of these might also have to be determined. The degree to which synergistic effects could be expected between the new pollutant and those already present might then be assessed. On the basis of such assessments any controls deemed necessary should seek to limit the quantities of material introduced to levels where the effects on the environment are considered acceptable.

An important element of any necessary control system will be confirmation that the pollutant is behaving as expected and that the limits imposed on its introduction are being observed. These aspects of control are often referred to collectively as monitoring or, perhaps more strictly, "regulatory monitoring", in which both the discharge and the environment are monitored. Since the design and implementation of monitoring procedures are crucially dependent upon the principal factors emerging from an assessment of potential environmental impact, they should not in practice be divorced from the assessment which should precede them, though they often are.

It might be useful to make a distinction between regulatory or point source monitoring, done for strictly local control purposes relating to short-term objectives, and longer-term environmental monitoring, done through repeated measurement of pollutant concentrations and distribution, usually over a wider geographical area. If the targets requiring protection are known, and if suitable standards for their protection have been defined, then point source monitoring of a local situation designed to show that some critical target or targets are adequately protected can be termed target monitoring to distinguish it from the broader brush, less sharply aimed trend monitoring. This latter category of monitoring usually represents a fall-back position where the polluting effect, if any, is not known with any certainty, so that appropriate standards to protect the target organism(s) cannot be set and no final judgement can be taken with respect to whether concentrations and/or trends are acceptable or not, though a feeling may exist that levels should not be allowed to rise unduly. The position usually adopted then is to keep trends under observation.

In practice, of course, this idealised situation of pre-discharge assessment followed by monitoring is seldom encountered, though it has been largely adhered to in the control of major discharges of radioactivity to coastal marine environments and in some dumping activities. It is more usual, as in the Baltic and North Atlantic baseline contexts, to be in a situation where discharges have persisted for a number of years without either pre- or post-discharge assessment and where baseline monitoring is undertaken in an attempt to assess the current environmental situation with a view to advising, where necessary, on regulatory actions, especially for the near-shore situation and perhaps subsequently to assess the effectiveness of any steps taken to improve the situation, or at least to follow trends.

ICES Baseline and Monitoring Activities

In the sense in which monitoring has already been carried out in an ICES context, it has been done in order to gain information about the present levels of harmful substances in discharges to the marine environment or in the environment itself - water or biota. In assessing the significance of such information, it is necessary to compare the levels found with the best available information about the effects of such substances on human health or that of living resources, or other aspects of environmental quality, so that we may gain an insight into the extent to which we may regard the marine environment in these areas as in a satisfactory condition.

The ICES activities in the North Sea, North Atlantic and Baltic have been concerned with the establishment of pollution baselines, i.e., current levels of discharge and current levels in the environment. In an ideal situation one would wish to relate input or discharge data to levels in the environment, and thus begin to develop the necessary predictive capability on which to base recommendations for regulatory measures where they appear necessary. It is not generally possible to achieve this position with our present survey data, even in relation to the pollutants so far measured, because

a) we do not always have sufficient information on the processes in the environment which influence the distribution (and concentration) of the pollutant in question, e.g., dispersion, degradation, bio-accumulation, removal to surfaces, role of interfaces, etc.; or

b) we do not know how many years of discharge at what rate have led to the observed levels in the environment; or

c) the input data are not sufficiently comprehensive, detailed or accurate.

We are therefore for the moment forced to consider our monitoring effort in the wider trend sense already referred to, that is, to observe trends in time and space against the background of our baseline results and any measures taken to regulate the situation. We may, however, note that levels are higher in some areas than others and in some cases be able to deduce, in a general way, that inputs are higher in these areas, or at least high in relation to the environment's capacity to dilute, disperse and/or degrade the material introduced, e.g., coastal areas versus open sea, or Baltic, Irish Sea, Southern Bight of North Sea and Gulf of St Lawrence compared with the Norwegian coast or the west coast of Greenland.

The ICES coordinated monitoring programmes in the North Sea and other areas are a step towards watching trends in coastal areas and some adjacent open sea areas. To improve the overall quality of the baseline, we need to extend its coverage to other media (e.g., sediments, atmosphere) and pollutants, guided by what we already know from the existing baseline data about geographical areas and pollutant levels. We need especially to improve the quality and coverage of input data for the pollutants already studied, e.g., Hg, PCBs, with respect to area, concentrating in the first instance on those areas where levels in the environment appear highest or of greatest significance. Consideration also needs to be given to process-orientated studies which will give us some understanding of the mechanisms leading to the observed distributions.

It may then be possible over a series of years to usefully relate trends in input to trends in environmental levels in broad geographical areas. The additional step may then be considered as to whether we wish to reduce levels further, provided that we have standards of exposure for the pollutants in question in relation to the targets we wish to protect. We might otherwise be forced to continue the policy of expediency so far adhered to for most pollutants and continue to keep pollutant input to the lowest practicable levels based on reasonable costs of effluent treatment, but without the requisite knowledge to judge whether or not such expenditures are warranted in relation to the value of the improvement they may lead to. Another major missing component in the present situation is thus the provision of appropriate exposure standards against which to judge the efficacy of any regulatory system. Without them, monitoring of environmental conditions cannot proceed except in the wider sense of trend determination. Their development may present extreme difficulties, but attempts even on an empirical basis would be a step forward.

The direct monitoring of biological effects and the interpretation in unequivocal terms of data gathered in such an exercise require a completely different approach to monitoring compared with that based on chemical residue analysis. It will require much further research effort before a point is reached where sensible coordinated monitoring programmes on biological effects can be deployed; such research effort is now underway. Meanwhile, chemical residue monitoring will have to be evaluated, where possible, in terms of biological effects on marine organisms by comparison with carefully assessed toxicity data and associated residue levels in test organisms. Standards may have to

be set, for the time being, on a purely empirical basis from toxicity testing primarily in the acute range. The design of sampling and analytical protocols for this biological monitoring will have to be set up on a rather different basis than residue monitoring conducted in a public health context, e.g., selection of critical targets, critical tissues, etc., for specific pollutants and specific areas.

Target Monitoring

Where target monitoring can be conducted on a sound basis, the guiding principle must be to deploy the monitoring effort as close to the critical target as possible, since the essential requirement is to derive data capable of the most simple and accurate interpretation of target exposure. If, for example, the critical target is the consumer of sea food, the ideal situation would be to monitor the body burden of the pollutant in the target, i.e., man. Failing this, the burden in the consumable product, e.g., fish, seaweed or shellfish, should be monitored. There is scant justification for monitoring the water mass unless the kinetics of bioaccumulation for the pertinent pollutant/biota combinations are known and from which sensible biota concentrations may be estimated from the water data. This technique has, however, been used for estimation of ^{137}Cs intake through fish consumption. The difficulties of representative water sampling should not be under-estimated.

In order to obtain data relevant to the assessment of target exposure, especially, for example, where the body burden of the target organism cannot be determined directly, it may only be necessary to determine concentration in some secondary target at relatively infrequent intervals, e.g., quarterly, half-yearly or even annually. It will in any case often be possible with persistent materials to bulk samples with respect to time and/or space and thus reduce the analytical effort.

The sensitivity and precision required in the determination of pollutant concentration requires careful judgement. If standards of exposure are known and pollutant concentrations are only a few percent of acceptable levels, there is little point in deploying analytical techniques capable of high precision at low concentrations.

Again, as with trend monitoring, if the behaviour of the pollutant with respect to fractionation, reservoirs, sinks and critical targets is understood on even a broad brush basis, the need to monitor concentrations in all but a few media may be dispensed with at an early date.

Finally, all monitoring operations of whatever kind should have clearly defined objectives and should be subject to regular and rigorous review, both in terms of the objectives and from the point of view of the resources deployed for their attainment.

ANNEX II

PROCEDURES TO BE FOLLOWED FOR SAMPLING AND PREPARATION OF FISH AND SHELLFISH TO BE USED IN MONITORING PROGRAMMES IN THE NORTH ATLANTIC AREA[1)]

1. Samples of fish or shellfish which are collected in connection with programmes designed primarily to assess the risk to human health are not always suitable for the detection of trends in either space or time, other than on a broad scale. In a public health context no set limits are suggested since it is obviously necessary for the samples collected to reflect the commercial landings and these will vary from site to site and country to country. However, as far as practicable, samples should be collected at the same time of year, and in the same conditions.

2. Multiple regression analysis of pollutant concentrations in relation to several physiological factors shows that in order to be able to establish small changes in pollutant concentrations with time or space, it is necessary also to have full information on the various physiological factors which can have an influence on the concentration of a pollutant found in an organism.

3. Thus, in order to be able to use samples of fish which are collected for human health risk assessment purposes for trend assessment as well, it is necessary to analyse the organisms individually and to determine their age, length, weight, and sex whenever possible and to calculate the condition factor and liver somatic index, so as to allow for a multiple regression analysis.

4. It may be possible to use fish samples without collecting information on all these variables, for any particular species, or pollutant, or area, provided that a thorough investigation is first made using multiple regression techniques to establish the critical variables. Once this investigation has been completed, it should be possible to standardise the critical variable(s). However, it is likely that this will have to be done separately for each species, pollutant and area, as different variables are likely to be significant in different cases.

5. Areas from which samples are to be taken will be those which countries have designated to the Secretariat of the Oslo and Paris Commissions[2)].

---

1) The footnotes found in these Procedures contain special instructions for laboratories participating in the ICES Coordinated Monitoring Programme and may be ignored by other laboratories.

2) Areas of special interest are the entire Irish Sea; the German Bight and Southern Bight of the North Sea; the estuaries of the Thames, Forth, Rhine, Schelde and Clyde; the Skagerrak, Kattegat, and Oslofjord; and certain parts of the Gulf of St Lawrence and the New York Bight.

6. Species on which sampling should be concentrated are mussels (Mytilus edulis), shrimp (Crangon crangon), and two of the following fish species: flounder (Platichthys flesus) or plaice (Pleuronectes platessa) and mackerel (Scomber scombrus or Scomber japonicus) and cod (Gadus morhua) or hake (Merluccius merluccius)[3].

7. All samples should, wherever possible, be collected in a manner which is similar in successive years for the particular species and sampling site.

8. All fish samples should be collected ungutted and preserved (deep frozen) as soon as practicable after collection, and length, weight and age should be determined before deep-freezing, if possible.

9. A sample of fish should consist of 20, or at least 10, individual specimens; if possible, each individual should be analysed separately. If this is not practicable, an equal-sized portion should be taken from each fish and the mixture should be thoroughly homogenised and the analysis done in duplicate. Details on sample preparation for analysis are given in Appendix I.

10. For environmental trend assessment, the muscle and liver of fish and the soft tissue of mussels should be analysed. For human health risk assessment, it is only necessary to analyse the muscle tissue of fish, in homogenised samples if more convenient, the peeled tail of shrimps and the soft tissue of mussels.

11. Mussels should be held in clean (settled) sea water from the area of collection for 12-24 hours to allow discharge of adventitious silt material as pseudofaeces. For trend assessment, maximum length regardless of orientation should be measured for each specimen. The number of individuals in each length range chosen should be recorded for each site and this distribution should thereafter be utilized for that site each year samples are collected.

12. A mussel sample should consist of at least 50 individuals and, after cleansing and measuring as described in 11 above, the individual animals should be carefully freed from their shells by cutting the adductor muscle. The shell cavity liquor should be discarded and the entire remaining shell contents placed in a beaker. The bulked body body meats may then be preserved (deep-frozen) or prepared for analysis.

13. A sample of shrimps should consist of at least 100 individuals and should be prepared for analysis by boiling in sea water, from the area of collection, for 10 minutes. The tails should then be removed, peeled and thoroughly homogenised in preparation for analysis. (This process assumes that the reason for selection of shrimps was purely for human health assessment, since a wide range of factors, not all of which are mentioned in 3 above, can affect the total body burden of a pollutant in shrimps.)

14. Pollutants to be analysed in particular are mercury, cadmium and PCBs[4].

---

3) In addition to the species named above, species also of value are herring (Clupea harengus), pilchard or sardine (Sardina pilchardus), and sole (Solea solea or Solea senegalensis).

4) Additional pollutants of special interest are copper, zinc, arsenic, lead and selenium, HCB and organochlorine pesticides. Data on other substances may be included at the discretion of the individual participants.

15. All results of analyses of fish and shrimps for metals are to be reported on a wet weight basis and preferably also on a dry weight basis. All results of analyses of mussels for metals are to be reported on a dry weight basis. All results of analyses for organochlorine compounds must be reported on both a wet weight basis and on an extracted fat weight basis, or as a minimum be accompanied by a fat weight determination result.

16. Dry weight determinations should be carried out in duplicate by air-drying to constant weight at 105°C of sub-samples of the material analysed for the pollutants.

17. Fat weight should be determined on a sub-sample of the extract used for the organochlorine compound analyses. The results should be accompanied by a brief description of the method used for extraction.

18. In all cases, full results of all analyses performed should be provided, i.e., individual data, geometric mean and second moment about the mean (assuming log-normal distribution of data) or arithmetic mean and standard deviation, together with full details of the site, date and method of collection, preservation details (if appropriate), date of analysis and brief details of the methods used. In the case of the results for PCBs, the formulation used for the quantification should be stated, and examples of typical standards and PCB chromatograms should be provided.

19. Analytical results should be submitted on an individual laboratory basis from laboratories which have recently taken part in an ICES intercalibration exercise. The name of the laboratory should be provided together with the details of the intercalibration exercises[5].

---

5) For laboratories participating also in the ICES Coordinated Monitoring Programme, data should be reported also to the Environment Officer (with a copy to the Chairman of the fish sub-group) not later than 31 March of the calendar year following that in which samples were collected.

ANNEX II, APPENDIX I

PREPARATION OF SAMPLES FOR ANALYSIS

1. When directly handling tissues to be used in analysis of harmful substances, all sources of possible contamination should be avoided. For material to be used for heavy metal analysis, direct contact with metallic substances should be avoided. Similarly, material to be used for analysis for organochlorines should not be placed in direct contact with plastics. As a general rule, the contact time between the sample and the tools should be kept as short as possible. Grinding procedures should be checked very critically to make certain that no contamination can occur and in removing the tissue and placing it in containers, it is very important to use appropriate materials, tools and storage containers.

2. To prepare material for metal analysis, cut or crushed pieces of glass should be used except for Hg analysis, in which case acid-resistant stainless steel scalpels may be used. Homogenisation and grinding of deep frozen material should be carried out using materials of silica or Teflon.

3. For organochlorine analysis the material may be cut with acid-resistant steel scalpels and homogenised using Ultra Turrax type homogenisers. All the tools used must be thoroughly washed and cleaned to prevent sample contamination.

4. The dissection room should be kept clean and the air should be freed from particles as much as possible. It is an advantage if the work can be carried out in a hood or under some shelter in order to prevent a direct fall-out of particles onto the sample. The dissection should always be carried out on a clean glass plate with the appropriate tools for each type of contaminant.

5. The dissection of fish is easiest when the material is half frozen, at least concerning the surface layers of muscle tissue. For dissection of other organs, the thawing must proceed further, but it is an advantage if, for example, the liver is still frozen, as the loss of liquid and fat when cutting the tissue makes the determination of dry weight and fat content less accurate.

6. The epidermis and subcutaneous tissue should be carefully removed from the fish. Samples should be taken under the red muscle layer. In order to ensure uniformity of samples, the right side dorso-lateral muscle should be taken as the sample. If possible the entire right dorsal lateral filet should be used as a uniform sample, from which sub-samples can be taken after homogenising for dry weight, heavy metal and organochlorine determinations. If, however, the amount of material so obtained would be too large a sample, a specific portion of the dorsal musculature should be chosen for the sample. It is recommended that the portion of the muscle lying directly under the first dorsal fin or, in flounder, plaice, and sole, the central part of the filet, be utilised in this case. As both fat and water content vary significantly in the muscle tissue from the anterior to the caudal muscle of the fish, it is important to obtain the same portion of the muscle tissue for each sample to ensure comparability of samples.

7. After muscle preparation, the liver should be completely and carefully removed while still partly frozen to avoid water and fat loss. Immediately after removing it from the fish, the liver should be returned to the freezer so that it will be completely frozen prior to further handling. This is particularly important for cod liver.

8. The whole soft body of the mussels including the adductor muscle should be carefully removed and combined with the others in the sample. In removing the mussel from the shell by cutting the adductor muscle, care should be taken to avoid excessive tissue damage and thus cell water loss. The sample should either be prepared for immediate analysis or stored in a deep freezer.

9. If the sample is to be used for trend analysis, for each fish the total body weight in grams should be recorded, as well as the total length (length between the nose tip and the tip of the tail) in centimetres. The sex should be indicated if at all possible. The age should be determined and should generally be given according to the number of annual rings on the scales or otoliths.

10. The weight of the liver should be recorded in grams. Obtaining the correct liver weight can depend on using the appropriate procedures. The complete liver should be removed very carefully during dissection of the partly-thawed specimen. This should be done by a person skilled in the technique to ensure that the full sample is obtained.

11. As a measure of physiological condition, the Liver Somatic Index and the Condition Factor should be calculated for each fish.

The Liver Somatic Index is obtained by

$$\frac{\text{weight of liver}}{\text{total weight of fish}}$$

The Condition Factor of the fish is calculated as

$$\frac{W \times 10^5}{L^3}$$

where W (in g) is the total body weight, and L (in mm) is the standard length (the length between the nose tip and the last caudal vertebra).

INDICATION OF SPINE COLOURS

Reports of the Advisory Committee on Fishery Management	Red
Reports of the Advisory Committee on Marine Pollution	Yellow
Fish Assessment Reports	Grey
Pollution Studies	Green
Others	Black

-o-o-o-