

REPORT OF THE STUDY GROUP ON SKAGEX

Moscow, 4-9 February 1991

1. OPENING OF THE MEETING

On behalf of the State Institute of Oceanography (USSR State Committee for Hydrometeorology and Environmental Control), the Director, Professor Sergey S Lappo, welcomed the participants to Moscow and the meeting of the Study Group. He stressed the importance of the work of the Group and wished good luck for the future activities.

The Chairman of the Study Group, Dr Bernt I Dybern, expressed his appreciation for the efforts made by Professor Lappo and his staff to arrange the meeting in Moscow in spite of the present difficult times. He expressed his conviction that the meeting would contribute not only to the scientific results but also to increased contacts between participants from all sides of the Baltic Sea.

A list of participants is found in Annex 2.

2. ADOPTION OF THE AGENDA

The Chairman explained the agenda (Annex 1), stressing that a good deal of the work must be carried out in smaller groups while the final decisions on how to proceed with the activities within the Skagerrak Experiment (SKAGEX) would be taken in plenary. The agenda was adopted.

3. ELECTION OF RAPORTEURS ETC.

The Chairman suggested that, due to the complexity of the work during the meeting, there should be different Rapporteurs for the plenary sessions and that the smaller groups should have their own Rapporteurs for reporting to the plenary sessions. The suggestion was accepted. Dr M Kahru, Dr S Fonselius and Dr E Fogelqvist acted successively as plenary Rapporteurs. One of the plenary sessions was chaired by Dr L Hernroth in the absence of the Chairman.

4. BACKGROUND

Dr Dybern gave a brief summary of the aims and hitherto achieved tasks of SKAGEX. The Skagerrak is part of the transition area between the North Sea and the Baltic Sea. It is a very productive sea area and thus economically important for the surrounding states. At the same time it has very complicated and dynamic hydrobiological conditions about which many details are poorly known. Furthermore it is threatened by pollution from all directions.

The planning of SKAGEX was started in 1988 and continued in 1989 and early 1990 (ICES C M 1990/C:31) during which period several meetings were held between scientists from the countries interested. The field phase started with SKAGEX-I in May-June 1990 with participation of 17 research ships from 7 states. The aim was to cover the sea area with measurements of key parameters in order to collect data for the mapping of the hydrographical and biological conditions and for compiling information on the transport mechanisms (mainly currents) and general dynamics (see further op.cit. above).

During SKAGEX-I an intercalibration exercise was carried out in Arendal, Norway, and in connection with this a meeting was held in which scientists on board the ships could participate and get preliminary information on the

first field results.

Already at an early planning stage it had been decided that three minor expeditions, SKAGEX-II-IV, should be carried out during 1990 and early 1991 in order to cover different seasons. After SKAGEX-I some of the scientists met in Lysekil to plan for SKAGEX-II scheduled for September 1990 (ICES CM 1990/C:31 Addendum), and another meeting was held, also in Lysekil, on 11 August for the same purpose.

Five ships took part in SKAGEX-II (10-15 September 1990) and the results were briefly discussed by the participants at the end of the expedition, on 15 September, in Lysekil, in which meeting also details regarding the further activities were discussed.

Scientists working with copepod egg production formed a sub-group and arranged a training workshop at Kristineberg Marine Biological Station, Lysekil, in spring 1990. Another workshop to discuss field results was held in Hel, Poland, on 1-4 October 1990.

During SKAGEX-I and SKAGEX-II several thousand phytoplankton samples and several hundred zooplankton samples were collected. To analyse these samples would be very costly and time-consuming business. On the initiative of Dr Dybern negotiations with the Sea Fisheries Institute in Gdynia, mother-institute of the Plankton Sorting Center in Gdynia/Szczecin, had been carried out to see if the Sorting Center could analyze the samples. If so, one of the advantages would be that all samples would be analyzed by the same persons in the same way and therefore better comparable. In connection with this a course for Polish phytoplanktologists was conducted in Gdynia in November 1990 and in connection with it a SKAGEX biologists' meeting was arranged to decide upon further work. After the course analyzes started on a provisional basis.

Samples from the research vessel Arnold Veimer had been analyzed in Tallinn. The Tallinn biologists were asked to provide a number of sub-samples to Gdynia for intercalibration.

SKAGEX-III was performed 12-18 January 1991. This time only three ships could take part, covering the most important transects. A small meeting was held in Hirtshals on 19 January to discuss the main results and to look forward to items to be dealt with at SKAGEX-IV planned for in the middle of May 1991.

It was agreed that so far the SKAGEX project had been performed according to the plans and that some very interesting results had been achieved. A brief summary of the results are given in ICES CM 1991/C: 2.

5. AVAILABLE DATA AND QUALITY CONTROL

Most of the available data had previously been compiled in graphical form in two volumes and sent out to the main SKAGEX scientists, to give an overview of the results. The graphs were based on uncorrected data. ICES had before the meeting received most raw data but some of them had come in very late. Dr Kai Jancke of ICES reported on what had been received and in what form. It was evident that in spite of careful instructions many data had been sent in according to various systems. Some information about the cruises (e.g. Roscop-forms) were still lacking. Dr Jancke said, however, that he now had a good overview of all obligatory and most nonobligatory data. He distributed preliminary horizontal distribution maps for some parameters at selected pressure levels, which were, as in the case of the previously mentioned graphs, based on uncorrected data.

After a short discussion it was decided that the chemical data from SKAGEX-I should be corrected according to the results of the intercalibration in Arendal. Nutrient data from SKAGEX-II could be treated in the same way, but it had to be elaborated further if data from SKAGEX-III and SKAGEX-IV should be corrected in the same way since it was considered uncertain if the intercalibration results were valid for half a year or more after the exercise. It

was left to ICES, the coordinator of the intercalibration, Dr L Føyn, and Dr E Fogelqvist to finalize this matter.

During SKAGEX-I some ships had intercalibrated their CTD's against each other. Each ship had also taken water samples for manual determination of temperature and salinity as comparison with the CTD values. It was left to the coordinator of the CTD-intercalibration, Dr E Svendsen, and the ICES Data Center to find the best way of getting comparable CTD-values.

Dr Jancke said that provided all remaining data and Roscop forms etc from SKAGEX I-III were sent in soonest (deadline 15 March 1991) the compilation and introduction of correction factors could be done in a few weeks and in the beginning of June a complete data set should be available to SKAGEX scientists in computerized form. It was decided that one complete SKAGEX data set should be sent to at least one a suitable institute in each country and that it there should be available for all SKAGEX scientists who would like to use it. In urgent cases it could also be possible for individual scientists to get a set or part of a set of his/her own provided the necessity could be proven to the ICES Data Center. A data inventory should be sent out to all scientists.

It was stressed that the SKAGEX data are available only to SKAGEX scientists until they have been published. The ICES Data Center will secure that the data are not used by other groups. On the other hand all registered SKAGEX scientists also have access to the entire ICES data base.

6. WORK IN PLENARY AND GROUPS

Already at the planning stage of SKAGEX participating scientists had been divided into five main groups for physics, chemistry, biology, remote sensing and currents. Dr Hans-Peter Hansen stressed the necessity to look at the data in an interdisciplinary way, possibly by describing water masses using grouping algorithms to distinguish them. Dr E Svendsen stressed the necessity to get a rough overview of the whole set of preliminary results available. The Chairman asked the original groups to remain but asked the participants to also form other groups when necessary. At various stages of

the meeting various groups for interdisciplinary discussions were thus formed.

The smaller groups met alternating with plenary sessions throughout the meeting and after having studied two lists of questions produced by Drs H Dahlin and B I Dybern they were requested to summarize their viewpoints in final statements which should be the basis for decisions on the further SKAGEX work.

At the plenary sessions several participants also presented special reports. Dr G Karabashev gave an account of investigations of the optical properties of the Skagerrak water in combination with fluorescence studies, Dr O Andrejev described briefly a model on the Skagerrak which he was going to elaborate in cooperation with Swedish SKAGEX scientists, Dr E Svendsen summarized the knowledge of the current systems in the Skagerrak and Dr L Hernroth reported on the findings with regard to the distribution of chlorophyll and the primary productivity. Dr H Dahlin reported that he is looking into the question of water level changes. His institute (SMHI) will also be responsible for the collation of meteorological and remote sensing data in cooperation with other relevant institutes.

7. CONCLUSIONS FROM GROUP WORK

The results of the discussions, within as well as between the special groups, were presented in the plenary sessions and gave the participants a better overall-view of the complicated conditions of the Skagerrak, and they also formed the basis for the discussion about items to be dealt with in the future. The following list gives examples on such items aimed at enhancing the possibility of getting a more synthetic picture of the Skagerrak conditions.

Physical items:

- Kattegat:
- General inflow/outflow
 - Transport routes of the Baltic water
 - Jutland current inflow
 - The anticyclonic eddy
 - Entrainment/mixing processes

- E Skagerrak:
- The splitting of the Jutland current E Skagen
 - Blocking of the Baltic water outflow
 - Mesoscale eddies
 - Upwelling along the Swedish coast
 - The "dome(s)"
 - Entrainment/mixing processes
- W Skagerrak:
- Variability in ingoing/outgoing transport of different water masses on different depths
 - Movements of the Norwegian coastal current
 - Upwelling at the Norwegian coast
- All areas:
- Budget estimates (especially transects A, B, G, H)
- Chemical items:
- Nutrients in coastal waters
 - Nutrient, especially nitrogen, chemistry in the interface between the "dome" and the coastal currents
 - Jutland current: budget and processes
 - The processes in the Kattegat and the fluxes over the border to the Skagerrak
 - Budget calculations for the whole area and for specific portions
 - 'Grouping' of nutrient and other data
 - Oxygen variability
- Biological items:
- Interactions between light, nutrients, stratification and species composition
 - Dynamics and interactions in the coastal currents and between them and off-shore waters.
 - Nutrient levels and profiles along the area of the Jutland current
 - Very low chlorophyll a values were found in the northern Kattegat during SKAGEX -I. What was the explanation for this?
 - A gradual building up of high and very high values of chlorophyll a was seen during SKAGEX-I at stations in the central Skagerrak at 15-20 m depth. Why? How far eastwards could this "core" of water be identified? What was the origin of the nutrient-poor water?
 - The shallow water areas north of Skagen showed the highest secondary production. Were there particular water conditions?
 - The secondary production was especially high 4-5 June 1990 along transects F and X. Were there

- particularly favourable conditions these days?
- Concentrations of phytoplankton were often found at 15-40 m depth in off-shore waters. Is this a general feature in the area and, if so, why?

Biological-optical items:

- Estimation of light available for photosynthesis
- Visualization of vertical profiles of chlorophyll with high resolution
- Statistics of parameters characterizing vertical distribution of chlorophyll and suspended matter
- Estimation of conditions for remote sensing of chlorophyll in the subsurface layers
- Tracing water movements and identifying water masses by using optical properties and combining all parameters
- Comparison of fine structure of phytoplankton and temperature and salinity
- Dependence of optical properties on physical and chemical parameters
- Diurnal cycle and chlorophyll concentration: estimations by using fluorescence

It is self-evident that many of these items are interlocked and that answering the questions will rather engage teams of scientists than individuals. It is also understood that the list can be extended quite a lot. The general opinion was that some questions could only be answered using the field data from SKAGEX and historical data available.

The time problem in comparability was discussed. After some discussion it was agreed that caution at comparison of data from different sampling stations in relation to the time laps between the samplings must be taken, but that no common rules could be given.

8. PUBLISHING OF THE RESULTS

Two different ways of compiling the results from SKAGEX were discussed. One way could be to engage a number of scientists in compiling all the main

results in order to produce a general report (something which was done by the previous ICES Study Group on Patchiness in the Baltic). Another way could be to let individual scientists choose among the items listed above and others in order to produce a series of scientific papers, published in relevant journals.

It was agreed to go the second way but at the same time to try and get as many of the papers as possible published in the same journal. This could be achieved by arranging a symposium or workshop at a rather early stage. In this way the scientific outcome of SKAGEX is given highest priority.

It was decided that individual scientists or groups of scientists thus could start elaborating papers as soon as possible. Data from the own ship could be used freely with knowledge of the responsible scientist while special permission must be obtained for the use of data collected by other ships (whose responsible scientists should be contacted). A list of the responsible scientists is in Annex 3.

All titles on intended papers should be sent to the Chairman of the Study Group (Dr Dybern) who with regular intervals will inform the responsible scientists in the different countries about them. This procedure would help avoiding both overlaps and gaps in the production.

The papers could be published in any suitable journal or (preferably) presented at a SKAGEX Symposium/Workshop to be held in May or June 1992 in Sweden. The contributions from this meeting should be published in a recognized international journal, eg Continental Shelf Research, preferably in a special SKAGEX issue.

Each paper published in another journal than the Symposium (Workshop) volume should have a special (foot-)note on the first page: "This paper is a report from the Skagerrak Experiment (SKAGEX) 1990-1991".

It was agreed that SKAGEX scientists should be free to invite other scientists to take part in the publishing work if appropriate.

Some participants were of the opinion that some kind of preliminary report on the scientific results of SKAGEX should be submitted to the next-coming Statutory Meeting of ICES (September-October 1991). It was decided that the Chairmen of the sub-groups on physics, chemistry and biology (Drs E Svendsen, L Føyn and L Hernroth) should form a small group which should elaborate such a report. Dr I Olsson should be secretary of this group. If necessary other scientists could be co-opted to the group. The report should merely give a hint on what was achieved during SKAGEX and could be based on an outline already discussed by Dr Svendsen. Since the corrected and complete set of data only could be available by 1 June it was decided that the group meet during August 1991 to compile the report.

9. OUTLINES FOR SKAGEX-IV

The already carried out SKAGEX-I-III field studies were mainly devoted to investigations along certain transects (ICES CM 1990/C: 31 and Fig. 1). Between those most of the ships had made special investigations, mostly of a voluntary character. It was decided to arrange the investigations during SKAGEX-IV in a somewhat different manner:

The first and last days should be devoted to measuring along most transects. During the remaining three days the ships should cover especially important parts of the northern Kattegat and the Skagerrak with the emphasis on the Jutland and the Norwegian coastal currents, the border area between the Kattegat and the Skagerak and the area north of Skagen between transects E and F. Most obligatory parameters (according to SKAGEX manual) should be sampled. Each ship should try to meet other ships at least at one occasion for joint sampling and intercomparison.

For the seven ships anticipated to take part a small planning Group

outlined the following programme (see also Fig 1):

Arne Tiselius covers transect C (start), the transition zone between Skagerrak and Kattegat, the Swedish coastline with special attention to the area north of Skagen.

Argos will start at transect B, cover as much as possible of transects C to G and the areas in between, especially the coastal currents, and finish at transect H.

G M Dannevig concentrates on transect F and short transects perpendicular to F in the area between transects E and G.

Johan Hjort will start at transect H, cover as much as possible of the transects G to C and the areas in between, and finish at transect B, i.e. the opposite to Argos.

Lev Titov covers the Kattegat stations on its way to (and from) Skagerrak, the E transect in the beginning of the week and the area between transects C and D.

Oceania shall make the G transect at least once and cover the area between transects F and H.

Shelf will perform optical and fluorescence measurements in the area from the B transect in the south to the Oslo Fjord in the north, and from the Swedish coast to the E transect.

10. MEETINGS

The following SKAGEX meetings are anticipated up to 1 July 1992:

- 1) A meeting between biologists for making more detailed plans for the working up of the biological data and give advice regarding the work of the Polish Sorting Center.
- 2) A meeting for producing the survey of the SKAGEX results for the ICES Statutory Meeting. Arendal, August 1991.
- 3) A meeting with the ICES Study Group on SKAGEX in Gdynia in October or November 1991
- 4) A few special meetings between groups of SKAGEX Scientists may be held during the period November 1991 to May 1992.
- 5) A SKAGEX Symposium or Workshop, including a concluding

meeting with SKAGEX scientists, in Sweden at the end of May or beginning of June 1992.

Support from ICES is sought for the Study Group Meeting in Gdynia (3) and the Symposium/Workshop (5), see Recommendations 1 and 2.

11. OTHER ITEMS

Participants were reminded on the importance to send in salinity data for samples for comparison with CTD-data (to Dr E Svendsen and the ICES Data Center).

Participants were reminded to send in technical data about the equipment for measuring fluorescence to Dr G Karabashev and to the ICES Data Center.

Drs L Edler, B Sundström, L Hernroth and B I Dybern will be responsible for the working up of the phyto- and zooplankton samples in Poland. The amount of samples to be worked up depends on the size of available funds (mainly given by the Nordic Council of Ministers). These funds can also to some extent be used for support for travels and ship-time for scientists and ships from countries with currency difficulties.

12. CLOSING OF THE MEETING

The meeting was closed at 1700 hrs on 9 February. The Chairman expressed the warm thanks of all the participants for the excellent arrangements for the meeting and the hospitality and friendship shown by the hosts, headed by Professor S S Lappo of the State Institute of Oceanography, and his staff. Special thanks were forwarded to Drs V Andrjuschenko and V Morozov who had done a tremendous work both before and during the meeting. The participants also very much appreciated the sightseeing of Moscow and the visit to one of the famous Moscow circuses.

RECOMMENDATIONS

Recommendation 1: The Study Group on SKAGEX should meet in Gdynia, Poland (Chairman Dr B I Dybern) 28 October - 1 November er 1991 with the following terms of reference:

- a) to discuss and compile results from the field studies SKAGEX I-IV
- b) to arrange for the coverage of special items which are not dealt with by individual scientists
- c) to plan the SKAGEX Symposium/Workshop

Recommendation 2: A Symposium/Workshop on SKAGEX should be arranged in Sweden during late May or June 1992 (Convener Dr B I Dybern, Co-conveners Drs Svendsen and S Sagan) in order to:

- a) Present scientific papers by SKAGEX participants
- b) Summarize the findings of SKAGEX
- c) Discuss the future work and finalization of SKAGEX

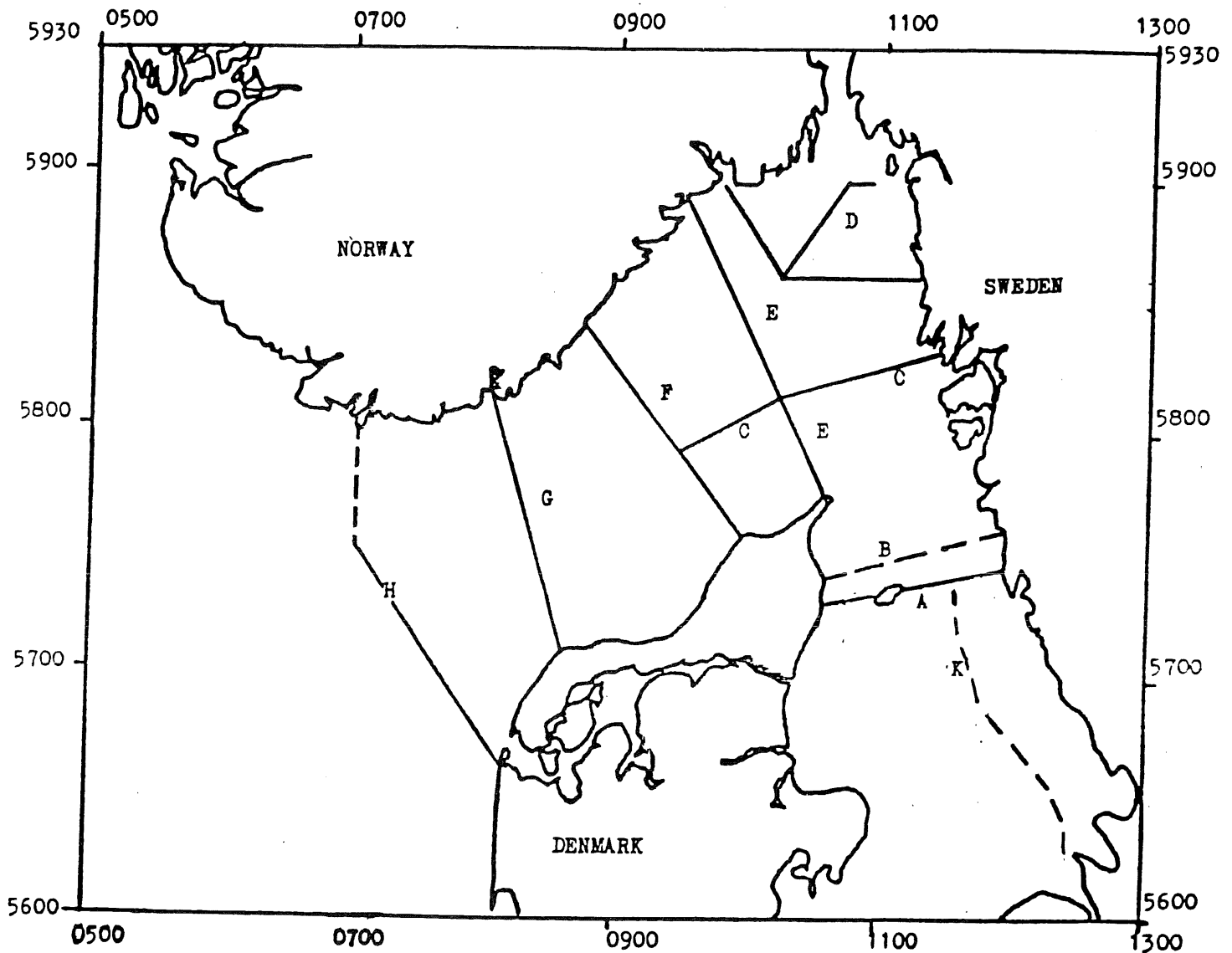


Fig.1 Transects during SKAGEX

- Section A Läsö (Gottskär - Albäck)
- " B " (Göteborg - Fredrikshavn)
- " C Hällö - E8
- " C E8 - F7
- " D Oslofjord
- " E Jomfruland - Skagen (Norway - E8 - Skagen)
- " F Hirtshals (Torungen - Hirtshals)
- " G Hansthalm (Oksö/Kristiansand - Hansthalm)
- " H Limfjord
- " Kattegatt

Comments: The sections B and K (Kattegat) are special obligatory sections.
The northernmost part of the section H will be sampled when possible.

MEETING OF THE STUDY GROUP ON SKAGEX
Moscow, USSR, 4-10 February 1991

Agenda

1. Opening and general information
2. Adoption of the agenda
3. Election of a Rapporteur
4. Background and aims
5. Available data and quality control
6. Work in plenary and groups
 - a. General outline
 - b. Groups
 - Physical
 - Chemical
 - Biological
 - Specialized
 - c. Conclusions from group work
7. Planning of the work until the next meeting
8. Outlines for SKAGEX-IV
9. Any other items
10. Time and place for the next meeting
11. Closing of the meeting

Time schedule

0800	Breakfast
0900	Start of the meeting
1030	Coffee
1300-1400	Lunch
1530	Coffee
1800, ca	Finishing of the meeting
1900	Dinner

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