International Council for the
Exploration of the Sea

C.M.1992/C:3

REPORT OF THE
WORKING GROUP ON SHELF SEAS OCEANOGRAPHY

Copenhagen, 26-28 February 1992

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CONTENTS

1 OPENING

The meeting opened at 10.00 am on Wednesday 26 February 1992. The Group welcomed Stig Carlberg and Lars Foyn of the MCWG, and Johan van Bennekom of the Oceanic Hydrography Working Group. Bill Turrell agreed to act as Rapporteur.

On the second day of the meeting, the Group was joined by Dr Skjoldal of the Expert Group on Nutrients to the Paris Commission.

2 APPROVAL OF AGENDA

The agenda was approved, with the addition of an update report on SKAGEX to be presented under Agenda Item 6.

3 MATTERS ARISING

3.1 Theme Sessions

It was noted that the planning of the Theme Session on Upwelling, to be held in December 1993, was well underway. The Group was reminded that the Hydrography Committee would welcome ideas for future Theme Sessions. One suggestion put forward was a Theme Session entitled "Marine Digital Atlases - GIS in the coastal zone". This would be convened by John Ramster (MAFF, UK). An outline should be presented to the Hydrography Committee at the Statutory Meeting.

3.2 Harmful Algal Bloom Meeting

The forthcoming meeting on Algal Blooms, to be held in Vigo (Spain) April 7-9 1992, was described. In this context, the importance of the interrelation between physics and population dynamics will be emphasised and it is hoped that this meeting will highlight an interdisciplinary approach to the problem of algal bloom dynamics.

The IOC dissemination of information relating to algal blooms via the Harmful Algal Blooms Newsletter, initially in the UNESCO IMS newsletter, was described.

3.3 Cod and Climate

The cod and climate program seeks to link physical oceanography (circulation and mixing) to the early, and possibly crucial, life-stages of cod, through modelling and experimental work. Hence long-term changes in the abundance of this species may be related to climate. If it is not possible to arrive at deterministic mechanisms for this well-studied fish species, then there is little hope for the eventual understanding of environmental factors influencing long-term changes in other fish stocks.

A list of necessary steps required to link oceanic and coastal circulation models produced following the Oceanic Hydrography Working Group (Hamburg 1991, ref ICES C.M.1991/G:78) has not yet been followed up.

A programme which may be of interest to the Cod and Climate Steering Group is the successor to JGOFS; the International GLOBEC (IGLOBEC) programme focusing on secondary production in the sea. One example of 'climate' influencing cod stocks is provided in the Barents Sea. Warm periods coincide with increased abundance of cod. This may be related with increased Atlantic inflow to this semi-enclosed sea area, resulting in increased nutrient supply and hence increased productivity.

4 NORTH SEA NUTRIENTS

This agenda item occupied the greatest portion of time during the Working Group meeting. During the discussions 10 documents were used by the Group and are listed in Appendix 2. These are referred to in the following text by their respective Document Numbers.

The terms of reference are in Annex I. In addition the Working Group Chairman was asked to review and comment upon the document now called "Definition of problem areas with regard to nutrients" JMG 17/Info 12-E (Document No. 2). This document originated as Annex 8 from the report of the 6th meeting of the Paris Commissions Nutrients Working Group (29 October -1 November 1991). The document was discussed at the 17th meeting of the OSPARCOM Joint Monitoring Group (JMG) (20-24 January 1992). The JMG felt that a review of the document by ICES would be beneficial prior to consideration of this document by the Technical Working Group (TWG). Once the TWG has reviewed it, the ultimate recipients of the document will be the Ministerial Conference in September 1992, and the North Sea Task Force in July 1992.

Hence the SSOWG has been asked to comment on this document by the Chairman of the ACMP (ICES), Dr G Topping.

The sampling strategy protocol review was focused on part of Annex 9 of the report of the MCWG 1991, entitled "Basic guidance for sampling and the determination of nutrients in sea water" (Document No. 10), which referred to sampling strategy.

In addition to these main tasks, two papers were received by the Group for discussion. These were supplied by Dr

R.R. Dickson (Document No. 4) and Dr B.E.M. Schaub (Document No. 3).

The result of the Group's discussion relating to the two main tasks are presented below. Details of the discussions are presented in Appendix 3.

4.1 Review of JMG 17/Info 12-E (Document No. 2)

The SSWG reviewed the document JMG 17/Info.12-E "Definition of problem areas with regard to nutrients". The Working Group focused on the hydrographic and nutrient aspects of the document.

The SSOWG stressed that this JMG 17/Info. 12-E is not a scientific document. It is an incomplete synthesis of papers, reports and discussion documents, many unpublished and never subjected to critical review. As well, the bibliography is quite incomplete with respect to the relevant, well-known scientific literature.

Specific Comments:

With respect to Figure 1:

It is confusing plotting both "highest winter nutrient concentrations" in some areas and "elevated winter nutrient levels" in other areas. The Working Group questioned the utility of "highest" levels. Also, the figure combines N, NO_3 and P. Such a plot trivializes the present state of knowledge on nutrients in the North Sea. A more appropriate approach is shown by the present draft (1:31/1/91) of the Report of the Expert Group on Nutrients to the Paris Commission Working Group on nutrients (Doc. No. 1), by Weichart (1986-Doc No.7), Korner and Weichart (1991-Doc. No.8) and by van Bennekom and Wetsteijn (1990-Doc. No. 6).

With respect to Figures 3.2.1 and 3.2.2:

These figures, although they (incorrectly) reference Laevastu (1983 - should be 1963), really go back to Bohnecke (1922). As such, they are not representative of the present knowledge of the circulation and water masses of the North Sea. Otto *et al.* (1990) have presented an updated review with a bibliography.

In Conclusion:

With respect to nutrients and hydrography, the SSOWG feels that the document should not be considered an appropriate discussion of the situation for its proposed audience. The document's utility may have been to focus energy on the analysis and interpretation of the available data but it should now be set aside in favour of more complete and accurate analyses.

4.2 Review of Annex 9, MCWG Report

At its meeting in 1991, the SSOWG had reviewed and commented on a text on "Basic guidance for sampling and determination of nutrients in sea water" that was produced by the MCWG at the specific request of ACMP for the use of the NSTF and the Nutrient Working Group of OSPARCOM. The two ICES Working Groups had their meetings almost back-to-back but in different countries and, therefore, the document had been transferred, without comments, by telefax at the very last moment. The SSOWG had duly offered its comments on what the Group then perceived as deficiencies in the text.

However, three members of the MCWG attended the 1992 meeting and in the discussion it was realised that the two Working Groups in their meetings in 1991 had roughly the same reservations against the development of the guidelines since:

a) the use (and the users) of the guidelines was not identified.

b) it was understood that the institutes that would be involved in monitoring of nutrients in the North Sea would be existing oceanographic institutes which are already dealing with the task in a professional manner.

The SSOWG then considered the fact that not only was the subject on the agenda of the 1992 meeting but also that ACMP, in view of the critical comments offered by the SSOWG in 1991, wanted an intersessional input from the Group in order to finalize its advice to the Commissions in 1992.

The SSOWG then reviewed the present situation and noting that the Monitoring Master Plan of the NSTF is already fully implemented and that plans for the continued monitoring of nutrients in the North Sea are being considered within the process of revising the Oslo and Paris Conventions, the SSOWG decided that the best way of assisting ACMP would not be to contribute a revised guidelines document, but rather to offer its services in participation in the work of the Commissions to design a revised programme for the monitoring of nutrients in the North Sea area.

Therefore, the SSOWG recommends that:

1. The SSOWG, or a sufficient number of its national members, should be involved in the design of a programme for the monitoring of nutrients in the North Sea within the framework of the revised Oslo and Paris Commissions.

and that

2. The SSOWG should have a meeting back-to-back with the MCWG in 1993 to discuss matters of common interest e.g. nutrients and other interdisciplinary aspects of shelf seas oceanography.

4.3 Some General Comments on Nutrients Trends

The Working Group has previously discussed nutrient trends (Lisbon) suggesting that too much energy is focused on this aspect of the problem. It is not the increased nutrients in the water column, but rather, the increased flux of nutrients into the coastal zone and the increased plant growth, that causes difficulties.

To focus on the trends in the level of nutrients, requires one to pick a time of year when biological effects are minimized. Hence, the comparisons are done in late winter. However, the major peak in runoff is at the end of the winter (e.g. Figure 2 document 1), usually after the period in which the comparisons are done. Given that the flushing time of the North Sea is on the order of 12 months, then what increases in nutrients do appear as a trend are a decaying integral of the previous years contribution, and may well not be at all indicative of the increased potential for undesirable production.

5 FUTURE OF WORKING GROUP

A general discussion took place on the possible future role of the SSOWG. Suggestions from the Group included an increased involvement in the Cod and Climate program, participation in the forthcoming harmful algal blooms study. One suggestion was that the oceanographic chemistry sub-group of the MCWG might join with the SSOWG to form a group which discussed more interdisciplinary subjects. The Group might like to review the work of the Hydrographer, and how ICES data are collated, presented and disseminated within ICES. Another idea was that the Group might like to consider fluxes within the ICES area, concentrating on shelf seas/ocean exchange and riverine/coastal exchange. One method of organising such a study would be an atlas of fluxes in the ICES area, which might supersede and replace Report 123 which currently forms the basis of many studies of the North Sea (including the NSTF MMP and QSR). A compilation of all the known quantifications of fluxes, and their variability both on seasonal and interannual timescales, within and into the shelf seas of the ICES area (not just the North Sea) may reveal significant gaps in our knowledge and hence stimulate future research programs. A related topic suggested for discussion by the Group was the role of advection in productivity studies, and the vital importation of material into any sea area.

Owing to the small number of members of the SSOWG present it was decided that the retiring Chairman will poll the present membership as to the future role and chairmanship of the Group. If no response is received from individual members it will be assumed that they no longer wish to actively participate in the Group.

Hans Dahlin was suggested as the next chairman of the Group. However, other commitments prevent his immediate acceptance of the chair, although these may alter before the next meeting of the Hydrography Committee.

6 OTHER BUSINESS

SkAGEX: Dr Hans Dahlin presented the Group with an update of the SKAGEX program. The experiment commenced in May/June 1990 and ended in May/June 1991. The analysis of data is progressing well, and ICES is acting as the data centre for the experiment. Preliminary results have been presented at the 1991 Statutory Meeting (C.M.1991/C:2). A data atlas will be released in March 1992, and a SKAGEX Workshop will be held in November 1992.

The progress of two other programs were described to the Group. These were the Benthic Links and Sinks (BeLS) program described by van Bennekom and the Land Ocean Interaction Study (LOIS) presented by John Howarth.

APPENDIX 1 - Terms of Reference

(From C.Res.1991/2:35)

The Working Group on Shelf Seas Oceanography (Chairman: Dr T. Osborn, USA) will meet at ICES Headquarters from 26-28 February 1992 to:

a) Develop further the protocol for a sampling strategy for determining nutrient trends in the North Sea;

b) report on work currently underway on the assessment of the nutrient status of the North Sea;

c) report to the 1992 meeting of ACMP and to the Hydrography Committee at the 1992 Statutory Meeting.

Members of the Chemical Oceanography Sub-Group of the Marine Chemistry Working Group, and members of the PARCOM Group on Nutrients (NUTS) will be invited to attend.

APPENDIX 2 - List of Documents used under agenda item 4

1. Colijn, F., H. Dooley, N.J.P. Owens and H.R. Skjoldal (1992). Report of expert group on nutrients to the Paris Commission working group on nutrients. Draft 1:31/1/92.

2. Anon.(1991). Definition of problem areas with regard to nutrients. JMG 17/Info.12-E.

   Previous title: Basic maps of agreed adverse eutrophication symptoms and an integrated administrative map of potential problem areas; a compilation and synthesis.

3. Schaub, B.E.M. and W.W.C. Geiskes (1991). Eutrophication of the North Sea; the relation between Rhine river discharge and chlorophyll-*a* concentration in Dutch coastal waters. In: Estuaries and Coasts; Spatial and temporal intercomparisons. Eds: M. Elliott and J.-P. Ducrotoy, Publ. Olsen and Olsen.

4. Dickson, R.R. and D.S. Kirkwood (1992). Analysis of historical phosphate data for the southern North Sea. Submission to NSTF QSR 1992.

5. van Bennekom, A.J. (1992). Note on the winter concentrations in Dutch coastal waters influenced by the river Rhine; emphasis on changes after 1985. Submission to SSOWG.

6. van Bennekom, A.J. and F.J. Wetsteijn (1990). The winter distribution of nutrients in the southern Bight of the North Sea (1961-1978) and in the estuaries of the Scheldt and the Rhine/Meuse. Neth. Jour. of Sea Res., 25(1/2), 75-87.

7. Weichart, G. (1986) Nutrients in the German Bight, a trend analysis. Dt. Hydrogr. Z., 39, 197-205.

8. Korner, D. and G. Weichart (1991). Nahrstoffe in der Deutschen Bucht, Konzentrations-verteilung und Trends 1978-1990. Dt. Hydrogr. Z. erg-H. A.,17, 3-41.

9. Anon. (1987). Spatial distribution of nutrients in the North Sea and their natural background and reference values. 2nd meeting of the WG of nutrients, Stockholm 27-29 October 1987, NUT 2/5/2-E.10.

10. Anon. (1991). Basic guidance for sampling and the determination of nutrients in sea water. Annex 9, report of MCWG, CM 1991/Poll:4.

APPENDIX 3 - Details of discussion under Agenda Item 6

Document 1 - Colijn, Dooley Owens and Skjoldal (1992)

The background to this document was described by the ICES Hydrographer to the Group. The NUTS Working Group was requested by the NSTF to prepare a realistic report which will form the background for the separate regional reports submitted to the 1992 QSR. The report was prepared during a short meeting of four of the NUTS group's members, and employed the 1985-1991 ICES nutrient database (of which over 50 % was provided by Lars Føyn), compared to data from two surveys in 1935/36 (Poseidon). It also addressed algal effects. As this report has not yet been submitted to the QSR, it is appropriate that the SSOWG makes suggestions as to possible revisions of the document.

The Group felt that the limited amount of historical data (i.e., just two surveys) should be stressed, and that the actual data coverage should be demonstrated on the figures. The Group also thought that ratios of historical to present data were more meaningful than differences. These last two points were addressed by the ICES Hydrographer, who presented the Group with revised figures incorporating their suggestions. The sparseness of the data is evident in these figures as the station locations are plotted along with the contours.

There was also some concern within the Group that numbers presented in the two tables did not match. These were nutrient inputs by country of origin (Table 1) and nutrient inputs by ICES flushing box (Table 2). Although it was initially thought that this was due to the addition of atmospheric inputs to the numbers in Table 2, it was later explained by Dr Skjoldal, one of the paper's authors, that this was not the case. The discrepancies arose from the omission from Table 1 of significant sources such as the River Elbe, as it was constructed from preliminary data, and that Table 2 indicated total N and P. The Group stressed that Tables 1 and 2 should be made to coincide, and that their legends should be expanded and clarified.

Figure 4 in the paper was queried. Dr Dooley thought that this diagram was in error and that it will be revised for the final draft of the paper.

Some of the general remarks in the text were questioned by the Group.

The statement that "no evidence for increases in phosphate outside the coastal band was apparent" (p.2 - 3rd para), referring to the coastal areas in the Southern Bight of the North Sea, was queried. van Bennekom presented evidence that did indicate increase in the offshore waters (Document No. 6) since 1935. Dickson and Kirkwood (Document No. 4) come to a different conclusion. More analysis is still required of the data available.

The use of trends since 1976 may be misleading as no increase is expected in coastal waters during this period. In fact a decrease of the slope of the phosphate/salinity regression has been observed since 1977 (Document No. 5). However, the observation of trends in nutrient/salinity relationships should always be considered along with the degree of analytical accuracy involved in the measurements.

It was felt that the link between nitrite (NO_2) distributions and areas of low oxygen content may be too easily made by the reader, if not intended by the authors. There are biological mechanisms which may produce patches of high nitrite concentrations in the early spring (February and March) which are only transitory and are removed once the length of the daylight period increases. The authors must ensure that the complex processes resulting in nitrite distributions are fully described. The statement, for example, on p.7, 3rd paragraph that "such [nitrite] concentrations in marine waters are invariably associated with low oxygen environments" requires expanding. The report also uses nitrite and oxygen distributions from different seasons, and hence are not directly comparable. The use of oxygen saturation values would be preferable to mg/l.

The description in the document of the Jutland current was questioned by the Group. It was felt that this current is more variable than the text implies, and that the resulting transport into the Baltic is highly variable.

The Group questioned the definition of eutrophication as stated in this document. The ICES Hydrographer will check the official ICES description of this term.

A general discussion followed on the section of the document covering the N/P ratio. Since the ratio is often calculated using just NO_3 and PO_4, the general oceanic value of 16 is not always found in the North Sea in winter owing to early productivity, especially in shallow well-mixed areas such as the Dogger Bank where the nitrogen may be in the form of nitrite and/or ammonia.

Non-standard Redfield ratios have been related to the occurrence of toxic forms of algal blooms. In this aspect silicate is another limiting factor. It has recently been shown that some species may also become toxic under nitrate and phosphate limitation. Dinoflagellates responsible for red-tide phenomena often have reduced growth rates and are favoured by an increased N/P ratio. There is some concern that removal of P in source waters can result in an excess of N which is exported into adjacent coastal areas causing disturbance. However in this context the effect of the availability of silicate

must first be addressed. The text may over-emphasise the importance of phosphate limitation when in fact problems are caused by nitrate excess.

Much of the evidence relating to N limitation in freshwater has been gained from studies of North American rivers (e.g., Ryther). European rivers often exhibit much higher N/P ratios owing to the greater land usage in Northern Europe. The alteration of N/P ratios in rivers requires considerable socio-economic change and hence political will.

Figure 6 in this document caused some confusion. It appears it is a plot simply joining derived fresh water concentrations in the River Rhine to perceived offshore/Atlantic water concentrations. The derivation of nutrient values at zero salinity is not described, but the Group assumes it is the result of back-extrapolation using nutrient/salinity regressions from observations obtained along a salinity gradient. The value of these back-extrapolated values was questioned, particularly as they are vulnerable to considerable uncertainty if only the more saline end of the zero to ocean salinity gradient is sampled.

In conclusion, the Group felt some concern that while the number of reports describing nutrient levels in the North Sea is increasing, driven by projects such as the QSR, the amount of new, in depth analysis is not, and the time available for the authors of these reports is, in fact, decreasing. For example, this report was written separately by the three authors who then had only a fraction of one day together. Although the approach was good, the Working Group identified many specific points of concern and felt it was not an adequate resumé of a complicated subject. As well the SSOWG does not see this report in the context of the other material it will finally accompany. The result is a multitude of reports which present incomplete pictures of the status of the North Sea.

Document 2 - JMG 17/Info. 12-E (Basic Maps)

Although this document was presented to the JMG by the Nutrients WG of the Paris Commission following their 1991 meeting, it was felt by the SSOWG that much of the content of the document was not new. For example, the Hydrography Committee during the 1989 Statutory Meeting in Bergen discussed a forerunner to this document and at that time felt it was open to misinterpretation by non-specialists lacking sufficient background knowledge.

The Group stressed that the document was not a scientific paper, rather it is a synthesis of many reports and discussion documents, many unpublished and not subjected to peer review. The Group felt that in many aspects the figures and text are not consistent with current scientific understanding. Specific examples were selected from the document:

Figure 1 - the background level of 10 umol N/l for the central North Sea exceeds most documented values in this area (e.g., see Document No. 7, Weichart 1986).
Figure 1 - Again is in conflict with well researched descriptions of actual nutrient concentrations, as represented, for example, by Document No. 4, Dickson and Kirkwood 1992. They present the results from 24 surveys in the area 52°N - 54°N and 2°W - 5°W conducted since 1935. None of their means exceed 0.8 umol P/l as indicated by Figure 1.

Figure 1 and text (p.5) - these both refer to areas of temporary elevated levels of nutrients along the southern Norwegian coast. It is not mentioned that this is a natural phenomenon arising from upwelling of nutrient-rich water of recent Atlantic origin.

Figures 3.2.1 and 3.2.2 - These derive from a 1922 reference and do not now represent current scientific opinion of the circulation of the North Sea. They should not be appearing in a 1992 document.

The Group felt that Figure 1 was particularly unhelpful for a number of reasons. The figure presents two separate parameters (highest winter nutrient concentrations and elevated nutrient concentrations). It combines three separate nutrient species (P, NO3 and N) on one map. The concept of highest winter nutrient concentrations was questioned by the Group as it felt it was this may be incorrectly influenced by a few unrepresentative values, and analytical errors.

A better approach is that employed by the Expert Group of the Paris Commission WG on nutrients (Document No. 1). They present similar maps to Figure 1 of this document, but these are derived from actual nutrient distributions in specific years compared to the 1935/36 Poseidon survey data (Doc. No. 1 - Figure 1), or from mean distributions computed from 7 years of observations compared to the historic distribution (Doc. No.1 - Figure 10).

The indication on Figure 1 of areas where no reliable background values are available is not understood by the Group. The Group assumes that this refers to the lack of 1935/36 data from the UK coast, but is unclear on this point.

While not wishing to comment upon the plankton distributions, the Group did feel that all of the figures lacked any indication of the extent of data coverage. Hence blank areas on the maps may be simply the result of a lack of data from these areas.

The Group examined the validity of the references employed by the document. One was selected at random - reference 92 p20 NUT 2/5/2-E (Document No. 9). This proved to be an unrefereed document itself employing both published and unpublished reports. A full review of this document is presented later.

Finally the ACMP should draw the TWG's attention to two imminent meetings of relevance to the updating and accuracy of this present document. These are:

1. Workshop on background levels in the North Sea and adjacent areas. Organised by Reni Laane (Netherlands), the Hague, 6-10 April.

2. Workshop to discuss background nutrient levels in the Kattegat and Skagerak, last week of April. Contact Stig Carlberg for details.

Document 3 - Schaub and Geiskes (1991)

This paper, submitted to the Working Group for discussion, was generally reviewed and found to be helpful. The regressions in Figure 7 of chlorophyll-*a* concentration to River Rhine discharge was considered to be dependent on one or two points, hence their statistical significance was questioned. Also the area averaging used to arrive at the data points was unclear to the Group.

Document 4 - Dickson and Kirkwood (1992)

This document was extensively reviewed and discussed by the Group. Some members were unsure how the spatial interpolation onto a fixed grid was achieved, and what degree of error this process introduced (the same concern apply to the figures prepared by the Hydrographer). The spatial coverage of the Corella 5/68 cruise differs in Figures 2 and 3.

This paper is a novel approach to the question of the nutrient trend in the North Sea by focusing on single ship grids of phosphate in the region 2-5°E and 52-54°N. Phosphate was chosen because the data are reliable back to 1935. Single ship surveys were chosen for uniformity of data and analysis procedures. The geographical area was determined to get the maximum number of cruises. The results in Figure 5 suggest little change in the average phosphate concentration over almost 55 years, and that what change appears may be due to a seasonal cycle (Figure 6).

The Group heard from van Bennekom (see next paper) of his interpretation that there are two distinct types of winter in the southern North Sea. Calm winters when significant productivity may occur as early as January resulting in patchy nutrient distributions, and windy winters resulting in increased mixing and homogeneous nutrient distributions. In only two winters have mixed conditions prevailed. The use of January distributions from other years may result in much noise in the nutrient signal.

The annual cycle of phosphate derived in this document was questioned by the Group, although no other data were presented with respect to the annual cycle. Other members expected an earlier peak in phosphate as production commences in late February/early March. Clearly, the subject of the seasonal cycle is now open for discussion!

The Working Group noted that the paper does not in any way correct for salinity, choosing instead to average geographically over an area several times larger "than the characteristic 'blob-scale' that seems to typify the interactions of coastal and oceanic water types in the region." The area selected is influenced by many factors such as variable Atlantic inflow from the Channel and fresh water discharge from the coasts. As both of these are ultimately driven by the weather they are not independent. The results presented in the paper may have been different if data were excluded which had been obtained within of the coastal zone.

Documents 5 and 6 - van Bennekom (1992), van Bennekom and Wetsteijn (1990)

These papers were presented to the Group by van Bennekom to demonstrate his type of analysis of data from the near-shore portion of the same general area as the previous authors. By employing salinity/nutrient regressions for specific years an increased trend is observed between 1961 and 1978. As both sets of data were from January no seasonal adjustment was necessary as in the previous paper.

Document 5 presented an update to document 6. Since 1977 the slope of the phosphate/salinity regression has decreased in the waters at the Dutch/German border. This implies that levels are reduced in the Rhine. Concentrations reaching the coastal zone, however, may still be as large as before because of the effect of industrial discharges within the estuary.

Documents 7 and 8 - Weichart (1986), Weichart (1991)

These papers were reviewed by the Group as a providing a better approach to the task of identifying elevated levels of nutrients, compared to the methods employed in Document No.2. They present a careful comparison of a single survey of the Southern Bight performed in 1978 to the one performed in 1936 (Poseidon data), along with a subsequent update survey performed in 1990.

The Group wondered why Weichart's analysis could not be extended beyond German waters, into the coastal

areas throughout the Southern North Sea. This is not always possible as synoptic data coverage is not always available. It may be the task of the MMP to provide such detailed synoptic data coverage in the future.

After reviewing this paper it was decided that the method of using ratios of present to historical data was desirable in addition to using differences as done in Document No. 1. The ICES Hydrographer undertook to reproduce the figures presented in Document No. 1 in terms of ratio.

Document 9 - NUT 2/5/2-E

This document was selected from the extensive bibliography used in Document No. 2 as an example of the data source from which Document No. 2 was constructed. The document presents reference nutrient (N, P and Si) concentrations within the Dutch coastal and offshore waters of the southern North Sea, derived from another unpublished NUT document. It does not reference the original source of the 1930s data. The Group assumes that the phosphate values must be from the Poseidon cruises 1935/36 presented by Kalle. However, the Group notes that Kalle did not record nitrate values as he did not consider the analysis techniques were reliable. The Group assumes that the nitrate values have been derived from work by Cooper, but this is not stated in the NUTS document. Although Cooper and other early chemists lacked the present-day technology, they were very competent classical chemists and their analyses may be quite valid.

Document 10 - MCWG Annex 9

The Group was told by Stig Carlberg of the MCWG that similar reservations as expressed by the SSOWG during the 1991 meeting were also held by the MCWG. It was regretted that both meetings were held almost simultaneously but at different venues.

The MCWG had previously gone into some detail devising a Monitoring Plan for the Baltic, including specifying station positions and sampling frequency. They did not wish to produce the same level of detail for the North Sea, at least not without consultation with the SSOWG.

An MMP may address two objectives: to determine spatial distributions, or to determine temporal trends. Both require different sampling strategies. The suggestion by MCWG that time trend monitoring should be accomplished by repeated winter surveys is complicated by factors such as production in the North Sea starting as early as January, and that major riverine inputs often occur in late winter/early spring. In this respect the last sentence of paragraph 5 (sampling frequency) is relevant.

If the objective is to get synoptic spatial distributions across the North Sea then national programs should concentrate around major input sources. Surveys should extend along a sufficient length of the salinity gradient in order to correctly characterize the fresh water component.

If both objectives are to be met, a system of frequent monitoring at selected sites is required, with occasional synoptic surveys.

The Group felt the purpose of the document was unclear. The present NSTF MMP covers a 2-year period. This document may be designed to provide guidance for future trend monitoring. It reads as if it is designed to provide advice to non-professional oceanographers. In some respects this is true as often MMPs are designed by EPAs with little direct oceanographic experience. Oceanographers are merely contracted to carry out the MMP.

It was felt that to stimulate more scientific input to an ongoing MMP, multi-national results should be rapidly distributed among the participants so that results from different areas may be compared and interesting phenomena identified.

The Nordic countries have decided to set up an MMP, including fast dynamic monitoring systems whereby administrators could gain almost real-time information on environmental conditions. This program includes the use of moored instrumentation, including nutrient analyzers, and of mathematical models. One objective is to recognise time of increased risk of harmful algal blooms.

A related project is that of SEAWATCH, to be run by a laboratory in Trondheim, funded under the EUROMAR initiative. This includes the deployment of up to 40 moored buoys in the North Sea recording currents, temperature and salinity and nutrient concentrations.

Finally, it was concluded that as this present document is now quite old, and was intended for a broader audience than the MMG, the SSOWG should become involved with the TWG in directly advising on the follow-up to the present North Sea MMP.

APPENDIX 4

List of Participants

Dr T. Osborn (USA) - Chairman
Mr S. Carlberg (Sweden)*
Mr O. Vagn Olsen (Denmark)*
Dr H. Dahlin (Sweden)
Dr L. Føyn (Norway)*
Dr J. Van Bennekom (Netherlands)
Dr W Turrell (UK)
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