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Theme Session T

REPORT OF THE WORKING GROUP ON EXCEPTIONAL ALGAL BLOOMS

Dublin, Ireland 23-25 April 1985

*General Secretary
ICES
Palaegade 2-4
DK-1261 Copenhagen K, Denmark

REPORT OF THE WORKING GROUP ON EXCEPTIONAL ALGAL BLOOMS
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1. Introduction

The Working Group met at the Fisheries Research Centre, Dublin, Ireland on 23-25 April 1985, with the following terms of reference (C.Res.1984/2:30):

(i) establish means of collecting and exchanging information on the incidence of problems due to exceptional blooms on mariculture operations, and on bivalve fisheries;

(ii) consider means of improving the predictability of bloom events in time and space scales relevant to fish and shellfish farmers, including analysis of weather patterns in relation to bloom incidence;

(iii) consider proposals for research on management techniques for overcoming the effects of exceptional blooms, and

(iv) prepare advice for Member Governments on the principles of site selection in mariculture, and on monitoring, predicting and managing bloom events for fish and shellfish farmers and fishermen.

1.2 Participation was as follows:

Mr. E. Dahl	Norway
Ms. J. Doyle (Chairman)	Ireland
Mr. T. Dunne	Ireland
Dr. L. Edler	Sweden
Prof. M. Gillbricht	Fed. Rep.Germany
Dr. R. Gowen	United Kingdom
Mr. D. Griffith	Ireland
Dr. K. Jones	United Kingdom
Mr. P. McDaid	Ireland
Mr. J. Marino	Spain
Dr. M. Parker	United Kingdom
Dr. C. Roden	Ireland
Ms. M.A. Sampayo	Portugal
Dr. P. Tett	United Kingdom

2. Adoption of Agenda

The agenda as adopted is attached at Annex I. A list of documents is at Annex II.

3. Appointment of Rapporteurs

The following acted as Rapporteurs for sections of the Report. Dr. Parker, Dr. Tett, Dr. Edler, Dr. Gowen and Dr. Roden.

4. Outcome of ICES Special Meeting on the Causes, Dynamics and Effects of Exceptional Marine Blooms and Related Events held in Copenhagen, October 1984.

4.1 The Convenor of the Special Meeting, Dr. Parker, informed the WG that the Special Meeting report (ICES CM 1984/E:42) had been discussed by four Standing Committees at the Statutory Meeting and would be also discussed by the ICES ACMP at its Mid Term meeting. MEQC and Biological Oceanography Committee had generally endorsed the conclusion and recommendations of the Special Meeting, and had recommended the publication of the selected papers in Rapports et Proces-Verbaux under the editorship of Drs. Parker and Tett (ICES C.Res 1984/1:3).

4.2 The Biological Oceanography Committee also made recommendations regarding remote sensing (C.Res 1984/2:2), primary production methodology (C.Res 1984/1.6 and 4:19) and exchange of information with WHO and the European Bureau of Standards (C.Res 1984/3:4) following views expressed at the Special Meeting.

4.3 Consideration of the Special Meeting Report by the Mariculture and Shellfish Committees, and recognition of the serious problems posed for the mariculture and shellfish industries by Algal Blooms resulted in the establishment of this Working Group (C.Res 1984/4:).

5.1 Collection and Exchange of Information

5.1.1. As a preliminary to discussing the requirements for, and means of collecting and exchanging information, the WG exchanged information on recent events of relevance to mariculture and shellfisheries in their countries, since those reported at the Special Meeting in October 1984.

5.1.2. The WG took particular note of the occurrence of a DSP outbreak in Norway and Sweden, associated with Dinophysis acuta (though Ceratium furca was numercially dominant throughout). This commenced in late summer when the D.acuta cell count rose briefly to 20-30,000 cells/litre but mussels remained toxic throughout the autumn and winter until mid-March. It was postulated that (1) the toxic level of the mussels might be maintained even by the very low numbers (200 cells/litre) of D. acuta present, and that (2) the combination of relatively low temperatures (<5 °C) and low concentrations of nutrients (<1 µg chlorophyll a) might reduce the metabolic activity in the mussels and hence the normal self cleansing processes. The 'starved rat' test was not found to be very useful in this case and toxicity testing was therefore carried out on acetone extracts using the standard mouse bio-assay. During a DSP outbreak in Ireland in 1984, the 'starved rat' test proved adequate; refusal to feed was taken to indicate unacceptably high concentrations. Indeed it was considered that any positive response was sufficient to stop shellfish sales.

The W.G. notes that these incidents will be reported to the Third International Conference on Toxic Dinoflagellates in Canada in June 1985 the proceedings of which will be published at a later date.

5.1.3. The Group also noted shellfish toxicity was associated in some areas in both Portugal in September 1984 and Norway in February 1985 with Prorocentrum minimum. During 1984 a long-lasting bloom of this species in an estuarine area in south-eastern Ireland resulted in no toxin accumulation in local shellfish. The symptoms of the Prorocentrum minimum intoxication are similar to DSP but for delayed (several days) onset; it may in fact be Venerupin Shellfish Poisoning (VSP).

5.1.4. At a national level, members of the Working Group identified many different organisations as having an interest in algal bloom problems as they relate to mariculture and shellfisheries. These include:-
Ministries of Fisheries and of Health

Local Public Health Control authorities

Research Institutes

Universities

Centres of taxonomic expertise.

It is felt that there can be problems of reporting within countries arising from such fragmentation. Few countries appear to have identified National Co-ordinating Centres to act as receivers of all reports and disseminators of information to relevant parties (including industry and trade interests, scientists and the public). Particularly because of the market implication, the WG recommends that each member country designate such a national focal point to undertake this responsibility. Such national centres would also have a role in international information exchange.

There would be a need for an international data filing and information exchange centre, and the Working Group suggests that the ICES Secretariat might provide such a service. It would need to be understood by contributors that the information supplied to ICES should be transmitted through the national centre and in a standard format, and that the reported data should be freely available from ICES in the same way as material on national fisheries statistics. The Annales Biologiques data which are currently edited by Dr. J.P. Mommaerts could be the foundation of such a system.

5.1.5 The WG identified two levels at which international information exchange presently occurs. Firstly, there are contacts between scientists and secondly, between Governments.

5.1.6. Scientists make initial contacts usually to gain (rather than offer) information and help when incidents occur, so the first requirements for communication is a classified directory of experts. At a later stage, scientists will publish incident reports and scientific papers and finally there will be communication via data archives. As a relatively rapid means of exchanging information, the WG recommends that incidents be recorded in each country's annual 'Administrative Report' to the Mariculture or Shellfish Committees.

5.1.7. ICES agreed in 1982 to an annual record of incidents in the archival journal "Annales Biologiques" under the editorship of Dr. J.P. Mommaerts. The WG considered a letter from Dr. Mommaerts and a draft of the report for 1982 which is now in press. Some data corrections are required and these should be sent rapidly by participants to Dr. Mommaerts (copy to Secretariat).

5.1.8. The WG agreed that this form of record was valuable and regretted that submission of data had declined since 1982. Noting that the lack of information about the role of Annales may be a factor in the lack of notification of incidents the WG considered that (1) information about this section of 'Annales' should be more widely disseminated, including to identified national centres (para 5.1.4 above) and the address list in the directory (para 5.1.6 above and 5.1.13 below), and that (2) this WG could play a useful role in co-ordinating data inputs. It was agreed that the Chairman should seek the participation of the editor of the blooms section of Annales in the Working Group.

5.1.9. With respect to the information to be included in this Archive, Dr. Mommaerts had prepared a draft report form (Annex III). The WG commented as follows:-

- Location of bloom. The 'general description' should include information on the nature of the sea area as included in the 'TYP' column in the 1982 report. In this respect, the term 'bay' should be subdivided to identify separately fjords, rias, coastal embayments etc. (a list of recognised terms could perhaps be added because the name of a place is not necessarily a good guide to its type.

- Interferences with biota (is taken to mean the effects of a bloom). This section should include quantitative data if possible (eg % fish losses, maximum toxicity level recorded).

- Composition of bloom. Since numbers and biomass do not always relate to each other, and non-numercially dominant species may be the cause of toxicity information about biomass or toxicity should be noted where available.

- Indication of previous occurrence. Distinction should be made between occurrence as exceptional blooms and occurrence in the 'normal' plankton (whether rarely or abundantly).

- Presumed cause. The WG agreed that opinions as to cause, such as "pollution" should not be included in the tables in the Annales, which should be limited to factual data. However the WG also agreed that it would help future evaluation of this data if a brief commentary (50-100 words) could be appended giving any other information about the the circumstances of the bloom. This would only be useful if the original forms could be stored in ICES, in addition to the publication of the tables (5.1.4 above).

-NAME AND ADDRESS OF REPORTER SHOULD BE STATED.

5.1.10. In order to harmonise data reporting for the archive, the WG agreed an interim procedure for sampling exceptional blooms. An integrated surface to 5 metre sample should be taken, using a flexible tube sampler. Counts should be expressed as 'cell numbers per litre in the surface 5 metres' and supported where possible by Chlorophyll "a" measurements. [It was agreed that all members should submit proposals for a common sampling procedure so that at the next meeting an improved bloom sampling protocol could be agreed]. Dr. Tett kindly agreed to prepare a draft for such agreement and proposals should be sent to him not later than December 1985.

5.1.11. In addition to exchange of information between scientists, more formal communication between Governments may be necessary in two instances, (1) when a country wishes to warn a neighbour of the occurrence of blooms in it's national waters that might subsequently affect it, or (2) when blooms have caused toxicity in fish and shellfish products which may be exported to other countries. An example of the former is the onset of Gyrodinium aureolum blooms in the North Sea/Skagerrak boundary area which is usually first obvious in Danish coastal waters and is subsequently transported to Norwegian and Swedish coastal waters.

5.1.12. In both cases, the reason why the WG suggests formal contact (ideally through the National Co-ordinating Centres) is to protect fishery interests. It is very important that only carefully balanced factual information is given, as the fish and shellfish trades are easily damaged by distorted 'scare stories'. In addition, in the second case, individual countries will need to demonstrate that they can protect their producers and customers particularly where an export trade is concerned. For this formal system of communication to work it should be compulsory for any bloom event at a mariculture or shellfish site, to be reported to the appropriate National Co-ordinating Centre.

5.1.13. The Working Group agreed that members would provide information to build up a directory of algal bloom expertise using the format attached as Annex [IV] to this report. This information should be annually updated.

5.2. Predictability of bloom events.

5.2.1. It was considered helpful to distinguish between prediction in time and prediction in space. Further useful distinctions are those made between small-scale (or local) and large-scale (or regional) prediction, and between prediction in the short-term (a few days or weeks) and in the long term (seasons and years). The distinction between the short-term local and the long-term regional is like the distinction between weather and climate. It may be fruitful to keep in mind the different problems encountered in weather forecasting and climatic description and apply this by analogy to the problem of predicting harmful marine blooms. Another useful distinction is that between the empirical statistical and the theoretical approaches to prediction. Finally, the Working Group recognized that requirements for prediction differ somewhat between fin-fish and shellfish cultivation.

5.2.2. It was felt useful in relation to categorizing harmful blooms or predicting their occurrence to distinguish two types of bloom : (a) those developing as a result of local conditions; and (b) those which were advected from an external seed-area, such as an offshore front, perhaps by a process involving physical concentration as well as intrinsic growth of the population. It also seems important to distinguish between (i) blooms originating from a seedstock of benthic cysts, which may persist for several years in the sediment, (ii) those developing from a planktonic inoculum.

Prediction in space : site selection

5.2.3. Prediction in space underlies the selection of a suitable site. Relevant local factors, which should be investigated on a number of occasions include (a) phytoplankton species composition and biomass; (b) toxicity levels in shellfish; (c) the strength of vertical stratification, and of horizontal water exchange; (d) sediment composition and content of dinoflagellate cysts. Regional factors, such as the presence of regions of high phytoplankton biomass (e.g. tidal fronts), must also be considered. Some of these factors are discussed in detail, and in relation to Scottish conditions, by Gowen (1984), - see list of documents Annex II.

5.2.4. Concentrations of dissolved nutrients were held to be useful partial predictors of bloom risk in some regions (Ireland, Scotland, Norway) but not in others (German Bight). The discussion in 3.3 and 3.4 of ICES CM 1984/E:42 should be referred to for a possible explanation of this difference of opinion.

5.2.5. General studies of the biology and distribution on sediments of dinoflagellate cysts are being carried out in Research Institutes in the UK and also in the US and Canada. The Working Group felt that a full report should be sought on this work and its relevance to bloom prediction. The participation of Scientists involved in these programmes would be valuable to future meetings of the W.G.

Local, short-term, prediction

5.2.6. It was considered that effective short-term predictions of toxicity can be derived from regular monitoring at a site. The type of monitoring depends on the animal cultivated and on the potential hazards. Monitoring for prediction should be distinguished from monitoring for managing the effects of blooms, although similar techniques may be employed.

5.2.7. In the case of fin-fish cultivation, depth-integrated water samples taken once or twice a week should be examined for phytoplankton species composition in order to detect the development of *in situ* blooms of harmful phytoplankton. This procedure may not be effective when blooms originate elsewhere or when they are dominated by very rapidly developing populations such as those of 'Flagellate X'.

5.2.8. In the case of shellfish cultivation, there are two monitoring options. The prediction of Paralytic Shellfish Poisoning (PSP) requires that regular bioassay for PSP, should be made whereas predicition of Diarrhetic Shellfish Poisoning (DSP) or Venerupin Shellfish Poisoning (VSP) requires regular examination (once or twice weekly) of integrated water samples for *Dinophysis accuminata* or other causative species.

5.2.9. Such monitoring should be combined with regular observations of water column structure (i.e. vertical temperature and salinity profiles), local weather and freshwater runoff. As steadily lengthening time-series of data are collected in this way, they should be subject to multiple correlation, time-series, or similar statistical analysis in order to obtain empirical correlations between toxic incidents, the occurrence of potentially toxic species, general seasonal succession of phytoplankton, and meteorological and hydrographic changes. Such analyses may lead to improved predictive ability on a local and short-term basis

Regional prediction

5.2.10. Where it is likely that inshore blooms originate offshore, it seems possible that some advance warning may be given by offshore monitoring, either of phytoplankton species composition and biomass, or of toxin in natural shellfish beds or especially installed mussel rafts.

5.2.11. In certain circumstances (such as blooms originating in the Skagerrak and the frontal zone between the Skagerrak and the North Sea, and advected by the Norwegian Coastal Current) it may be possible to give considerable advance warning to the final target areas by regular monitoring of the region of bloom initiation.

5.2.12. There was felt to be a need to identify the role of remote sensing (of sea-surface temperatures or chlorophyll concentration) in bloom detection and short-term prediction. This is probably most relevant in a regional context.

5.2.13. Regional monitoring programmes should be combined with regular hydrographic observations and subject to statistical and empirical analysis as described above and below.

Basic research to improve prediction

5.2.14. Some more general analysis of blooms, weather and hydrography should be carried out in order to discover whether blooms are more likely in some years than others, and to predict long term changes in the mean abundance of harmful species. One way of doing this might be to have a climatologist examine archive data on exceptional blooms and to report on any unusual weather associated with them, or on any climatic trends associated with changes in the occurrence of particular types of bloom. It was however felt that the available data concerning exceptional blooms might prove to be inadequate for this purpose, emphasizing the need for improved recording of such blooms. The approach of Professor Gillbricht (see for example Gillbricht 1983) may be adopted when long-time series of regular measurements of phytoplankton abundance and species composition are available. The aim here would be to improve prediction on a regional and long-term basis.

5.2.15. It was felt that at the same time as the empirical and statistical approach to bloom prediction there should be (a) detailed studies of the life histories and physiology of potentially harmful phytoplankton, and (b) theoretical and experimental investigations of the relationship between phytoplankton biology and the physical and chemical features of the marine environment. These studies should lead to the development of numerical models capable of short-term predictions of the development of toxic blooms. It was recognized that whereas it may not be possible to predict, long in advance, the development of a bloom of a particular toxic species, it should eventually be possible to predict the local or regional growth of particular algal groups, such as gonyaulacoid dinoflagellates, given information on hydrographic and meterological conditions.

5.2.16. There is thus a need to grow toxic species in culture and to study in detail the physiology of their growth and toxin production.

Specific recommendations - Predictability

1. Seek documented examples of monitoring schemes that have successfully been combined with empirical-statistical predictive models.

2. Obtain an opinion from climatologists on the utility of seeking correlations between archived data on exceptional blooms, unusual weather conditions, or long-term climatic variation (Distinguish this from work done at e.g. IMER or long-term trends in plankton in general).

3. Seek a report on relevant aspects of current research work on dinoflagellate cysts.

4. Request a paper on the potential application of numerical modelling to short-term bloom prediction.

5. Draw up a list of species whose physiology and toxicology should be investigated in culture, and collect information on work already in hand on these species.

5.3. Research on management techniques.

The required research falls into three categories:

5.3.1. Management options in bloom events
5.3 2. Management options when blooms are expected
5.3.3. Basic understanding of toxic algae and the action of toxins.

5.3.1 Management options in bloom events.

(a) For cages or land based farms pumping of good quality water from below the surface zone may be beneficial. (Good quality water means water of low algal concentration, free from other contaminants and adequately oxygenated. This has been successful on a small scale and has reduced mortality of caged fish during a bloom of Gyrodinium aureolum. The multifactorial effect was stressed, as apart from dilution of blooming algae, the pumping is likely to remove mucilage and particles from the cage tank or raft. Also the variety of possible uses of pumping deep water were considered. It has, for example, successfully been used to keep fish alive during cold winters.

(b) Oxygenation through cages (or rafts) and possibly shore based facilities may have positive effects and needs further investigation.

(c) In areas of short day light time illumination of cages at night has been shown to relieve signs of Gyrodinium aureolum effects. The mode of action is not known as yet, and should be determined.

(d) Moving cages horizontally and/or vertically in order to prevent direct exposure to blooming algae needs further investigation. It was considered that this possibility, however, is likely to be restricted to smaller farms.

5.3.2. Preventative Management options when blooms are expected

(a) Protection of caged fish may be achieved by plastic curtains being applied around the cages.

(b) For farms located in fjords or narrow bays it may be possible to prevent advected blooms by closing the fjord or bay entrance with an air bubble curtain.

(c) Experimental work is needed on the use of land based systems with alternative water inlets. It was felt that such arrangements may be useful in high risk areas, in order to avoid loss of fish during a bloom. Such systems would also provide better opportunities for controlled experimentation on the toxic action of blooming species and associated pathology.

5.3.3 Basic understanding of toxic algae and the action of toxins.

(a) It was considered that culturing of toxic algae should be given high priority. The basis for future research on the ecophysiology and life cycles of toxic species, and on toxicity, is the ability to successfully grow algae in culture. For many species this is difficult and for some species e.g. of the genus Dinophysis there has been no success at all as yet.

(b) The mode of action of toxins on other organisms and the concentrations required to bring about toxic effects needs further study in order to develop management techniques. The multifactorial nature of the cause of death was stressed. Histopathological studies, as well as studies of sublethal effects are important fields, where knowledge is lacking.

(c) Considerable research is needed on algal toxins and their production. This includes the chemistry, the toxicology and the analysis of the toxins. It was considered that comparative studies be made on cultured and natural populations of the same species.

5.4 Preparation of Advice to Member Governments etc.

Advice on principles of site selections

5.4.1. The Working Group considered this 'Term of Reference' in conjunction with the Report of the Special Meeting on Causes Dynamics and Effects of exceptional algal blooms (ICES CM 1984/E:42) and with draft sections of the report on discussion under items 5(1)-(3).

5.4.2. The WG considered that provision of advice was the long-term function of the Group. A start had been made in the Special Meeting report and further advice had been added in the discussion on sections 5(1)-5(3). The Group considered however that they should aim at the production of a comprehensive advisory manual [or manuals], perhaps in the form of a Co-operative Research Report.

5.4.3. The Working Group considered that the principles of site selection and monitoring in mariculture should distinguish between those identified for (1) Fin fish farms, (2) those for shellfish farms and (3) those for natural shellfish beds. The main criteria for fin fish site selection were identified at the Special Meeting (CM 1984/E:42) and cannot be advanced without further detailed studies.

Nevertheless it is considered important to re-emphasise the following:-

5.4.4. In the absence (at present) of any effective management strategy to 'protect' the stock of salmonids at cage farms, site selection offers a means of reducing the impact of toxic blooms.

5.4.5. Land based farms afford the possibility for avoiding blooms and could thus be a means of farming in areas which are suitable in all aspects other than risk from toxic blooms. However the limitations of such farms in terms of economic cost of setting up and running is recognised.

5.4.6. Current research in Scotland suggests that different hydrographic regimes support phytoplankton populations with different compositions. Diatoms dominate vertically mixed optically deep water and dinoflagellates dominate stratified optically shallow water (see Jones and Gowen 1985). The hypothesis can be used as the basis for distinguishing areas of coastal water in which dinoflagellate blooms might occur.

5.4.7. The generalisation can be refined by considering a number of the key factors at the site as identified at §5.2.2 of CM 1984/E:42.

5.4.8. Criteria for site selection have to be based on well founded hypotheses indicating the continuing need for research on the relationships between phytoplankton, chemical and physical processes.

5.4.9. The Working Group notes that a scheme for site evaluation has already been prepared for Scotland and strongly recommends that similar schemes be developed by other member countries.

It is further recommended that member countries prepare reports on existing schemes in operation and submit these to R. Gowen who will draft a paper on site selection procedures primarily in relation to phytoplankton blooms for discussion at the next meeting of the WG.

5.4.10. In considering site selection criteria for shellfish production this Working Group distinguished between bottom layings which reflect natural distributions and rafts or longlines which can be placed in many areas.

5.4.11. The algal bloom problem is only one of several important factors determining site location, others include the need for plankton rich water and adequate spatfall. "Ideal" sites may not exist and some requirements are contradictory.

5.4.12. Although some mortalities of bivalves have been associated with algal blooms, in general they are not so affected. This strategy for shellfish farms and fisheries should be based on good management and on marketing controls rather than on avoiding 'dangerous' areas.

5.4.13. For bivalves most emphasis should be placed on developing screening measures which minimise closure periods as is already happening in the Netherlands, Maine Galicia and North East England. For control there is no subsitute for continuing investigations of phytoplankton ecology and hydrography in economically important areas.

6. Action List for members of the Working Group

It was agreed that the following tasks be undertaken by members of the Working Group.

1. The Chairman
   (a) to contact Dr. Mommaertsto transmit the Working Groups views on the report form for the 'bloom section of Annales Biologiques.

   (b) to seek through the appropriate channels, his participation as Sectional Editor of Annales Biologiques in future meetings of the Working Group.

   (c) to discuss with him and with the ICES Secretariat the long term archiving of the report forms.

2. All members to ensure that national reports are returned to the editor of Annales Biologiques utilising as far as possible the interim common sampling method.

3. All members to provide information to the Chairman by [Dec 1985] on national institutes and experts for compilation in a directory of Expertise on Exceptional Algal Blloms using the format attached in Annex (IV).

4. The Chairman to seek the ICES Hydrography Committee views (and assistance) on the climatological analysis of algal bloom data.

5. Any member to provide reports and papers on national progress on cyst mapping to the Work Group for tabling at next meeting.

6. Any member to provide reports or papers to the next meeting on observation on or proposals for means of ameliorating effects of blooms.

7. All members to provide papers to the Working Group on their national approach to site selection to Dr. Gowen (copy to Chairman) by [Dec. 1985].

8. Dr. Gowen to draft a paper on site selection for the Working Group based on national contributions.

9 Dr. P. Tett to draft a paper for the Working Group on a common approach to bloom sampling for information exchange purposes.

10. All members to prepare bibliographies of recent publications relevant to the terms of reference.

7. Recommendations

The Working Group on Exceptional Algal Blooms recommends:-

1. that member countries designate an appropriate national co-ordinating centre for information exchange on exceptional blooms, to facilitate national co-ordination of action and control and international information exchange.

2. in order to allow progress towards overcoming effects on mariculture and shellfisheries, that member countries encourage research into the biology and life histories of bloom organisms which affect commercial species and in particular

   (a) culturing

   (b) identification of toxin

   (c) assessment of mode of toxic or pathogenic action

3. that the Working Group on Exceptional Marine Blooms meet for 3 days in [Spring 1986] in Copenhagen with the same terms of reference as in 1985 but in particular to commence preparation of a Co-operative Research Report on 'Management of Effects of Exceptional Algal Blooms on Mariculture and Shellfisheries' in response to the fourth term of reference.

ANNEX I

ICES WORKING GROUP MEETING ON EXCEPTIONAL ALGAL BLOOMS

Fisheries Research Centre

Abbotstown, Castleknock, Dublin

Ireland

23 - 25 April 1985

AGENDA

Tuesday, April 23rd

1. 10.00 hours: Opening of the meeting

2. Adoption of the Agenda

3. Appointment of Rapporteurs

4. Brief summary of the Report of ICES Special Meeting on the causes, dynamics and effects of Exceptional Marine Algal Blooms.

5. Terms of Reference

   1. Means of collection and exchange of information on problems due to exceptional blooms.

   2. Predictability of bloom events.

   3. Proposals for Research on Management Techniques.

   4. Advice on principles of site selection.

6. Action list:- Future work of the Group

7. Recommendations

JAQUELINE DOYLE
4th April 1985

Annex II

Documents referred to by the Working Group

Dahl, E. and Brockmann, U.H. (1985). The growth of Gyrodinium aureolum Hulburt in in-situ experimental bags. (Paper submitted to Third International Conference on Toxic Dinoflagellates June 1985)

Dahl, E. and Yndestad, M. (1985). Diarrhetic Shellfish Poisoning (DSP) in Norway in the Autumn 1984 related to the occurance of Dinophysis spp. (Paper submitted to Third International Conference on Toxic Dinoflagellates June 1985).

Gassmann, G. and Gillbracht, M. (1982). Correlations between phytoplankton, organic detritis and carbon in North Sea waters during the Fladenground Experiment (FLEX '76) Helgolander Wiss. Meeresunters 35, 253-262.

Gillbricht, M. (1983). Eine "red tide" in der sudlichen Nordsee und ihre Beziehungen Zur Umwelt. Helgolander wiss. Meeresunters 36, 393-426.

Gowen, R. (1984). The Ecology of phytoplankton in Scottish costal water with particular reference to toxic species and their importance to mariculture. SMBA Report to the Highland and Islands Developments Board, 92pp.

Jones, K.J. and Gowen, R.J. (1985). Mixing and summer phytoplankton composition in coastal and shelf seas of the British Isles. Unpublished MS.

Report of the ICES Special Meeting on the Causes, Dynamics and Effects of Exceptional Marine Blooms and Related Events ICES CM 1984/E:42.

Annex III

International Council for
the Exploration of the Sea

A DATA BASE ON PHYTOPLANKTON BLOOMS IN THE ICES AREA

by J.P. Mommaerts

Management Unit of the North Sea and Scheldt Estuary Mathematical Models
Ministry of Public Health and Environment
14, rue J. Wytsman, B-1050 Brussels, Belgium

As emphasized at the Special Meeting on The Causes, Dynamics and Effects of Exceptional Marine Blooms and Related Events, Copenhagen, 4-5 October 1984 (ref. CM 1984/E: 42), concern is now growing as phytoplankton outbreaks seem to have been recurrent phenomena in areas where red tides or paralytic shellfish poisoning (PSP) were practically unknown before the late 70's. The lack of long-term records from many areas makes it difficult however to assess whether this increase is real or only apparent.

In particular, coastal areas and embayments of the United Kingdom, Ireland, France, the Iberian peninsula, Germany and Norway have been affected by exceptional dinophycean blooms in recent years. These blooms occur generally in late summer and must be distinguished from the regular spring blooms which in most cases are dominated by diatoms. On the other hand, Dinophyceae are normally abundant in late summer in these areas and some of the red tides observed are just paroxysmal events of an otherwise normal phytoplankton successsion (e.g. Ceratium spp. blooms) whereas other blooms involve species that are genuinely new to the coastal areas concerned (e.g. Gyrodinium aureolum blooms).

In order to improve the data base on these events, it is the intention of ICES to publish in Annales Biologiques from Vol.39 on, an annual report on the observations of exceptional phytoplankton blooms in the ICES area.

In an initial report, a synopsis of the records of the last ten years is presented under the form of a computer-generated table (see example) where species and accompanying data are sorted out as to geographical locations. Cross-referencing with a taxonomical list (to be found in a separate table) is possible, thanks to the identification codes. Moreover, this data base holds informations on the circumstances and interpretations relevant to individual records. This synopsis is certainly far from complete and will be continuously improved upon and enriched with fresh information.

Contributions are therefore kindly requested from all scientists who observe exceptional marine blooms. An ad hoc form has been designed in order to facilitate both reporting and data processing (see form attached). As the response has been rather feeble in 1984, it is thought that this form should be widely distributed to potential contributors each year, together with a reminder.

ID	LOC1	LOC2	SPEC	TYP	PER	YE1	YE2	INTERF	REF
078	Atlantic NE	Biscay	Scrippsiella faeroense	Bay		68	68	None	Lassus, ISTPM, 1980.
066	Atlantic NE	Brittany	Ceratium fusus	Bays				None	Lassus, ISTPM, 1980.
070	Atlantic NE	Brittany	Gonyaulax spinifera	Bays		69	79	None	Lassus, ISTPM, 1980.
076	Atlantic NE	Brittany	Noctiluca scintillans	Coastal			RE	None	Lassus, ISTPM, 1980.
079	Atlantic NE	Brittany	Pouchetia rosea	Bay					Lassus, ISTPM, 1980.
024	Atlantic NE	Ireland S	Nitzschia spp.	Coastal	May-Jun	78	RE	None	Parker et al., ICES CM 1982/L:44.
025	Atlantic NE	Ireland S	Phaeocystis pouchetii	Coastal	May-Jun	72	81	Clogging	Parker et al., ICES CM 1982/L:44.
030	Atlantic NE	Ireland S	Prorocentrum minimum	Bays	Jul-Aug	81	81	PSP	Parker et al., ICES CM 1982/L:44.
023	Atlantic NE	Ireland SE	Gyrodinium aureolum	Coastal	Jul	76	76	Fish kills	Parker et al., ICES CM 1982/L:44.
027	Atlantic NE	Ireland SW	Dinophysis sp.	Coastal	Jul-Aug	76	RE	DSP	Parker et al., ICES CM 1982/L:44.
029	Atlantic NE	Ireland SW	Gonyaulax polyedra	Bays	Aug	76	RE		Parker et al., ICES CM 1982/L:44.
028	Atlantic NE	Ireland SW	Gonyaulax sp.	Coastal	Jul-Aug	76	RE		Parker et al., ICES CM 1982/L:44.
022	Atlantic NE	Ireland SW	Gyrodinium aureolum	Coastal	Jul Aug	76	RE	Fish kills	Parker et al., ICES CM 1982/L:44.
026	Atlantic NE	Ireland SW	Prorocentrum micans	Coastal	Jul-Aug	76	RE	PSP ?	Parker et al., ICES CM 1982/L:44.
031	Atlantic NE	Ireland SW-S	Noctiluca scintillans	Coastal	Aug ?		77		Parker et al., ICES CM 1982/L:44.
032	Atlantic NE	Ireland W	Ceratium sp.	Bay	Aug-Sep	81	81		Parker et al., ICES CM 1982/L:44.
033	Atlantic NE	Ireland W	Mesodinium rubrum	Bays		68	RE		Parker et al., ICES CM 1982/L:44.
047	Atlantic NE	Portugal	Mesodinium rubrum	Coastal	Jun	80	81	Resp.zoopl.	Cabecadas et al., ICES CM 1982/L:55.
083	Atlantic NE	Spain	Scrippsiella faeroense	Coastal					San Feliu et al., 1971, in Lassus et al., 1982.
048	Atlantic NE	Spain NW	Amphidinium sp.	Bays	Sep	77	78		Campos et al., ICES CM 1982/L:27.
052	Atlantic NE	Spain NW	Ceratium furca	Bays	Sep	81	81		Campos et al., ICES CM 1982/L:27.
049	Atlantic NE	Spain NW	Dinophysis spp.	Bays	Aug	78	79	DSP	Campos et al., ICES CM 1982/L:27.
056	Atlantic NE	Spain NW	Gymnodinium breve	Bays					Campos et al., ICES CM 1982/L:27.
053	Atlantic NE	Spain NW	Gymnodinium catenatum	Bays	Oct	76	81	PSP	Campos et al., ICES CM 1982/L:27.
050	Atlantic NE	Spain NW	Mesodinium rubrum	Bays	May-Aug	79	RE		Campos et al., ICES CM 1982/L:27.
051	Atlantic NE	Spain NW	Olithodiscus luteus (?)	Bays	Oct	80	80		Campos et al., ICES CM 1982/L:27.
055	Atlantic NE	Spain NW	Prorocentrum rostratum	Bays	Oct	81	81	None	Campos et al., ICES CM 1982/L:27.
054	Atlantic NE	Spain NW	Prorocentrum triestinum	Bays	Oct	81	81	None	Campos et al., ICES CM 1982/L:27.
020	Atlantic NE	UK NW	Gyrodinium aureolum	Bays	Sep	80	RE	Fish kills	Ayres et al., ICES CM 1982/L:38.
021	Atlantic NE	UK NW	Olithodiscus luteus (?)	Bays	May-Jun	79	RE	Fish kills	Ayres et al., ICES CM 1982/L:38.
008	Atlantic NW	Bay of Fundy	Gonyaulax excavata	Bay	Jul-Sep	44	RE	PSP	White, ICES CM 1982/L:13.
059	Atlantic NW	Chesapeake	Cochlodinium heterolobatum	Bay	Jul-Sep	77	RE		Zubkoff, ICES CM 1982/E:9.
062	Atlantic NW	Chesapeake	Glenodinium sp.	Bay	Jun	80	80		Zubkoff, ICES CM 1982/E:9.
058	Atlantic NW	Chesapeake	Gymnodinium splendens	Bay	Aug	75	80		Zubkoff, ICES CM 1982/E:9.
057	Atlantic NW	Chesapeake	Heterocapsa triquetra	Bay	Mar-Apr	79	81		Zubkoff, ICES CM 1982/E:9.
063	Atlantic NW	Chesapeake	Katodinium rotundatum	Bay	Aug	80	80		Zubkoff, ICES CM 1982/E:9.
077	Atlantic NW	Chesapeake	Oxytoxum sp.	Bay	Aug	71	71		Loftus et al., cit. Lassus, ISTPM, 1980.
090	Atlantic NW	Chesapeake	Prorocentrum minimum	Bay	Summer		RE		Tyler & Seliger, Limnol.Ocean., (26), 1981.
061	Atlantic NW	Chesapeake	Scrippsiella sp.	Bay	Jul-Aug	80	81		Zubkoff, ICES CM 1982/E:9.
084	Atlantic NW	Delaware	Coscinodiscus wailesii	Coastal	Apr	78	78	Clogging	Mahoney et al., Bull.N.Jersey Acad.Sc., 1980.
044	Atlantic NW	Gulf Maine	Gonyaulax excavata	Coastal	Summer	78	78	PSP	Balch, J.Exp.Mar.Biol.Ecol., 55(1), 1981.
046	Atlantic NW	Gulf Mexico	Gymnodinium breve	Coastal	Sep-Feb	46	RE	NSP	Steidinger, Florida Dept.Nat.Res., 1975.
068	Atlantic NW	Massachusett	Gonyaulax excavata	Coastal		72	RE	PSP	several authors, cit. Lassus, ISTPM, 1980.
086	Atlantic NW	N.Y. Bight	Ceratium tripos	Coastal	Jun-Sep	76	76	O2 depl.	Mahoney & Steimle, in Taylor & Seliger, 1979.
091	Atlantic NW	Narragansett	Skeletonema costatum	Bay	Jan/May		72	None	Smayda, Norw.J.Botany, (20), 1973.
088	Atlantic NW	New Jersey	Katodinium rotundatum	Coast/bay	Jun-Aug	62	RE	Several	Mahoney & McLaughlin, J.Exp.Mar.Biol.Ec., 1977.
089	Atlantic NW	New Jersey	Olithodiscus luteus	Coast/bay	Jun-Aug	62	RE	Several	Mahoney & McLaughlin, J.Exp.Mar.Biol.Ec., 1977.
087	Atlantic NW	New Jersey	Prorocentrum micans	Coast/bay	Jun-Aug	62	RE	Several	Mahoney & McLaughlin, J.Exp.Mar.Biol.Ec., 1977.
004	Baltic	Finland SW	Anabaena lemmermannii	Open sea	Jul-Aug	75	RE	Allergies	Niemi, ICES CM 1982/L:10.
003	Baltic	Finland SW	Aphanizomenon flos-aquae	Open sea	Jul-Aug	75	RE	Allergies	Niemi, ICES CM 1982/L:10.
001	Baltic	Finland SW	Gonyaulax catenata	Open sea	Apr-May	72	RE	None	Niemi, ICES CM 1982/L:10.
006	Baltic	Finland SW	Heterocapsa triquetra	Coastal	Jun	76	RE	None	Niemi, ICES CM 1982/L:10.
002	Baltic	Finland SW	Nodularia spumigena	Open sea	Jul-Aug	75	RE	Allergies	Niemi, ICES CM 1982/L:10.
005	Baltic	Finland SW	Oscillatoria agardhii	Coastal	Jun-Oct	72	RE	Taste fish	Niemi, ICES CM 1982/L:10.
010	Baltic	Kattegat	Ceratium furca	Strait	Sep-Nov	80	RE	None	Edler et al., ICES CM 1982/L:20.
011	Baltic	Kattegat	Ceratium fusus	Strait	Sep-Nov	80	RE	None	Edler et al., ICES CM 1982/L:20.
012	Baltic	Kattegat	Ceratium lineatum	Strait	Sep-Nov	80	RE	None	Edler et al., ICES CM 1982/L:20.
013	Baltic	Kattegat	Ceratium tripos	Strait	Sep-Nov	80	RE	None	Edler et al., ICES CM 1982/L:20.
014	Baltic	Kattegat	Gyrodinium aureolum	Strait	Oct	81	81	None	Edler et al., ICES CM 1982/L:20.

REPORT ON A PHYTOPLANKTON BLOOM IN THE ICES AREA

to be forwarded to : Dr J.P. Mommaerts , Management Unit of the Mathematical Model of the North Sea
Ministry of Public Health
14 rue J. Wytsman, 1050-Brussels, Belgium

LOCATION OF THE BLOOM
- general description (name of the place) :

- latitude/longitude (if in open sea) :

PERIOD OF BLOOMING
- date of beginning :
- date of maximum :
- date of end :

INTERFERENCES WITH BIOTA ETC...
- color of water :
- fish or shellfish kills (PSP ? NSP ?) :
- diarrhoeic shellfish poisoning :
- allergies :
- oxygen depletion :
- others :

TAXONOMIC COMPOSITION OF THE BLOOM
(if possible according to the most recent generic and specific names , cf. the Check-List of British Marine Algae - Third revision , by M.Parke and P.S.Dixon, J.mar.biol.Ass.U.K.(1976) 56,527-594)

- dominant species :
- number of cells/liter :

- co-dominant species :
- number of cells/liter :

- co-dominant species :
- number of cells/liter :

- co-dominant species :
- number of cells/liter :

INDICATION OF PREVIOUS OCCURENCES OF SUCH BLOOMS OR SPECIES IN THE SAME LOCATION

PRESUMED CAUSE OF THE BLOOM (upwelling, organic pollution, etc.)

ANNEX IV

Proposed format for

The Directory of National Expertise on Exceptional Algal Blooms

Country: Year this report submitted

Institution	Type	Address	Tel	Telex	Personnel	Expertise**

* Examples:
- National co-ordinating centre — A
- Other control agencies (Fisheries, Health — B
- Centre of taxonomic expertise — C
- Centre of toxicological expertise — D
- Centre of Ecological expertise — E
- Other (specify)

**Examples:
- Phytoplankton Identification general — a
- Taxonomic specialist (specify group) — b
- Toxicologist — c
- Ecologist — d
- Physiologist — e
- Hydrographer — f
- Other (specify)