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REPORT OF THE WORKING GROUP ON THE BALTIC MARINE ENVIRONMENT

Sopot, Poland, 13-14 April 1989

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Sopot, 13 - 14 April 1989

1 OPENING OF THE MEETING

On behalf of the Director of the Institute of Meteorology and Water Management, Warsaw, the participants were welcomed by the organizer of the meeting, Dr E. Andrulewicz. Thereafter, Dr P. Krzyzanowski from the Ministry of Environmental Protection and Natural Resources of Poland, in his capacity as the present Chairman of the Scientific-Technological Committee (STC), highlighted recent activities of the Helsinki Commission (HELCOM). He reminded the group of the important decision from the 1988 HELCOM Meeting on ministerial level to reduce most harmful discharges by 50 % by 1995. The great importance of the close cooperation with ICES, from which the HELCOM continuously receives scientific advice, and the key role which the WGBME and the former ICES/SCOR Working Group on the Study of the Pollution of the Baltic (SCOR WG 42) played were thereby acknowledged.

The Chairman, Dr L. Brügmann, then opened the meeting on 13 April 1989 at 9.20 hrs.

2 ADOPTION OF THE AGENDA

The Working Group considered the draft agenda prepared by the Chairman and adopted it with minor changes. The agenda is attached as Annex 1. The list of participants is given in Annex 2. Because several members of the Working Group and the ICES Hydrographer had to leave already on 14 April, it was agreed that the meeting should be closed earlier than outlined in the draft agenda. Dr H. Dooley agreed to serve as Rapporteur for the time of his stay at the meeting. In addition, other participants were asked to prepare reports on selected items. Before further following the agenda, the participants at the meeting briefly introduced themselves because several new members were recognized.

3 REPORTS ON ACTIVITIES OF INTEREST TO THE WGBME

3.1 Related Activities within ICES

Dr H. Dooley introduced a paper on relevant resolutions from the 1988 Statutory Meeting prepared by the ICES Environment Officer (extract in Annex 3). There was no further discussion concerning this information paper.

Dr M. Perttilä provided information on the outcome of the meeting of the Marine Chemistry Working Group (MCWG) which had been held in Savannah, Georgia in February 1989, chaired by Dr G. Topping (UK). The main activities of that group are related to organizing intercomparison exercises, reviewing methodology and individual contaminants in the marine environment. The work is performed in three sub-groups dealing with chemical oceanography (nutrients),

trace inorganic and organic substances. The main item from the nutrient sub-group was the forthcoming intercalibration exercise on nutrient measurements, coordinated by Drs Kirkwood (UK), Aminot (France) and Perttilä (Finland) in which about 80 laboratories are participating, including many from the Baltic Sea. Pre-intercalibration runs among a small number of laboratories have shown that the samples are sufficiently stable. The samples will be distributed in May 1989. Results should be submitted by the end of August 1989 because a report on the outcome of the exercise shall be presented to the MCWG at its next meeting.

The trace metal sub-group dealt mainly with issues related to existing and planned overviews on metals in the marine environment, and with quality assurance programmes, including especially the use of standard and un-compromised reference materials which are available now for many media.

The organic sub-group dealt with, inter alia, two intercomparison exercises. The first of these was on analyses of PAHs, in which preliminary results indicate that problems arise when acetonitrile is used as a solvent for the preparation of samples to be distributed. A repetition of the first stage of that intercomparison is possibly needed. Therefore, the second stage, including extraction and clean-up steps, will not start before the end of 1989. An intercomparison exercise on analysis of chlorobiphenyl (CB) congeners will be carried out in three steps, the first of which is presently underway. Overviews are planned for PCBs, HCB, PCDFs and PCDDs in the marine environment.

Further information was provided by Dr Perttilä on the Meeting of the Working Group on Marine Sediments in Relation to Pollution (WGMS), chaired by Dr J. Calder (USA), which was held in Savannah immediately after the MCWG Meeting. This Group plans to carry out an intercomparison exercise on trace metals in suspended particulate matter (SPM), which will commence during the second half 1989. 'Normalization' of trace metal contents in sediments was another important issue. Depending on the area in which studies are carried out, different elements are proposed to be used as normalization tools, e.g., for the Baltic Sea the organic carbon content and for sediments of the North Atlantic coastal areas Al, Li, Sc and others. As with MCWG, the WGMS discussed problems related to analytical complexities, quality assurance and quality criteria.

3.2 Relationship with other Organizations

Dr B.I. Dybern informed the Working Group on the next Symposium of the Baltic Marine Biologists (BMB), to be held from 11 to 15 September 1989 in Szczecin, Poland. This will provide possibilities for improved cooperation amongst biologists, especially to enable joint action in different aspects of marine biology.

Dr H. Dahlin informed that the 17th Conference of Baltic Oceanographers (CBO) will be held in Norrköping, Sweden, on 3-7 September 1990. The participants are invited to attend the meeting with research vessels. The necessary approval of the local authorities has already been granted.

Dr H.P. Hansen informed the Group that the Proceedings of the 16th CBO (Kiel, September 1988) will probably be ready for distribution in May 1989. The Proceedings will be published in two volumes (about 500 copies and 1200 pp.). He noted that the number and extent of papers to be published has further increased and questioned whether the publication of the entire manuscripts will be possible in future CBOs due to the increasing funds necessary.

Dr. Falkowski informed on an IUPAC conference to be held in Stockholm this year in which one of the main items will be "Marine Chemistry".

Dr Dahlin introduced a paper describing the progress in the Swedish/Finnish Gulf of Bothnia Committee in preparing a "Gulf of Bothnia Year 1989-93". The investigations will start in 1989/90 with "pre-studies". In 1991 the main activities in relation to field measurements will take place. For 1992 and 1993, the evaluation of the results and seminars are planned. Topics such as "input from land", "biogeochemical cycles", "toxic substances" and "modelling" are included in the preliminary programme, which is presently available only in Swedish, but will soon be available in English also. Dr P. Tulkki stressed that laboratories from other Baltic Countries are invited to take part in the various investigations. The programme is coordinated by a Swedish/-Finnish Steering Group chaired by Drs Ehlin and Perttilä. Interest was expressed by some of the participants in the WGBME Meeting to join parts of the proposed programme.

3.3 National Activities

Written reports on national activities were received from Working Group members from Finland, the German Democratic Republic and the USSR. Information on relevant activities in the Federal Republic of Germany, Poland, and Sweden was provided by Drs Hansen, Andrulewicz and Aitsam, respectively. Additions were made by Drs Piechura, Dera, Bengtsson, Wulff and Dybern which were promised to be included in the written reports on these countries to be submitted by the end of April to the Chairman.

4 WORK PROGRAMME IN RELATION TO THE HELCOM

The Scientific Secretary of the Helsinki Commission, Dr T. Melvasalo, informed the Meeting about recent activities within the Helsinki Commission (HELCOM) and its subsidiary bodies, of possible interest to the WGBME, as follows:

- Since August 1988, the new Executive Secretary of the HELCOM is Commander Fleming Otzen, Denmark, the Maritime Secretary is now Dr Lars Thorell, Sweden, and the first Technological Secretary is Dr Vassili Rodionov, USSR.

- Guidelines for the Third Stage of the Baltic Monitoring Programme (BMP) have recently been published as Baltic Sea Environment Proceedings (BSEP) No. 27 in four volumes (A, B, C and D). Also, a combined volume in loose sheet copies has been issued. A number of these publications have been distributed by the HELCOM Secretariat in January 1989 through national contact persons in each Baltic Sea State.

- The Biological Workshop (intercalibration with the participation of research vessels) intended to be organized by Sweden in Visby in August 1989 has been postponed by one year, to the last week of August 1990 to be held in Sweden (Visby). Steering Groups have been nominated to plan the exercise. Additional contact persons were requested to be nominated by each country during the HELCOM 10 Meeting (February 1989). Information should be submitted to the Swedish organizers (SNV Solna).

- The Group which will prepare the Second Periodic Assessment of the Baltic Sea environment (GESPA) will meet in Tallinn in the first week of May 1989. Nine chapters will be included in the Second Assessment, each of them also covering evaluation of the state of the coastal zone. Also included is a chapter on fish stocks to be prepared by ICES. BMB will possibly cooperate in advising on coastal species. The conclusions are to be prepared in spring 1990.

- The Group of Experts on Airborne Pollution (EGAP) will meet for four days in April 1989 in Copenhagen. Amendments to the present monitoring programme will be considered, e.g., additional heavy metals and organochlorines will be included. EGAP is interested in cooperating with other scientific groups dealing with measurements in sea water, biota and sediments to have the same determinands to be monitored also by marine scientists. A report evaluating the deposition values to the Baltic Sea for 1983-1986 will be published in the BSEP this year. The next evaluation will be prepared in cooperation with the ECE, which will also host in future the HELCOM Airborne Data Base for various substances using the ECE-EMEP facilities in its data centers. Emission data are collected for the purpose of modelling on trace metals and organic substances. That data base will be hosted by the Federal Republic of Germany.

- The Group of Experts on Monitoring of Radionuclides (MORS) is working on the basis of a revised programme. An evaluation of the status of the Baltic Sea will be considered during a meeting held in May/June 1989 in Rostock. The outcome will be published in the summer of this year. MORS seeks advice from ICES in relation to sediment sampling.

- A new group has been established to consider the question of air pollution from ships.

- The HELCOM Bibliography is now available as an on-line data base called "BALTIC" which is hosted by the Swedish National Environmental Protection Board (SNV). The volume of data is increasing every year by about 450 to 500 references. All environmental literature should be included, also the "grey literature". The same type of information on magnetic tapes will also be available soon in some other data centers, e.g., in Moscow.

- HELCOM 10 passed a number of Recommendations, e.g., regarding the preparation of coastal assessments as an obligatory task, the pollution load compilation to cover all input data to the Baltic Sea to be collected in 1990 according to a special programme, and a recommendation concerning abnormal environmental situations like toxic algal blooms in the Baltic Sea, intended for the establishment of an early warning system similar to those already existing for oil accidents. The ICES Work Programme of requests from the HELCOM includes the task of providing information on conditions relevant to the potential development of unusual algal blooms in the Baltic Sea area (see Annex 5).

In addition, it was mentioned that HELCOM has granted observer status to Greenpeace International for Commission meetings.

4.1 Preparation of the "Critical Sediment Assessment"

The ICES Sub-Group on Baltic Sediments, chaired by Dr Perttilä, had met two times since the last WGBME Meeting with the aim of producing a "Critical Review on the results of Contaminant Studies in Baltic Sea Sediments". The underlying reason for this work is that HELCOM has asked ICES for advice on whether to include sediment studies into the BMP.

At a meeting held in September 1988 in Tallinn, the contents of the "Critical Review" were agreed upon; and authors and possible data originators were identified. Unfortunately, a great part of the responsibilities had to be tentatively designated to scientists not present at the meeting.

At the meeting held in Sopot, 10-11 April 1989, the progress in the work was reviewed. Even though a considerable number of the agreed chapters of the Critical Review have already been drafted, there are still gaps, mainly due to the slow, delayed or non-existent response from scientists not present at the meetings. Because the expertise of those Sub-Group members present was not considered sufficient to cover all the aspects which should be included in the Critical Review, again part of the work to be done had to be left for the Chairman to discuss with experts not present in Tallinn and/or Sopot. Relevant trace element data for the preparation of "Baltic Sea Sedimentation Maps" are now available, but were received by the Chairman too late to produce even draft maps for the Sopot Meeting. Data on organochlorines and petroleum hydrocarbons in sediments are considered scarce in comparison with data on trace metals. A first draft of the critical review should be presented at the 1990 WGBME meeting.

In spite of the slow progress of the work, a tentative recommendation was given for the consideration of the WGBME. Because sediments provide a medium in which long-term trends of contaminant levels could possibly be detected, and because contaminant budgets can be calculated only if sediment content data are available, the Sub-group recommended that Baltic Sea sediments should be investigated on a multilateral basis under the framework of HELCOM. However, because changes in environmental stress due to contaminant levels can be detected only slowly in sediments, monitoring should not be carried out in the same way as it is organized by the BMP for other marine media. Rather, "exten-

sive baseline studies in sediments", repeated at intervals of five years or more, were considered more suitable and would additionally provide a real chance to detect changes as well as to prepare the studies and assess their results more carefully. An ad hoc (Study) Group should be nominated to coordinate these sediment baseline studies, which should not be started until 1993, and to organize the assessment of the results.

The Scientific Secretary of HELCOM welcomed that a long-needed answer has been given by the expert group. She stated that she wished to receive, if possible, preliminary advice from ICES on this matter in due time before the next STC Meeting (October 1989) for distribution among the STC members.

In addition, the HELCOM MORS Group (Chairman: Dr H. Nies), which will meet in May/June 1989 in Rostock, is seeking advice regarding the most representative sedimentation areas for sampling sediments for the monitoring of radionuclides in the Baltic Sea, conducted under that Group. These questions may be answered by the Critical Review, expected to be available in draft form in 1990. The ICES Observer present during that MORS Meeting should provide information on relevant activities within ICES.

The recommendation prepared by the Sediment Sub-Group was approved by the Working Group with minor modifications. The WGBME supported the idea of including nutrient data in the Critical Review and nutrient measurements in the proposed sediment baseline studies, even if no authors could presently be identified for writing the necessary chapters.

4.2 Implications of PEX for the BMP

Dr Dybern summarized the outcome of the PEX Study Group meeting preceding the WGBME meeting. Although PEX was considered successful in many respects, the methods applied did not provide the data quality desired. This included the comparability of sampling depths, and the accuracy of the determinations of salinity and nutrients. Sometimes large correction factors were needed to compensate for these variances.

Dr Dooley showed that the variances in nutrient measurements observed during PEX between different ships (laboratories/-countries) seems to follow exactly the same trend as found from the analysis of BMP data sets (e.g., for station BY15) reported from the same laboratories. This would indicate serious systematic errors and would certainly question trends derived from the analysis of data from different sources. This should be further investigated and will certainly be a matter for GESPA to consider during its forthcoming meeting in Tallinn in May 1989. There was a general agreement that better quality control is urgently needed and that certainly many data that are highly suspect are stored in data banks.

In comparison to chemical and hydrographic parameters, biological monitoring was considered the most difficult. Significant differences between the ships and individual biologists were observed.

To provide measurements on a long-term basis of parameters which could reflect the state of the Baltic Sea environment; the use of

the large potential of "ships of opportunity", especially ferries, was proposed. Dr Dahlin reported on the experiences of Sweden in the use of high-speed ferries, equipped with current meters, that cross the Kattegat or the Great Belt. An ad hoc Group, not related to PEX, should be set up by ICES aimed at assessing the present opportunities to use ships, platforms and buoys for such measurements and which should also identify modern equipment and methods that function more or less independent of specialized service by crew members. In future, the need for real-time data to calibrate satellite sensor signals and the use of automatically working buoys in the Baltic Sea will increase.

4.3 Overview on "New Contaminants"

Dr Andrulewicz reviewed the information which had become available through other relevant international organizations and their expert groups (GESAMP, IOC, ICES/MCWG, HELCOM). "New contaminants" has been a standing item of this Working Group for many years. There has also been a standing complaint on not enough analytical effort undertaken to study these compounds. In particular, the work on organochlorines in the Baltic Sea environment requires very much money and is considered to be a challenge for analytical chemists. It was noted with appreciation that in recent years other international bodies have become more and more concerned about "newly detected contaminants".

A lot of attention is now focused on these compounds within HELCOM. As far as the Baltic Sea is concerned, there was no striking new information on "newly detected contaminants". It is now commonly understood that the introduction of new synthetic compounds should be more careful and that some measures to eliminate particularly toxic and persistent compounds are needed. Control and limitation of discharges of "new contaminants" are now undertaken by the HELCOM, e.g., in relation to organo-tin compounds in fouling paints.

The revised list of substances under consideration in HELCOM has now the following composition (STC 13/6d/4,1986):

- Chlordane,
- Chlorinated phenols,
- Freons,
- Halogenated paraffins,
- Hexachlorobenzene (HCB),
- Lindane (gamma-HCH),
- Toxaphene and other chlorinated terpenes.

Suggested for inclusion are:

- Diphenyl sulfone,

- Phenoxy acids,

- Polychlorinated dibenzo-dioxins (PCDDs),

- Polychlorinated dibenzo-furans (PCDFs),

- Polychlorinated naphthalens (PCNs),

- Pyrethroids,

and already considered are

- Phthalate esters,

- Polychlorinated terphenyls (PCTs).

The list of "new contaminants" should be kept under continuous review, having in mind that with the present powerful analytical instruments it will be possible to detect an increasing number of compounds in the marine environment which are of anthropogenic origin. However, this cannot be accepted as sufficient reason for the inclusion of a compound into a list of those to be investigated and monitored. More knowledge on the possible biological effects of "newly detected compounds" is needed.

4.4 Overview on Contamination by Petroleum Hydrocarbons

Petroleum hydrocarbons in water were determined on an obligatory basis during the second stage of the Baltic Monitoring Programme using the UVF technique together with an "Ekofisk standard". The UVF technique was commonly applied with the understanding that this was a screening technique and in case unusually high concentrations were found by UVF, other relevant techniques should be applied additionally, e.g., GC-MS. In recent years, there was no significantly contaminated area recorded, although some tanker accidents occurred, e.g., the "Antonio Gramsci" accident in the Gulf of Finland, and some smaller cases of oil pollution took place, including unwanted oil discharges as, e.g., reported for Polish economical waters.

On the basis of UVF records taken from the 1970s and including recent measurements within the BMP, it can be concluded that there is no proof of a growing oil contamination in the Baltic Sea and that there is no evidence for a greater contamination of the Baltic Sea than the North Sea with respect to oil. Most commonly reported values for the open sea areas are between 0.2 and 2 µg/l (UVF, Ekofisk standard, see Fig. 1).

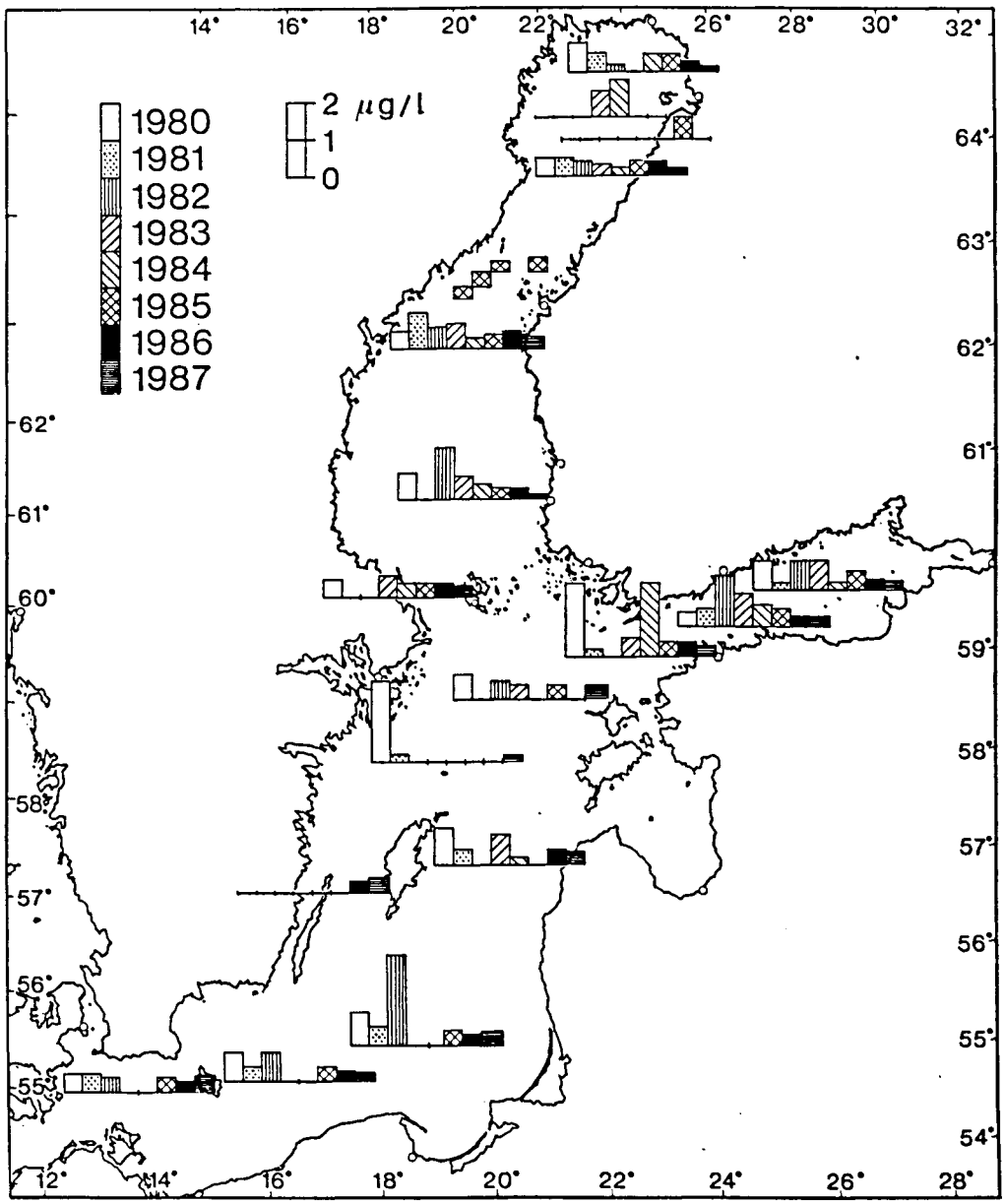

Figure 1 Total hydrocarbon concentrations in the time period 1980-1987 (Poutanen, 1988; Proc. 16th CBO, Kiel).

In addition, a very even distribution of PHs has been observed in Baltic Sea waters. This could be due to airborne input of UVF "active" combustion products. Another explanation could be that there is a relatively evenly distributed pool of UVF active and PH-related substances which are degraded only slowly in relation to other components of the oil.

It is worth noting that more studies applying powerful GC-MS techniques have been started in the Baltic Sea countries. Concentrations of individual compounds have been shown to occur at the level of ng/l. For example, Dahlmann and Theobald (HELCOM/GESPA-2, Hamburg 1988) analysed the composition of the non-polar fraction of a typical water sample from the Baltic Sea and found 40 compounds with concentrations between 0.2 (4-M-phenanthrene) and 11.8 ng/l (n-C29) including n-alkanes from C14 to C30, aromatic compounds of petroleum origin (weathered oil, combustion products) and products of natural origin (pristane).

Studies on oil contamination of sediments and on the effects of the oil on biota are not as well developed as the studies on water contamination. More effort should be spent to close this gap, especially in developing the necessary analytical methods.

5 OTHER PEX MATTERS

It was noted that the Pex Main Report had already been distributed amongst the PEX Study Group members. This report is now in more or less final form and will be officially available soon as an ICES Cooperative Research Report. There will be a page of errata to draw attention to individual errors.

The PEX Atlas is understood to be a product containing a more complete set of the PEX data. The discussion in the WGBME revealed clearly that the PEX Atlas should be distributed preferably in a computerized form accompanying a small number of hard-copy maps. It was agreed that a group including the ICES Hydrographer should investigate this question intersessionally with respect to the necessary effort, costs, etc.

Previously it had been planned to hold a PEX Symposium together with the next CBO. The experience of the last CBO, however, was not to combine too many meetings. Therefore, the possibilities will be assessed to hold the PEX Symposium together with another activity, e.g., with an ICES Symposium on "Hydrobiological Variability in the ICES Area, 1980-1989" (Convener: Dr D. Dickson), to be held for 3 days in 1991 in Mariehamn.

The PEX Study Group should meet again for one or two days in connection with the 1990 meeting of the WGBME to deal with the final proposal of a PEX Atlas, the preparation of the PEX Symposium, and a discussion of further PEX-related field studies.

6 PROPOSAL ON MULTILATERAL STUDIES IN THE SKAGERRAK AREA (SKAGEX)

Dr Dybern introduced the report from a first planning meeting on multilateral studies in the Skagerrak (SKAGEX), held in Lund on 7-9 February 1989. Despite the fact that the composition of that group is similar to the group working on PEX, the main objectives of PEX and SKAGEX are different. The Skagerrak, belonging geographically to the North Sea, is of great importance for the Baltic Sea. The experiment is based on Danish, Norwegian and Swedish initiatives and is more concerned with circulation than

with "patches". The studies should be carried out under the umbrella of ICES. However, the three Scandinavian countries mentioned would carry out these studies even without ICES support.

The main SKAGEX exercise should be carried out in May/June 1990 with about half of the ships (about 23) working in the first part and the other half in the remaining period. Some ships should cover the whole period. An intercalibration will be arranged in the middle and work should be extended by transects through the adjacent parts of the North Sea and Baltic Sea. The parameters are similar to those studied in PEX. Smaller investigations carried out in September 1990 and winter/spring 1990/91 by a few ships shall provide information from other seasons. Finland is unable to participate due to Antarctic commitments. The next planning meeting is proposed to be held in Kiel or Rostock in October/November 1989.

Drs Dooley and Dahlin provided information on the discussion of the SKAGEX project in the ICES Shelf Seas Oceanography Working Group. No one in this Group was in principle against the project. However, the lack of scientific objectives, and the short planning period were criticized. It was further felt that the existing scientific information has not been sufficiently worked up. In addition, some other North Sea States had expressed their interest in participating. Dr Dybern responded that due to other plans for multilateral studies (Bothnian Gulf Year 1991; follow-up of PEX), the only practical solution seen was to carry out the studies in 1990. He stressed that the multinational planning group has already considered in depth the existing information on the study area. In the subsequent discussion it was agreed that not only should the hydrographic, nutrient and biological determinands be considered, as done during PEX, but additionally, studies should be encouraged on organic and inorganic trace contaminants. It should be kept in mind that such studies would need specialized equipment, ships and personnel if they shall give adequate answers on distribution patterns. The experience of PEX has shown the need for proper quality control. More time and effort should be spent during SKAGEX on this problem. Modelling activities are also included in SKAGEX.

Preferably, synoptic information on the conditions in the North Sea should be obtained during SKAGEX. It was, furthermore, proposed that similar types of investigations should be carried out in the North Sea. Despite the existing criticism in ICES, the WGBME supported the recommendation of the PEX Study Group that SKAGEX should be carried out in 1990 as proposed, with the understanding that the SKAGEX Planning Group still remains open to further cooperation and assistance from other countries bordering the North Sea and open to suggestions on how to use such a very large effort in a still more optimized way.

Additionally, Dr Dybern mentioned that a Swedish programme (project leader: Dr I. Cato) has been set up to investigate the sediments of the Skagerrak.

7 HYDROGRAPHIC INVESTIGATIONS IN THE BALTIC

Dr W. Matthäus reported on recent statistical analyses concerning the water volumes penetrating before and during major inflows of highly saline waters into the Baltic Sea. The analyses are based upon 90 major inflows identified between 1897 and 1976. Major inflows - the final stages of longer lasting inflow processes - are characterized by two periods: the precursory period covering inflows of lower saline water before the onset of the major event and the true inflow period. Fig. 2 shows the frequency distribution of the water volumes penetrating before the beginning of major events at the Darss Sill (V_b) and during the inflow events (V_d).

The water volumes crossing the sills during the precursory period range between 20 and 230 km^3 (on average 120 km^3). In 69 % of the events the volumes vary from 80 to 160 km^3. The volumes entering the Baltic Sea during major events range between 3 and 235 km^3 (on average 70 km^3). Generally speaking, it can be stated that the inflowing volumes are >100 km^3 during strong events and <100 km^3 during weaker inflows.

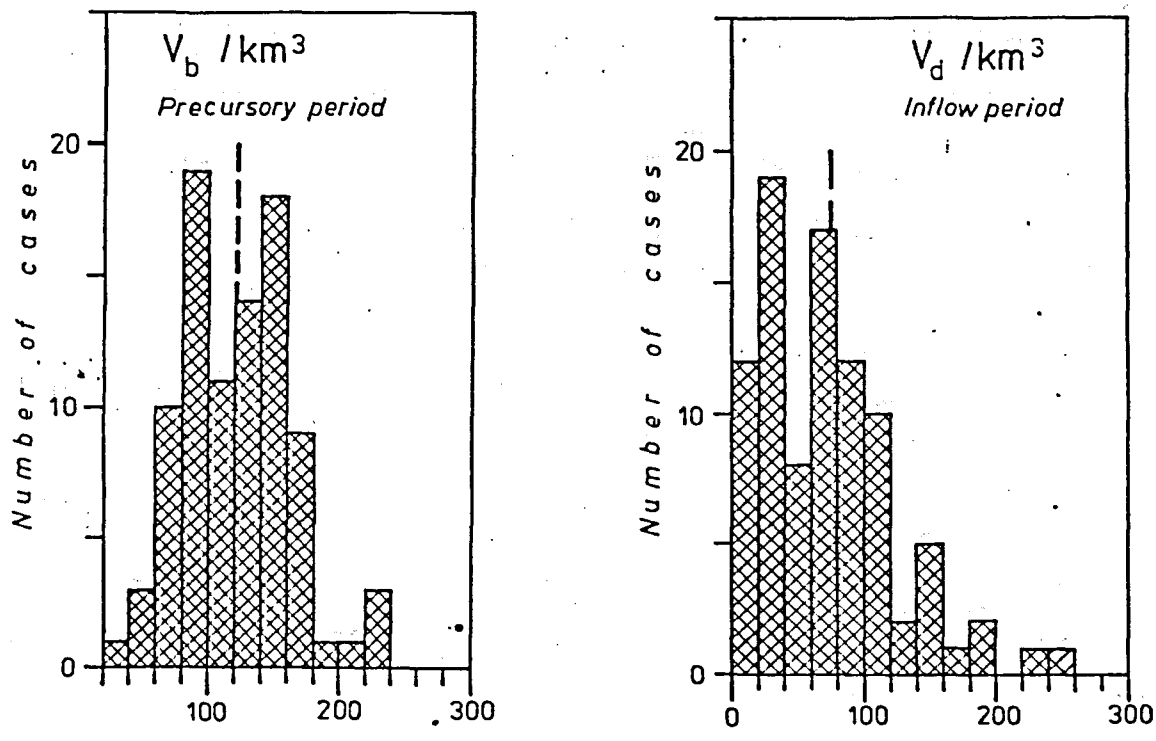

Figure 2. Frequency distribution of water volumes penetrating before the beginning of major events (V_b) and during the major inflow (V_d).

Dr Dahlin reported on BALTEP which aims to monitor inflow events to the Baltic Sea and is part of the IGOSS programme. Dr Dahlin regretted that, owing to technical problems, the SMHI had been unable to prepare a first assessment of the data obtained to date

for the WGBME Meeting. Dr Dahlin encouraged all participants to investigate their possibilities of reporting more Bathy/TESAC messages. He showed the initial results of a Swedish national programme from continuously measuring buoys located in the Øresund (Malmö, current meter, salinometer) and in the Kattegat (outside Fladen with T/S sensors and off Gothenburg with current meter profilers). The results from daily analyses of data illustrate the slope of the sea surface between the Kattegat and the Baltic Proper due to pressure differences.

During the 16th CBO (September 1988, Kiel), a first meeting of the Study Group on Baltic Sea Modelling (Convener: Dr Dahlin) was held. It was recommended that a workshop be held in April 1990 which should bring together modelling experts from Baltic Sea countries. The aims of this workshop are to show the state-of-the-art in modelling and point out possible objectives to be achieved.

The Modelling Group will continue to work by correspondence. It was noted that the final membership of this Group needs to be further revised; some countries have been reluctant in nominating their respective experts.

Dr. Melvasalo mentioned a HELCOM Seminar on Modelling, to be held in Leningrad in 1989. According to Dr. Dahlin, the objectives of tis seminar are rather different from the proposed ICES Workshop because the seminar will deal with models in a more "open way".

8 REVIEW OF OTHER ENVIRONMENTAL STUDIES IN THE BALTIC

Dr Koblentz-Mishke informed the Group about the results of an ecological cruise carried out in 1984 with the R/V "Kurtchatov" in the Baltic Sea in which a scientific crew of 62 persons, including scientists from the GDR and Poland, participated. From continuous measurements of fluorescence, typical patterns, including a large eddy, were recorded. For the winter season December 1989/January 1990, another cruise of a similar type is being planned with the R/V "Stockman". Of the 25 places for scientists, about half have been reserved for participants from other Baltic Sea States (Poland 4, Finland 3, other countries 1 each). The names of interested persons who could participate as observers or preferably with investigations to be integrated into the programme should be submitted to her as soon as possible. The parameters to be investigated include, inter alia, primary productivity, pigments, micro-zooplankton, nutrients and background hydrographic information.

Dr Koblentz-Mishke presented the collected results of the 1984 cruise. She is prepared upon request to submit even raw data to interested scientists who may need them as additional input for models.

Dr B. Hägerhäll informed about the activities and plans of Greenpeace International for the Baltic Sea. In August 1988, with support from Sweden, Finland, the USSR and Poland, a field trip using a bus equipped with sophisticated analytical instruments was carried out to study the quality of waterways of those four countries relevant to the Baltic Sea. Greenpeace supports the

"Wisla Project" (September 1989) with international participation. New projects related to the Baltic Sea will include the verification of the 50 % input reduction by 1995 and the observation of "large-scale gas and oil exploration in the Baltic Sea". In future, the Greenpeace vessel "Beluga" is planned to work partly in the Baltic Sea as well as in cooperation with scientists of the region, following the necessary formal procedures, e.g., prior notification, etc.

8.1 Contamination Effects by Aquaculture

Dr Tulkki introduced two papers dealing with environmental effects caused by fish farming in Finland. Leppäkoski and Häkkilä ("Fish farming causing eutrophication in Finnish coastal waters", 14th CBO, Gdynia 1984) showed that due to improved treatment of waste waters from industrial and municipal sources, the fraction of nutrients released by fish farming inceased but is still below 10 % of the total loadings. However, as a local point source of eutrophication, the fish farms cannot be neglected.

According to Mäkinen ("Report on suspended solids from fish-farms in Finland", Finnish Game and Fisheries Research Institute, Mimeog. Publ. No. 74), between 80 and 280 g solids per kg feed (110 to 520 g/kg fish produced) will be released into the marine environment. The loading factors for BOD_7 (145 to 720 g), nitrogen (51 to 86 g) and phosphorus (7 to 18 g) per kg fish produced may be locally significant because already in 1985 more than 6000 tonnes of fish were produced by fish-farming. The collection of sludge below net cages seems a logical solution.

8.2 Input Studies/Studies on Sections Coast - Open Sea

Dr Tulkki introduced a paper by Pitkänen et al. (1986, "Phosphorus and nitrogen balance of a coastal bay", Publications of the Water Research Institute, Natl. Bd. of Waters, Finland, No.68) in which annual mass balances for N, P and suspended solids were estimated in a shallow enclosed bay of 53 km^2 located at the coast of the Gulf of Finland. The results showed that only relatively small portions of the total loading of nitrogen (2 to 3 %), phosphorus (16 %) and suspended solids (17 %) are retained in the estuarine area.

An extensive discussion followed showing the further lack in information on which percentages of contaminants are retained in coastal areas and which part may reach the open sea. This is especially important for those coastal areas where any inputs must pass bays and/or areas covered by many islands with restricted exchange of water with the open sea. These zones may act as efficient traps for some contaminants, but not for others. The WGBME noted with satisfaction activities within the HELCOM to prepare stepwise improved gross contaminant load assessments for rivers. The next step would be to encourage HELCOM further not only to organize the preparation of such assessments on the "discharge rates" at the river mouths, but also on the "discharge functions", i.e., the final fate of those inputs, their gradients in a seaward direction. Those "discharge functions" are needed for the major rivers separately because each individual river mouth and the coastal areas may show a different behaviour in contaminant retention. It was agreed that, for the next meeting,

material should be prepared summarizing the present state-of-the-art and proposing details of possible (pilot) programmes. Drs Aitsam and Hansen volunteered to try to provide or organize such presentations.

Despite the fact that relevant advice on why and how to perform net input studies has been provided by ICES to HELCOM in a generalized form, this advice has not yet been considered in the present pollution load compilation programmes. The present BMP Guidelines should be checked in relation to chapters which would need to be added for carrying out the necessary studies on real net input figures.

8.3 Environmental Influences of Unusual Meteorological Conditions

Dr Tulkki introduced a paper (Rönnberg and Haahtela, 1988: "Does anchor ice contribute to the decline of Fucus in the Baltic?", Mar. Poll. Bull., 19, 388-389) in which a new theory on the decline of bladder-wrack, Fucus vesiculosus L., in the northern Baltic Sea in the late 1970s and early 1980s is provided. So-called "anchor ice" is formed in Finnish coastal waters during exceptionally mild winters when no solid ice occurs at the surface. The whole water column is gradually cooled down close to the freezing point (about -2^{0}C in SW Finland). A cold period then provides supercooling of the water. Ice is then formed in the water as a crust on solid objects. The ice lifts up to the surface and removes the bladder-wrack from the solid substrate. By this mechanism, the Fucus will partly disappear, with all the consequences for fisheries.

8.4 Exceptional Algal Blooms

Dr Dahlin summarized the present results of investigations on the Chrysochromulina polylepis bloom in the Kattegat/Skagerrak area in May/June 1988. A preferred hypothesis is that a disturbed nutrient balance is the main reason for a pronounced flagellate bloom after the normal diatom bloom. Extra nitrogen was made available. In principle, the sources for that "nitrogen-excess" could be run-off from the land, airborne deposition, inflow from the North Sea or from the Baltic Sea. In January/February 1988, the input from air and land was extremely high, 1.5 times higher than the average; 2.5 times more precipitation was noted, introducing nitrogen but only very little phosphorus. In addition, the possibility can be noted as to whether the North Sea is responsible by the entrainment of nutrient (nitrogen)-rich water. For instance, in 1988 relatively high amounts of nitrogen compounds were introduced with the North Sea water. Even in the Kattegat an increasing trend of such North Sea related nutrients was recognized. Up to 25 µmol/l nitrate-N were observed. When, during its bloom, Chrysochromulina polylepis "felt" a phosphorus deficiency, the algae started to produce toxins.

The Working Group discussion centered around the question of whether a silicate deficiency in the Skagerrak/Kattegat area could have contributed to such unusual blooms. The eutrophication of rivers reduces the amount of silicate, which derives mainly from natural weathering processes and is only little influenced by anthropogenic activities, reaching the sea with freshwater run-off. The implications of these findings are that silicate

measurements should be performed more routinely and that studies in the transition area between the North Sea and Baltic Sea (SKAGEX) are urgently needed.

9 ANY OTHER BUSINESS

In Rec. 9/1988 the WGBME had recommended that ICES should invite HELCOM to co-sponsor this Working Group. At the ACMP and Statutory Meetings in 1988, this item had been discussed and contacts between ICES and HELCOM proposed. Because up to now ICES has not yet approached HELCOM in this matter, the WGBME asks ICES to reconsider the former recommendation.

The WGBME was of the opinion that the Working Group should continue its work, under the Chairmanship of Dr L. Brügmann. Dr. Aitsam promised to check the possibility of holding the next meeting in Tallinn, preferably 10-12 April 1990, with parallel or preceding meetings, for one to two days each, of the PEX and sediment Groups.

10 ADOPTION OF RECOMMENDATIONS

The recommendations as listed in Annex 7 were agreed in principle by the Working Group. The final drafting was left to the Chairman.

11 CLOSURE OF THE MEETING

After finishing all business, the Chairman thanked the participants for their efficient work and the organizers for providing such excellent working conditions. He closed the Meeting at 19.30 hrs on 14 April 1989.

ANNEX 1

Working Group on the Baltic Marine Environment
(Sopot, 13 - 14 April 1989)

AGENDA

1. OPENING OF THE MEETING

2. ADOPTION OF THE AGENDA

3. REPORTS ON ACTIVITIES OF INTEREST TO THE WGBME

   3.1 Related Activities within ICES
   3.2 Relationship with other Organizations
   3.3 National Activities

4. WORK PROGRAMME IN RELATION TO THE HELCOM

   4.1 Preparation of the "Critical Sediment Assessment"
   4.2 Implications of PEX for the BMP
   4.3 Overview on "New Contaminants"
   4.4 Overview on Contamination by Petroleum Hydrocarbons

5. OTHER PEX MATTERS

6. PROPOSAL ON MULTILATERAL STUDIES IN THE SKAGERRAK AREA (SKAGEX)

7. HYDROGRAPHIC INVESTIGATIONS IN THE BALTIC

8. REVIEW OF OTHER ENVIRONMENTAL STUDIES IN THE BALTIC

   8.1 Contamination Effects by Aquaculture
   8.2 Input Studies/Studies on Sections Coast-Open Sea
   8.3 Environmental Influences of Unusual Meteorological Conditions
   8.4 Exceptional Algal Blooms

9. ANY OTHER BUSINESS

10. ADOPTION OF RECOMMENDATIONS

11. CLOSURE OF THE MEETING

ANNEX 2

WORKING GROUP ON THE BALTIC MARINE ENVIRONMENT

(Sopot, 13-14 April 1989)

LIST OF PARTICIPANTS

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ANNEX 3

RELEVANT RESOLUTIONS FROM THE 1989 STATUTORY MEETING

The Council accepted the 1988 WGBME recommendation that the main report on the Patchiness Experiment in the Baltic (PEX-86) be published in the Cooperative Research Report series (C.Res.1988/1:6). Work on Part 1 of this volume, "General Report", has been completed and the volume is presently in press. The WGBME recommendation that a meeting of the Sub-Group on Sediments be held in 1989 was also accepted (C.Res.1988/2:33), as was the recommendation that the Study Group on Patchiness Investigations in the Baltic meet in 1989 (C.Res.1988/2:34). The WGBME recommendation that the BALTEP project begins on 1 November 1988 was also accepted (C.Res.1988/4:12).

Of the recommendations not accepted, the recommendation on the publication of the 1985 Baseline Study of Contaminants in Fish and Shellfish was not accepted because the full report on this Study, including the data submitted, has already been published as Cooperative Research Report No. 151. The recommendation that a Symposium on Patchiness in the Baltic and Adjacent Sea Areas was not accepted owing to a lack of adequate details concerning the aims of and issues to be covered by the Symposium, as well as a specific date and venue. The recommendation that construction activities that might influence the water balance of the Baltic Sea should be subject to open discussions among the countries around the Baltic Sea was accepted by the Marine Environmental Quality Committee, but did not go further owing to a lack of specific action requested. Finally, the recommendation that the Helsinki Commission be requested to co-sponsor the WGBME was not accepted in that form, but the Council requested the Secretariats of ICES and HELCOM to explore possible means of strengthening the membership of the Working Group.

A Joint Meeting of the Working Group on Baltic Seals and the Study Group on the Effects of Contaminants in Marine Mammals will be held in Helsinki from 15-18 May 1989 to assess the impact on seal populations of the high mortality of seals due to a disease epidemic and to evaluate available data on contaminants in seals to evaluate whether contaminants had any impact on the seal mortalities (C.Res.1988/2:44).

The Council has accepted (see C.Res.1988/3:5) a joint role with the Oslo and Paris Commissions in implementing the request concerning the "enhancement of scientific knowledge and understanding of the North Sea environment" from the Ministerial Declaration of the Second International Conference on the Protection of the North Sea. A North Sea Task Force has been established in this regard, which held its first meeting in December 1988. The work of this Task Force will also cover the Kattegat and it is possible that one element of its work will be a consideration of the exchange of water and materials between the Kattegat/Skagerrak and the Baltic Sea.

The Council approved the conduct of the intercomparison exercises on the analysis of trace metals in suspended particulate matter (C.Res.1988/4:13) and on the analysis of nutrients in sea water (C.Res.1988/4:10). The Working Group should assist in ensuring that the appropriate laboratories participate actively in these exercises.

The Working Group on Assessment of Pelagic Stocks in the Baltic and the Working Group on Assessment of Demersal Stocks in the Baltic will prepare the first drafts of the chapter on fish stocks in the Baltic and the extent to which environmental factors have affected these stocks (C.Res.1988/2:4:10(e) and 2:4:11(f)), intended for the Second Periodic Assessment of the Baltic Sea, being conducted under the Helsinki Commission.

COUNCIL RESOLUTIONS RELATED TO ENVIRONMENTAL ISSUES FOR 1989

1:3 The "Report on an Intercomparison Study of the Determination of Polychlorinated Biphenyls (PCBs) Isomerids in Baltic Herring Oil" (6/OC/BT), by Dr L. Reutergårdh and Dr K. Litzin, will be published in the Cooperative Research Report series. The estimated number of pages is 25.

1:6 The main report of the Patchiness Experiment in the Baltic (PEX-86) will be published in the ICES Cooperative Research Report series as a volume entitled "Baltic Sea Patchiness Experiment (PEX-86). Part 1 - General Report", edited by Dr B.I. Dybern and Dr. H.-P. Hansen, who will provide a camera-ready copy of the text, figures and tables. The estimated number of pages is 260.

1:10 Subject to clearance by the Chairman of the Consultative Committee, the Proceedings of the Workshop on the Chrysochromulina polylepis Bloom, edited by H.L.L. Rees, C. Heip, M. Vincx and M. Parker, will be published in the Cooperative Research Report series. The estimated number of pages is 50.

2:2 A Symposium on "Hydrobiological Variability in the ICES Area, 1980-1989", with Dr R.R. Dickson as Convener, will be held for 3 days in Mariehamn, Finland, in June 1991.

A scientific Steering Group of 4-5 members will be established to assist the Convener in planning the Symposium. The members will be chosen by the Convener in consultation with the Chairman of the relevant Subject/Area Committees and the Chairman of the Consultative Committee.

ANNEX 4

NATIONAL REPORTS

FINLAND

During 1988, Finland participated in the Baltic Monitoring Programme of the Helsinki Commission in the Baltic Proper, the Gulf of Finland and the Gulf of Bothnia. Joint monitoring with Sweden was conducted in the Gulf of Bothnia. National monitoring in the coastal waters includes about 100 observation stations, of which twelve are so-called Intensive Stations. In addition, loads from rivers are monitoried at 22 river mouth stations.

Monitoring of benthos, initiated by ICES in the 1960s, has continued annual since 1963. In connection with this research, the oxygen situation of the Baltic Proper, the Gulf of Finland and the Gulf of Bothnia has been measured and corresponding maps have been drawn. Also, long-term changes of zooplankton in the Archipelago Sea have been studied.

Finnish scientists participated in the compilation of the Second Periodic Assessment of HELCOM for the years 1986-1990, as well as in the PEX studies.

Cycling of organic substances in the Gulf of Finland was studied, as well as the cycling of nitrogen. In particular, the increase in nitrate levels in the Bothnian Bay and the blooms of blue-green algae in the Gulf of Finland and the Baltic Proper are the reasons for this nitrogen research.

The distribution of trace elements and organochlorine compounds in sea water was studied in the sea areas around Finland, especially in the Bothnian Bay.

Sediment studies were continued in order to map the spatial organochlorine distribution and trends. An extensive sediment sampling was also carried out for later trace element analysis.

A cooperative model study on the water quality of the Bothnian Bay was started in 1987. It is based on the data from 20 years at ca. 200 stations. The aims of the project are, i.a., to interpret the heterogenous field data, to improve the basis of water quality assessment, management and planning, to analyse the cost/effective ratio in field sampling, to provide more adequate response to catastrophes on the sea, and to specify factors influencing the state of the Bothnian Bay. The project will last until 1990.

An impact of an oil spill in 1987 on the marine ecosystems was continued in the Gulf of Finland. The project included mainly biological studies in 1988.

A project "Fish diseases as indicators of water quality" continued its second study year in the Archipelago Sea. Plaice was studied over its whole area of occurrence.

A revised monitoring programme on heavy metals and chlorinated hydrocarbons in fish and mussels in coastal water was started.

Heavy metal inputs from rivers into the sea and methods to monitor them have been studied in the lower courses of several rivers.

Mass balances of nutrients, suspended matter and organic matter in the archipelago zone has been studied off two estuaries, one in the Gulf of Finland and the other in the Archipelago Sea.

A special study concerning the dependence of elevated primary productivity and plankton blooms on currents, climatological factors, and loading and nutrient circumstances was started in the easternmost Finnish waters of the Gulf of Finland. The project will last until 1992.

GERMAN DEMOCRATIC REPUBLIC

The following report refers mainly to studies carried out either directly at the Institute of Marine Research (IfM)/Rostock, Warnemünde or to studies performed by other institutions in close cooperation with the IfM.

Water circulation studies

Within the framework of circulation studies, investigations on topographically controlled circulation patterns were continued. The analysis of experimental data from the western Baltic Sea was continued for the case of weak external forcing. A surprisingly high variability has been observed during a period of weak wind fields and small pressure gradients during an experiment in summer 1987. In July 1988, together with the Institute of Thermo- and Electrophysics of the Estonian Academy of Sciences, Tallinn, USSR, an experiment on inertial waves (INWEX'88) was conducted in the Arkona Sea off the coast of the island of Rügen. The studies were aimed at verifying theoretical models on the reaction of a stratified sea, bounded by the shoreline, to wind forces. The reactions of the near-shore wave guide were investigated by three current meter buoys orientated along-shore and by hydrographic sections perpendicular to the coast. Reactions of the open sea were followed by a combination of time series from buoy and ship stations with profiling on along-shore and off-shore sections. First interpretation showed surprisingly strong signals in the coastal wave guide.

The theoretical analysis of the dynamic response of the flow over isolated topographic features in a continuously stratified sea has been commenced. Particularly, the generation of topographically trapped waves around a cylindrical obstacle and the processes of vortex shedding are analysed in the frame of the quasi-geostrophic theory.

Investigations on salt water inflows

Analyses were concentrated on both the physics of single events and on the statistical description of inflows. Investigations on the salt water inflow in 1975/76 showed the following results:

- a preceding positive anomaly in salinity in the Skagerrak/Kattegat area,

- in the middle of November 1975, at the beginning of the inflow, a reduction of the mean sea level of the Baltic Sea of about 40 cm below the mean,

- the inflow was maintained by a steadily increasing east component of the wind until the beginning of January 1976,

- the actual inflow took place approximately 20 days after its beginning when about one volume of the main connecting channel (Great Belt, Fehmarn Belt and Mecklenburg Bay) was transported into the Baltic Proper, and

- the inflow was finished by an increasing mean sea level of the Baltic Sea (about 50 cm above the mean value) and by a decrease in the east component of the wind.

Further statistical investigations on major inflows of highly saline and oxygenated water into the Baltic Sea were carried out. Concerning the frequently quoted preconditions for major Baltic inflows, it has been shown that neither positive salinity anomalies in the Kattegat deep water in a 30-day period preceding major inflows nor negative mean sea levels of the Baltic Sea in a 15-day period before the onset of an event are necessary preconditions. Each of these situations were observed only in 50 to 60 % of all periods preceding identified inflow events.

The water volumes penetrating before and during major inflows were estimated. During the true inflow period, the penetrating volumes of highly saline water range between 3 and 235 km^3 (on average 71 km^3). The water volumes crossing the sills during a precursory period were estimated to range between 20 and 230 km^3 (on average 120 km^3). That means, on average, about 42% of the volume of the Belt Sea passed the sills before the major events began.

Trends of hydrographic determinands and nutrients

In 1988/1989, studies were continued in the framework of the BMP on basic hydrographic characteristics of the Baltic Sea. In the period under consideration, five oceanological expeditions ('seasonal cruises') were performed in the western and central Baltic Sea. The stagnation period in the eastern Gotland Basin continued for 12 years. The salinity and density values observed in the beginning of 1989 were among the lowest measured since the 1920s in the deep water. The almost continuous shifting of the 10 to 11 isohalines in the Gotland Deep down to more than 110 m and 140 m, respectively, finished at the greatest depths observed since the turn of the century. Since January 1988, the salinity of the deep water has been permanently below 12. The stagnation period led to the formation of the highest concentrations of hydrogen sulphide (4 and 5.7 mg/dm^3) ever measured at the 200 m and the near-bottom levels of the Gotland Deep. By the end of 1988, the stagnation period has resulted in mean decreases of 1.1 in

salinity, 1.4°C in temperature, 0.7 units in density and 4.8 cm^3/dm^3 in oxygen concentration at the 200 m level in the Gotland Deep.

The rather warm winter in 1987/88 was followed by a summer with nearly normal temperatures. The behaviour of the temperatures was similar in the surface layer of the Baltic Sea.

The influx of water rich in salinity observed in October/November 1988 in the Arkona Sea did not reach the extent of a major inflow. However, in the Bornholm Basin, its consequences were more pronounced than the intrusions found there every autumn. The renewal of the deep water in this basin was combined with an increase in salinity of 0.7 to 1.1 and in temperature of up to 2.8°C, whereas the oxygen concentration of the inflowing water was not high enough for the complete oxidation of the hydrogen sulphide.

Low phosphate and salt concentrations were measured in the winter surface layer of all Baltic Sea areas studied in 1988, whereas the nitrate concentrations increased regionally. In January/February 1989, not only the phosphate and salt concentrations but also the nitrate concentrations were relatively low in the surface layer as well. In contrast to the off-shore regions, the eutrophication increased strongly in the area of the Odra Bank. Unfavourable variations are therefore occurring in the spawning areas of the Rügen herring.

Increasing attention was paid to urea in the Baltic Sea environment. Although its average concentrations are low in different areas and depths, ranging only between 0.3 and 0.5 $\mu mol/dm^3$, seasonal variations were identified indicating that urea is linked with biochemical cycles. The phytoplankton was much more active than bacteria in the transformation of urea labelled with radiocarbon.

Investigations on biological determinands

In March 1988, ecological experiments were performed in the western Mecklenburg Bay. The investigations were aimed at examining temporal changes of the chemical and biological parameters during the spring bloom of phytoplankton in the open water as well as in 25 dm^3 containers. The biological parameters estimated included the heterotrophic potential, primary productivity, chlorophylls a, b and c, pheopigments, carotenoids, phytoplankton (qualitative and quantitative), micro- and meso-zooplankton (qualitative and quantitative), zooplankton respiration and remineralization. The analysis of the results from these experiments is underway.

During four seasonal cruises, i.e., March 22 to April 3, May 4 to May 17, August 1 to August 11, and October 22 to November 20, 1988, the following biological determinands were estimated: primary productivity, chlorophylls a, b and c, pheopigments, carotenoids, phytoplankton, micro- and meso-zooplankton, zooplankton respiration and remineralization (May and August only), secchi depth. In the Mecklenburg Bay, the onset of the spring bloom of phytoplankton was later than in previous years (end of March). In the other sub-areas of the Baltic Sea (Arkona Sea, Bornholm Sea, Gdansk Deep, Gotland Sea), the bloom started when expected.

In 1988, a very high autumn bloom of phytoplankton from the Mecklenburg Bay to the central Gotland Sea was the main event. The corresponding biomass and primary productivity data were comparable to those from the spring bloom. From the Arkona Sea up to the Gotland Sea, diatoms dominated; in the western part of the Mecklenburg Bay, the peridinians did.

Contaminant studies

Surface sediment samples (0-3 cm) and sectioned mud cores taken in the fishery zone and in near-shore coastal waters of the GDR were analyzed for their content of (petroleum) hydrocarbons estimated by applying the UVF technique. The preliminary observed values were in the range reported from other studies of mud sediments being anthropogenically impacted.

In 1988, sediment cores were taken from more than 200 sites in the Arkona Basin, on a grid covering most parts of the German Democratic Republic fishery zone in this basin. The cores were sectioned and the two uppermost slices, i.e., 0-3 and 3-6 cm, will be analysed in the near future to study the spatial distribution of trace metals, sedimentological and other background parameters.

Since September 1986, at the meteorological station "Arkona", located at the northeastern edge of the island of Rügen, filtered aerosols (48-hour sampling periods) and (bulk) precipitation samples (monthly sampling) have been taken continuously by the IfM. The first analyses of trace metals seem to reflect the representativeness of this station to characterize the conditions in the western Baltic Sea with respect to the 'airborne contamination'. Depending on the origin of the air masses passing the station, very different levels of metals in the aerosol samples were observed. From the precipitation samples, seasonal concentration differences for metals in the atmosphere could be related. Sampling at Arkona and the analysis of already existing samples will continue.

POLAND

During 1988, studies on chemical and biological processes in relation to pollution problems of the Baltic Sea have been carried out as follows:

Academy of Agriculture, Szczecin

- Analyses of trace metals (Hg, Cd, Cu, Pb, Zn) and chlorinated hydrocarbons (γ-HCH, Σ DDT, Σ PCB) in fish.

- Crustacea plankton biomass and species composition.

- Meiobenthos biomass and species composition.

Geological Survey of Poland, Branch of Marine Geology in Sopot

- Studies on ecological effects of possible sand and gravel extraction in the Slupsk Sandbank.

Institute of Meteorology and Water Management - Maritime Branch, Gdynia

- Airborne Pollution Studies for Helsinki Commission
- Baltic Monitoring Programme of the Helsinki Commission (chemistry)
- National Monitoring Programme of the coastal area (hydrology and chemistry) and hydrographic services.
- Analyses of petroleum hydrocarbons in sediments.
- Analyses of radionuclides (Cs-137, Sr-90, natural K, U, Th) in sea water, marine sediments, atmospheric fallout and marine algae.
- Pollution discharge of Polish rivers (the Vistula River in particular).

Institute of Oceanology of the Polish Academy of Sciences, Sopot

- Analyses of radionuclides (Po-210, Ra-226, Cs-137) in suspended matter, sediments and marine organisms.
- Joint ecological studies with Estonian Academy of Sciences on environmental factors influencing primary production.
- Trace metals (Pb, Cd, Zn, Cu, Cr, Fe, Al) in marine sediments.

Sea Fisheries Institute, Gdynia

- Primary production.
- Phytoplankton, zooplankton, zoobenthos biomass and species composition.
- General fisheries studies on fish diseases of herring, sprat, cod and flounder.
- Studies on ecosystem functioning in the Gulf of Gdansk.

University of Gdansk, Department of Oceanography, Gdynia

- Wet and dry deposition of N and P compounds into the Baltic Sea.
- Analyses of N and P compounds in the water of the Gulf of Gdansk.
- Analyses of trace metals (Ni, Pb, Zn, Cu) and N, P, Cl in interstitial waters.
- Phytoplankton, phytobenthos and zoobenthos species composition of the Gulf of Gdansk.

Veterinary Hygiene Research Station, Gdansk

- Chlorinated hydrocarbons (γ-HCH, HCB, Σ DDT, Σ PCB) in fish and fisheating birds.

- Fish diseases.

- Microbial pollution of the Puck Lagoon.

USSR

During the year 1988, the USSR has continued to run the all-Union programme of the Baltic Sea Study. This programme is led by the Leningrad Branch of the State Oceanographic Institute and by the Department of the Baltic Sea of the Institute of Thermophysics and Electrophysics of the Academy of Sciences of Estonia and involves participants from 25 research institutes. In 1989, the following main reults have been obtained within this project.

In the study of the Baltic Sea dynamics, comparatively strong jets have been observed in the open sea as well as in the coastal areas. The jets can transport pollutants to considerable distances. The deep intrusive lenses found in the deep layers (halocline) of the Baltic Sea play an important role in the vertical mixing of water masses and substances. It can be assumed that these lenses are of the main importance in the mixing processes through the halocline in the open sea.

The analysis of the intrusion processes in the formation of the fine structure of the Baltic Sea water masses has been continued. The vertical structure of the quasi-inertial waves was determined and the existence of layers of low hydrodynamic stability in the Baltic Sea pycnocline was found. These layers are connected with the large current shear of the inertial waves (Academy of Sciences of Estonia, Department of Baltic Sea).

The vertical structure of the radiative heating of water masses was studied and the depth of euphotic zones determined.

The horizontal distribution of chlorophyll and different sizes of particles were measured and the results compared with satellite (measurements) data.

In the Gulf of Finland, the study of spring plankton blooms was continued.

The use of the lidar technique for pollutant examination, especially for oil pollution, was initiated. A catalogue of different oil spectral images was composed that allow the origin of the oil patches measured to be determined. The search for possibilities of measuring the hydrodynamic processes of water masses by the lidar technique was continued (Department of Baltic Sea).

A great effort was to study the pollutant content in the Baltic Sea ecosystem elements. The sediment study of the Gulf of Finland was continued with the aim of determining the pollutant exchange

between the sediments and the water masses. Sediment samplers of special construction were used for these studies (Department of Baltic Sea).

Special efforts were made to use the Finest ecosystem model for the determination of the phosphorus concentration forecasts, in the case of increases in the phosphorite excavations in the northeastern part of Estonia (Academy of Sciences of Estonia).

Investigations in the coastal zone of the Gulf of Riga revealed overall enhanced eutrophocation and increased pollutant content in certain regions.

Studies of the biproductivity and seasonal dynamic oceanological basis in the reproduction of Baltic Sea industrial fish were continued.

Regression prognostic links to determine the trends in the salinity regime variations of different layers of the Baltic for long-term perspectives have been found (up to 2000-2020).

A background long-term prognosis for trends in the variations of the main factors determining the salinity regime (river inflow and water exchange through the Danish Straits) as well as general trends in the salinity variation up to 2015 have been presented.

Pecularities of the spatial and temporal variability of the chlorophyll-a concentration distribution in the waters of the open and coastal regions of the northeastern Baltic have been studied. Methods for the evaluation of the trophic level of the coastal zone waters relying on the data on the zooplankton and chlorophyll-a content have been suggested.

A test of the multi-layer liquid dynamics model on the data of multi-diurnal stations showed that the long-term part of the fluctuations is satisfactorily reproduced, whereas the short-term part is filtered out. Preliminary, it has been ascertained that the model does not reproduce extreme meteorologilcal situations.

The programme realization of the modified model of the substance multi-year dynamics in the Baltic Sea ecosystem has been accomplished and the initial data for calculations within 1951-1985 prepared.

Directions for the third stage of the Baltic Sea Monitoring have been elaborated and the recommendations for the reduction of pollutant input by shower flows entering the Baltic Sea given.

During the year 1988, the USSR has continued to participate in the Baltic Monitoring Programme of the Helsinki Commission. Pollutant loads by rivers and industry were determined.

The field study of the Baltic Sea by the R/V "Arnold Veimer" and others has been continued.

ANNEX 5

REQUESTS FROM HELCOM TO ICES

(February 1989)

The present requests:

1. To conduct a specific assessment of contaminants in sediments;

2. To continue the work on evaluating the size of seal populations in the Baltic and to assess their condition in relation to contamination;

3. To review the results of the Patchiness Experiment (PEX) in terms of any possible implication on sampling schemes used in the BMP;

4. To provide advice on reliable, intercomparable methods to determine concentrations of suspended particulate matter in sea water;

5. To study the problem of the intercomparability of nutrient analyses and coordinate an intercalibration exercise on analyses of nutrients and oxygen;

6. To provide information on "new contaminants", particularly those of special concern to the Baltic marine environment;

7. To provide information on progress in the intercomparison work on determination of specific hydrocarbons in marine samples;

8. To provide information on the environmental impact of aquaculture, including nutrients and organic load impacts;

Additional (new requests):

1. To report on the outbreak of recent epidemic diseases in seals in northern Europe in 1988 and its impact on seals in the Baltic Sea Area;

2. To provide information on as quantitative a basis as possible on conditions (physical, chemical and biological) relevant to the potential development of unusual algal blooms in the Baltic Sea Area.

ANNEX 6

ACTION LIST

1) All members are encouraged

   - to send information on concentrations, inputs and effects of "organic persistent contaminants" to Dr. Andrulewicz who will prepare a review for the next meeting,

   - to organize written reports on national activities so that they are available for the next meeting,

   - to be prepared to report at the next meeting on how the recommendations (pending confirmation by ICES) have been followed in the intersessional period,

   - to organize that names of national experts working in the field of Baltic Sea modelling will be submitted in due time to Dr Dahlin (SMHI, Sweden) and that these experts are informed about the forthcoming Modelling Workshop,

   - to organize that Bathy/Tesac messages, especially covering the period October to April, will be submitted from relevant ships according to the guidelines distributed by the SMHI.

2) Drs Aitsam and Hansen have offered to organize contributions on questions related to studies of net inputs of contaminants to the Baltic Sea.

3) Dr Perttilä is requested to present some information on the results of the ICES nutrient intercalibration exercise and their implications for studies in the Baltic sea.

4) Dr Dybern will present information on PEX and SKAGEX matters.

5) Drs Dooley and Perttilä will continue to investigate systematic deviations and trends in the different national BMP and PEX data sets.

6) Dr Dahlin will present information on the preparations for the Modelling Workshop and on other matters related to hydrographic investigations in the Baltic Sea.

ANNEX 7

RECOMMENDATIONS

Recommendation 1

The Working Group on the Baltic Marine Environment recommends that "repeated extensive baseline studies" (REBAS) on contaminants in sediments of the Baltic Sea should be organized starting not before 1993 and with at least five-year intervals

- to quantify changes in contaminant contents caused by accidental and/or long-term chronic inputs,
- to assess possible effects on the ecosystem, and
- if possible, use models to predict contaminant trends and to evaluate theoretically the effects of environmental regulations.

(for full text see Report of the Sub-Group on Baltic Sediments)

Recommendation 2

The Working Group on the Baltic Marine Environment recommends that an ad hoc (Study) Group should be nominated, preferably with members from all Baltic Sea States, to coordinate the REBAS on contaminants in sediments of the Baltic Sea.

Recommendation 3

The Working Group on the Baltic Marine Environment recommends that the Study Group on Baltic Sea Modelling should continue to work according to its terms of reference and that a Workshop be held in late April 1990 at ICES Headquarters (Convener: Dr Dahlin) with the following objectives:

- to present the state of modelling in the Baltic Sea area,
- to describe the state-of-the-art regarding marine modelling,
- to define what is possible to achieve by a joint effort on Baltic Sea modelling and to describe how this effort could be planned.

Recommendation 4

The Working Group on the Baltic Marine Environment recommends that

1) A joint international investigation in the Skagerrak area (SKAGEX) be carried out under the auspices of ICES from spring 1990 to late spring 1991, with a main stage lasting for four weeks in May/June 1990 and shorter and less intensive stages during other seasons, with the following objectives:

   - to identify and quantify various water masses entering and leaving the Skagerrak area with the time aspect involved,

   - to link the circulation patterns to external forces and biological phenomena,

   - to investigate the pathways of contaminants through the Skagerrak, and

   - to apply models being developed presently to the results.

2) An ICES Study Group on SKAGEX should be set up for the combined planning of the investigations, conducting the field work, and the working up of results. The Study Group should report to the Hydrography Committee and to the Marine Environmental Quality Committee. The Group should be encouraged to cooperate with other relevant bodies within ICES.

3) The ICES Hydrographer, assisted by the ICES Data Centre, should be actively involved in the work of the proposed Study Group.

4) A Meeting of the Study Group (Chairman: Dr Dybern) should be arranged in Kiel or Rostock on 31 October to 2 November 1989 and another meeting in February or March 1990 for continued outlining and planning of SKAGEX.

Recommendation 5

Based on implications from PEX, the Working Group on the Baltic Marine Environment recommends that problems of quality assurance and quality control need to be paid more attention for all kind of studies in the Baltic Sea. This includes

- to follow exactly the procedures for using CTDs as described in the Report of SCOR WG 51,

- to perform routine calibration checks for all series of measurements, including tests of instruments and methods against standards, for physical, chemical and biological determinands,

- to organize intercalibration workshops to be held at least every fifth year, and

- to ensure that all institutes participating in joint Baltic studies and/or the BMP should investigate the reasons for discrepancies shown by intercalibration results and take appropriate measures.

Furthermore, an ad hoc Group should be established to prepare a "Quality Assurance Manual" for Baltic Sea conditions relevant for those data to be exchanged between countries and/or delivered to international data bases. This manual should contain practical advice on standard equipment, calibration of this equipment, methods to automatically or manually carry out tests of the relevance of collected data, a standard checklist to be used before and (daily) during the expeditions, and any other advice which could improve the data quality. The ad hoc Group should further identify institutes which are able and willing to produce and distribute on a non-profit basis different standards for Baltic environmental investigations, e.g., for salinity, a low salinity standard of about 10, and for nutrients a standard stock solution giving with one dilution step the "working standard".

Recommendation 6

Following from the results of PEX, it is clear that due to the 'patchiness noise' in each of the sub-areas of the Baltic Sea, the conditions are not necessarily always adequately represented by the stations presently used in the BMP. Therefore, participants in the BMP should be encouraged to submit, with not much extra effort involved, all data from stations visited in the same sub-area as the obligatory 'representative' BMP station and, if necessary, collect additional data relevant to the monitoring station concerned, but which need not comprise the full list of parameters. Such additional data could be generated by, e.g.,

- measurements around the monitoring station over an area with a radius of about 10 n.m.,

- transects through the monitoring station, and/or

- time series measurements at the monitoring station, e.g., from an anchored ship or performed by automatically operating buoys.

Recommendation 7

The Working Group on the Baltic Marine Environment recommends that the Study Group on Patchiness in the Baltic Sea should meet immediately before the next meeting of the WGBME, under the Chairmanship of Dr Dybern,

- to continue to consider and discuss the results of the patchiness investigations (PEX-86) and their implications for marine research in the Baltic Sea,

- to continue the work on a PEX Atlas,

- to prepare an International Patchiness Symposium to be held in 1991, and

- to discuss the need for arranging a new patchiness study in the Baltic Sea.

Recommendation 8

The Working Group on the Baltic Marine Environment recommends that an ad hoc Group should be established to consider the technical and scientific possibilities of using 'ships of opportunity', especially ferries, to provide surface data from installed sensors which continuously record relevant environmental background parameters without much effort for servicing them.

Recommendation 9

It is recommended that the Working Group on the Baltic Marine Environment (Chairman Dr L. Brügmann) should meet on 10 - 12 April 1990 in Tallinn to perform the following tasks:

a) exchange information on national activities relevant to the Baltic Sea environment,

b) review the progress in the work of the Sub-Group on Sediments, particularly the draft critical review and the sedimentation maps presented during the preceding one-day meeting,

c) review the progress in the work of the Study Group on Baltic Sea Modelling, particularly the final plans for the Workshop to be held in April 1990,

d) review the progress in the work of the PEX Study Group, particularly the proposal for the PEX Atlas and the preparation of the PEX Symposium in 1991,

e) review the final plans for SKAGEX,

f) deal with items raised as special HELCOM requests to ICES during the STC Meeting in October 1989,

g) discuss the question of whether and how on-going pollution load activities of the HELCOM may be supplemented and optimized by additional studies, e.g., on sections coast-open sea, to obtain information on actual net inputs of contaminants and "discharge functions",

h) review the results of studies carried out on eutrophication and exceptional algal blooms,

i) review the outcome of intercomparison exercises and their implications for Baltic studies,

j) review information on new contaminants and on oil contamination, and

k) investigate the environmental influences of extreme meteorological conditions, e.g., mild winters or the exceptionally long stagnation period in the Baltic Sea.