International Council for the
Exploration of the Sea

C.M. 1992/C:1
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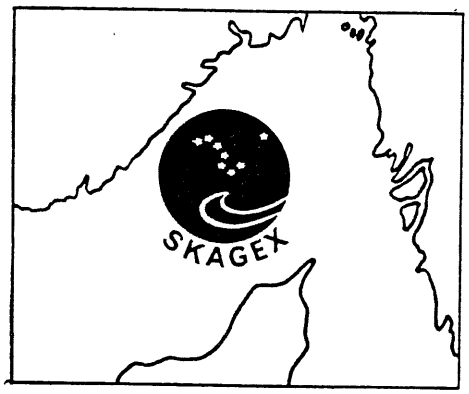

MEETING OF THE ICES STUDY GROUP

ON SKAGEX

Gdynia, Poland 4-8 November, 1991

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REPORT OF THE ICES STUDY GROUP ON SKAGEX

Gdynia, Poland, November 4-8, 1991

1. OPENING OF THE MEETING

On behalf of the Institute of Meteorology and Water Management, Marine Branch in Gdynia, Director Zibigniew Dziadziuszko welcomed the participants to Gdynia and to the meeting of the Study Group. He hoped that the meeting would be fruitful, whereafter representatives from each participating institute received an interdisciplinary monography on the Gdansk Bay as a gift.

The Chairman of the Study Group, Dr Bernt I Dybern, expressed his thanks for the gift and for the efforts made by Mr Dziadziuszko and his staff to arrange the meeting.

A list of participants is given in Annex 2.

2. ADOPTION OF THE AGENDA

The chairman pointed out that the Study Group had many problems to solve and that it was necessary to find a basis for the continuation of the work within SKAGEX. Major tasks to be performed during the meeting were a compilation of all the data that were missing in the ICES SKAGEX data base, the final decision on whether correction factors should be applied concerning nutrients, etc., a list on what had been worked up so far, and what was being worked up. A compilation should also be made of all the non-obligatory investigations carried out. Finally, the Study Group should discuss the SKAGEX Symposium/Workshop planned to take place in the middle of 1992. Mr Dybern stressed that much of the work had to be conducted in smaller groups while final decisions would be taken in plenary sessions. The preliminary agenda (Annex 1) was adopted.

3. APPOINTMENT OF RAPPORTEUR, ETC

Dr I Olsson, Sweden, acted as Rapporteur during the plenary sessions.

4. REVIEW OF RECENT ACTIVITIES AND THE MAIN RESULTS

The chairman presented the terms of reference decided upon during the ICES Statutory Meeting, September 26 - October 4, in La Rochelle, France. These were as follows:

a) to consider and assign the responsibility for the compilation of the results from the field studies SKAGEX I-IV;

b) to summarize on-going research based on SKAGEX results;

c) to plan a SKAGEX Workshop.

The chairman then summarized the **ICES PAPER C.M. 1991/C:2 "SKAGEX: some preliminary results"**. The paper was mainly based on results obtained during SKAGEX I in May-June 1990. The hydrographic conditions of the Skagerrak and adjacent sea areas were demonstrated to be very complicated and dynamic. Six different water masses of importance had been identified. These water masses constitute or merge into different water transport systems. Typical transports of water into or out of the western Skagerrak were estimated to be 0.5-1.5 Sverdrup in the upper 100 m. Blocking of surface water seems to be a frequent phenomenon. Several eddy-like features were observed both at hydrographic measurements and with drifting buoys. Nitrite maxima were found at all larger Skagerrak sections in the core of the inflowing Atlantic water. At one section, where ammonia was also measured, a separate ammonia maximum was found. These maxima indicate a diversified nitrification process in the water and may be used as a tool for distinguishing the different water masses entering from the west. The production maxima were generally deeper than expected. Chlorophyll a and phytoplankton distribution showed pronounced patchiness. The species composition of phyto- and zooplankton may be used for characterizing water masses. Secondary production, measured as copepod egg production, reached its highest values in the shallow areas north of Skagen.

Mr J Svensson, Sweden presented on-going work with a **numerical model for the Skagerrak and the Kattegat.** Certain SKAGEX data had been included. The model has a horizontal grid system of 5 km^2, while there is a vertical division of the water into layers of different thickness. The tidal motions are not taken into consideration in the model. Markers have been used in the velocity fields. The suitable time scale is about one week. Computerized data and observed SKAGEX current data exhibit rather good agreement at one section, and the model also indicates the occurrences of eddies. The model makes it possible to give a coarse picture of the pathways of nutrients in the area. The establishment of the boundary conditions between the Skagerrak and the North Sea seems to be difficult. In the ensuing discussion the work with several other models was mentioned, **e.g.** on-going Norwegian work with a North Sea model. To be able to handle the problems with boundary conditions in the outer Skagerrak, it might be necessary to combine that model and the above-mentioned model.

Representatives of the different vessels participating in SKAGEX were then asked to report on the **delivery of data to the ICES.** Information on data so far not delivered is compiled in Annex 3. It was requested that the missing data should be sent in as soon as possible. It was further recognized that current data from the mooring stations are to be submitted as daily means. It was further evident that the submission of Secchi disc values had to be amended.

The participants were then asked to give a short presentation of the **non-obligatory investigations** carried out during the SKAGEX missions. A compilation of those investigations can be found in ANNEX 4.

5. CONCLUSIONS FROM GROUP WORK

In the presentations of the work carried out by the different groups, reference was made to the ICES paper C.M. 1991/C:2 mentioned above, as it identified some major basic physical, chemical and biological characteristics of the Skagerrak.

5.1. Physical parameters (conveners: Dr E Svendsen and Prof J Dera)

Dr M Ostrowski and Dr S Sagan at the Institute of Oceanology, Polish Academy of Sciences, will produce a **Data Atlas of physical and chemical data** and software for electronic display of the Atlas (salinity, temperature, derived physical parameters, nutrients and chlorophyll). Mr J Svensson, Sweden, will cooperate with them in order to file also the current meter data in the same system (as a separate section). Mr Svensson will contact Dr L Rydberg, Sweden, in order to get the data obtained from the current mooring stations at the A-section in the northern Kattegat. Mr Svensson will also be responsible for the submission of all current meter data to ICES. The Data Atlas will be ready by March 1992 and will then be distributed. In view of this, all data must be submitted by the end of December 1991 at the latest to the ICES secretariat in order to have the Atlas produced in due time. Reference was made to the report "Preliminary Data Report from SKAGEX I with R/V G.O. Sars, May 18 - June 8, 1990 (ed. E Svendsen, Institute of Marine Research, Bergen, Norway). It was further recognized that the ADCP measurements carried out by the Norwegian vessel H Mosby had been compiled in a report "SKAGEX Data Report, CTD/Seasoar and ADCP data, Håkon Mosby, 23-27 May, 1990", by Mr P M Haugan. These two reports will be submitted to SKAGEX participants.

There still seems to be some uncertainty concerning which **optical and related data** are available. The earlier request from Dr G Karabashev concerning technical information on the individual fluorescence meters had not been properly responded to. The following general rules for chlorophyll versus fluorescence computations were recommended:

* Data taken from depths less than 5 m should not be used.
* Data that have been measured at corresponding depths at the same time should be used.
* Assuming that fluorescence was recorded "continuously" the fluorescence values should be evaluated as an average from readings over the depth range covered by chlorophyll samples.
* All data should be taken as one set without dividing them into sub-sets (**e.g.** according to some depth ranges).
* Correlation coefficients between data sets should be at significant levels and preferably over 0.90.
* Linear regression coefficients (slope and intercept) should be used for chlorophyll evaluations.

The calculated chlorophyll/fluorescence values should be submitted to ICES with a copy to the Institute of Oceanology in Poland (Mr Sagan) by January 1, 1992 at the latest.

It was recognized that Dr U Horstmann, Kiel, has at his disposal quite a lot of information based on **satellite images** (from NOAA, LANDSAT, etc.) and that he probably will prepare a paper covering a longer time-span than that of SKAGEX. It will then be possible to consider the special water mass distributions during the SKAGEX missions from a more general viewpoint. Dr B

Håkansson, SMHI, Sweden, who is the SKAGEX remote sensing coordinator, is also looking at satellite data in relation to specific surface water distributions and wind conditions during SKAGEX. If there are LANDSAT data of good quality available, they should be calibrated against **in situ** data.

With respect to **CTD data**, it had already at previous meetings been agreed that it was the responsibility of each participating vessel to ensure that calibration was carried out individually against water-bottle samples.

It was recognized that Mr H Dahlin, SMHI, Sweden at the SKAGEX meeting in Moscow had been given the responsibility to look into the question of **water level changes.** His institute will also be responsible for the collation of the **meteorological data.**

5.2. Chemical parameters (Convener: Dr E Fogelqvist)

The following recommendations concerning the **intercomparison exercise** at Arendal, Norway, were agreed upon. It should be noted that the following three parameters were included in the exercise, **i.e.** nitrate, phosphate and silicate.

In line with recommendations earlier given by Mr L Föyn it was agreed that no correction factors should be made to the SKAGEX data stored in the ICES data bank for the following reasons:

a) Most of the vessels exhibit reasonably good precision in their measurements over a large concentration range. In all cases except one (L Titov's silicate measurements) it is possible to adjust the data to a median in the intercomparison, but doubts remain as to whether this would be relevant for the entire exercise.

b) The preparation of standards and the quality of water used for reagents may have caused certain deviations between ships noticed in the exercise. As some of the reagents were freshly prepared every or every second day, it is impossible to say if correlation factors calculated on the basis of the exercise would be valid over the SKAGEX I period (certainly not over the entire SKAGEX year).

c) Any application of correction factors means that new errors will be introduced.

d) The users of the data are encouraged to apply other statistical methods directly on the field data in order to assess the quality of them (there are various ways of doing that), and thereafter normalize the data for the field of interest.

Regarding **outliers**, it was decided that no exclusion of data from the data bank should be made. For those who intend to make special studies of SKAGEX data it might, however, be useful to apply the correction factors obtained during the intercomparison at Arendal. For that reason, a report will be written and distributed to all chief scientists. It will contain all the correction factors and constant deviations as compared to the median, and it will also give a measure of a laboratory's individual precision in measuring each of the parameters. Drs E Fogelqvist, H-P Hansen and L Föyn will be responsible for this report and it will be submitted to Dr H Dooley at the ICES and also distributed to any user of the SKAGEX I data.

As a result of the experiences from the intercomparison exercise at Arendal it was strongly recommended that in a future exercise involving numerous separate laboratories a proper intercalibration should take place in the beginning of the field work, including both an intercomparison as at Arendal and a detailed intercalibration of methodologies and analytical instruments in order to ascertain the highest possible level of data quality.

Dr H-P Hansen, Kiel, will produce a special paper analysing the statistical procedures for data obtained during SKAGEX I (cf. Annex 6).

During SKAGEX IV another intercomparison took place, the data of which are to be collected and treated. It is urged that material be sent to Mr L Föyn as soon as possible.

5.3 Biological parameters (Convener: Dr L Hernroth)

Chlorophyll a

A control of all currently available field data has first to be carried out in order to see if there are any systematic errors in the measurements. After that, an evaluation of the intercomparison exercises will be conducted. Dr L Edler, Sweden, is responsible for the evaluation.

Fluorescence

Biologically, the values of fluorescence measurements are mainly regarded as indicating tools for, e.g., the chlorophyll distributions. It was recognized that at least three vessels had carried out simultaneous measurements of chlorophyll and fluorescence. This fact calls for a special joint action (cf. also part 5.1, 2nd paragraph).

Phytoplankton

About 400 preferential samples have been sorted by an especially trained group in Gdynia. Another 100 samples are to be sorted in this first batch. In addition, about 80 samples have been analyzed in Tallinn by trained personnel. An intercomparison exercise of the Tallinn samples has indicated quite an acceptable result and another 20 samples will be analyzed in Tallinn.

The results will be available as lists with species and cell numbers. Charts showing the horizontal distributions of dominating species will be elaborated. This work is now in progress. The information will be distributed on diskettes.

Potential primary productivity

Today only a few data are missing from SKAGEX I, mainly from the Danish vessel G Thorson. Additional data will be added to maps already produced. A statistical test of the field raw data will be performed (by Dr H-P Hansen, Kiel, cf. part 5.2). The efficiency of the photosynthesis can be

evaluated in some cases by comparing measurements of potential primary productivity with values obtained from **in situ** measurements of primary production.

Secondary production

Results of the measurements of secondary production have already been published by Tiselius **et al. (1991).** It was stated that those results will have to be reviewed later in the light of available new data.

Zooplankton

About 75 preferential samples have been analyzed at the Sorting Center of the Polish Sea Fisheries Institute in Szczecin. Priorities are now to be set for the further analyses. It was recommended that this priority step should also be based on the experiences reached from the secondary production measurements.

Note

It was agreed by the Biological Group that after SKAGEX I priority should be given to SKAGEX IV as to the further analyses of the biological data. It was further agreed that Dr L Edler, Sweden, should have the main responsibility for the submission of data on phyto- and zooplankton to ICES.

6. GENERAL OUTLINE OF FURTHER SKAGEX WORK

After some discussion the Study Group decided on a general outline for the continuation of SKAGEX work. The principles of a holistic approach and joint authorships were strongly stressed. Following presentation of the Data Atlas by the end of March 1992, a drafting Group will produce an overall picture of the Skagerrak in view of new information obtained during all four SKAGEX missions. This document, being a general synthesis, will be a basis for authors intending to present papers during the SKAGEX workshop. This does not exclude presumptive authors from starting to work on their papers already now. It was further recommended that maps should be produced covering all transects on obligatory sampling days for salinity, temperature, nutrients, chlorophyll a (also calculated from fluorescence) and currents (presented as daily means with reference to the tidal periods). It should also be possible to have the data on currents calculated as hourly mean values. The maps should illustrate values from the mixed surface layer (0.5, 5, 10 m), 15, 20, 25, 30 m and the fluorescence peak levels. Concerning potential primary production and the phytoplankton (dominating species), maps should be produced from values of mixed samples (0.5, 5, 10 m) and from fluorescence peak depths. It was considered important for participating institutes to have computer software available for the further production of maps.

A time schedule for further SKAGEX work and the responsible persons assigned is given in Annex 5.

At the last ICES Statutory Meeting the following recommendation was agreed upon:

A Workshop on SKAGEX will be arranged in Sweden during 4-5 days in June 1992 (Convener: Dr B I Dybern, Sweden; co-conveners: Dr E Svendsen, Norway, and Dr S Sagan, Poland) in order to:

a) present scientific papers related to SKAGEX and Skagerrak issues in general;

b) summarize the findings of SKAGEX;

c) discuss the further work necessary for understanding processes in the Skagerrak, including fluxes.

In the light of the findings at the present meeting it was decided that the Workshop should preferably be held in November 1992 rather than in June. A few invited scientists outside the ICES SKAGEX Group could be invited to (1) cooperate with SKAGEX scientists on papers to be given or (2) to present their own papers. Suggestions on scientists to be invited should be submitted by the SKAGEX chief scientists to the main Convener, Dr B I Dybern, by January 1, 1992 at the latest. Invitations to the Workshop should be sent out as soon as possible, including the list of tentative titles given in Annex 6. In this connection, reference will also be made to the examples of items given in the report from the SKAGEX meeting in Moscow (C.M. 1991/C:1, Ref. E), see Annex 7. There should be a deadline for submitting working titles on 1 February, 1992, to Dr Dybern. The titles will give an overview of the areas of interest by individuals and groups of people. A new updated list of titles should later be submitted to all SKAGEX participants. Final titles for the Workshop, including abstracts, should be submitted to the Convener no later than June 15, 1992. After the Workshop, a final summary of the principal SKAGEX findings and conclusions should be published.

The SKAGEX Data Atlas mentioned in part 5.1 is considered to be of great value for the work on the papers. After the introductory work at the Institute of Oceanology, which will be finished on March 31, 1992, the Drafting Group mentioned above, assisted by a Reference Group, will elaborate an overall view of the Skagerrak, which will be distributed to the authors and other members of the SKAGEX Community before May 1, 1992, **i.e.** well in advance of the deadline for submitting final titles of their papers (June 15, 1992). The members of the Drafting Group and the Reference Group are listed in Annex 5.

In order to have SKAGEX participants well informed about SKAGEX activities it was decided to start distributing an informal and about six-weekly SKAGEX NEWSLETTER. Drs B I Dybern and I Olsson were assigned to arrange this.

7. FUTURE JOINT INTERNATIONAL INVESTIGATIONS

The chairman of the Study Group presented some examples of future joint investigations being discussed in different groups of scientists in the Baltic Sea area, such as:

a) Fluxes from coastal waters to the open sea
b) Systematic investigation on the distribution of fish diseases/parasites and their implication for fish stocks
c) Studies of ecosystem fluxes
d) Continued patchiness studies
e) Estimation of reproductive areas for cod
f) The role of bacteria and ciliates in the Baltic ecosystem (cf. title c) above)
g) Influences of big river mouths and their contents of nutrients, pollutants, etc. on biota.

The chairman then gave some information on efforts being made to include phytoplankton analyses in the activities of the Sea Fisheries Institute in Gdynia.

Prof A Aitsam, Estonia, leader of an ICES Group to consider the first suggestion above, gave some comments on this in view of some on-going projects in Estonia. He underlined the need for such a project in light of the difficulty to show real correlations between the input from land and rivers and the concentrations of different substances in the open sea.

Dr S Schulz, Germany, reported that some steps had already been taken with regard to the title "Studies of ecosystem fluxes". Invitations had already been sent out to a first meeting in Rostock, Germany, in December. A working group will be established for the elaboration of an investigation programme on fluxes in the ecosystem itself to be carried out during about one year. One important aspect was the harmonisation of methods.

Mr D S Danielssen, Norway, reported on a symposium planned for June 15-18, 1993, at the Flödevigen Marine Research Station in Arendal on stock enhancement of cod and other marine species with focus on the ecological effects of large-scale releases.

It was recognized from the Baltic point of view that there seem to be possibilities for combinations of different projects. It was decided that the matter should be further taken up at the coming SKAGEX Workshop.

8. CLOSING OF THE MEETING

The meeting was closed at 12.00, November 7. The Chairman, Dr B I Dybern, expressed the warm thanks of all participants for the excellent arrangements made and for the hospitality and friendship shown by the hosts, headed by Director Z Dziadziuszko of the Institute of Meteorology and Water Management, Marine Branch in Gdynia, and his staff. Special thanks were forwarded to Dr E Andrulewicz for his kind support both before and during the meeting. The Chairman then expressed special thanks to the Rapporteur, Dr I Olsson, for his devoted work related to SKAGEX.

The Chairman finally invited all SKAGEX participants to the Workshop in 1992 to be arranged at or near Lysekil on the shore of the Skagerrak.

INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA

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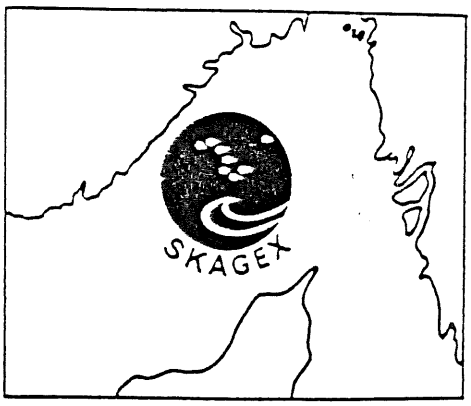
ANNEX 1



SKAGEX Meeting in Gdynia 4-8 November 1991

Preliminary Agenda

1. Opening, information etc.
2. Adoption of the agenda
3. Appointment of Rapporteur etc.
4. Review of hitherto carried out activities and the main results
5. Available data and the correction problem
6. Proceeding of work carried out in different institutes and by individual scientists
7. The working up of the plankton samples
8. Discussion on continued working up of the SKAGEX data (to start with these discussions will be carried out in groups, then in plenary)

   Arranging coverage of items which are not covered so far
9. Summarizing of the findings and planning for the SKAGEX Symposium/Workshop in 1992.
10. Future joint international investigations
11. Any other business
12. Closing

BID 1991-08-26

ANNEX 2

LIST OF PARTICIPANTS

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ANNEX 3

COMPILATION OF DATA NOT HITHERTO DELIVERED TO ICES

SKAGEX I

G THORSON:	Data on primary productivity not submitted.
All vessels:	The submission of all Secchi disc and optical data should be checked.

SKAGEX II

ARGOS:	Data on chlorophyll a and on primary productivity not submitted.
LEV TITOV:	Data on primary productivity partly submitted.
ALL VESSELS:	The submission of all Secchi disc and optical data should be checked.

SKAGEX III

ARGOS:	Data on chlorophyll a and on primary productivity not submitted.

SKAGEX IV

ARGOS:	Data on chlorophyll a and on primary productivity and some other data not submitted.
JOHAN HJORT:	Nutrient and biological data not submitted.
OCEANIA:	All data will be submitted within two weeks.
A. TISELIUS:	Data on silicate and on chlorophyll a not submitted.
LEV TITOV:	Submission of hydrographical and chemical data must be checked. Biological data have not been submitted.

ANNEX 4

COMPILATION OF NON-OBLIGATORY INVESTIGATIONS CARRIED OUT DURING SKAGEX. WORKING UP OF DATA IS GOING ON.

SKAGEX I

G THORSON	Apparent net primary production, bacterioplankton biomass and production and nano- and microzooplankton biomass, composition and production in pooled surface samples (1, 5 and 10 m depth) and in samples from the subsurface fluorescence maximum. Measurements of nutrient dynamics (phosphate and nitrate). Intensive studies at two stations with size-fractioned samples from the fluorescence maximum in deck-incubators (long-time studies). The sedimentation flux was quantified at one station.
A v HUMBOLDT	Every 3rd day special physical measurements at C-E section. Measurements with vertical current profiler and of fluorescence (daytime). Very tight grid system in order to study eddy structures (night-time).
G M DANNEVIG	Special investigation at section A with CTD.
G O SARS	During the period May 20-26 1990 general mapping of most of the Skagerrak area. Later on studies of the Jutland Coastal Water (JCW) and the Southern North Sea Water (SNSW) west and northwest of Jutland. Deploying of several Argos buoys. Continuous CTD- measurements in the surface, vertical ADCP (Acoustic Doppler Current Profiler) measurements, special studies of nitrogen and phosphorus uptake and recycling etc. For further information reference is made to the report" Preliminary Data Report from SKAGEX I with R/V G.O. Sars, May 18 - June 8, 1990 (ed. E Svendsen, Institute of Marine Research, Bergen, Norway).

HYDROMET	Special investigations at section K. In addition to the obligatory parameters currents, TotN, TotP, oxygen and transparency were measured. A report will be delivered in December 1991.
OCEANIA	Drifting experiment outgoing from station G3 (May 1990). CTD- and optical measurements every hour. In situ measurements of primary production and measurements of potential primary production. Chemical measurements.
	Measurements along G1-G5 (MAY 1990) of susp. matter, chlorophyll, fluorescence, colour index, CTD-measurements.
	Drifting experiment from G7 (May 1990).
	Special investigation of the Jutland Coastal Water at an anchor station.
PROF SIEDLECKI	Mapping of the Jutland Current near the Danish Coast 2-3 times.
	Mapping of the Norwegian Coastal Current 2-3 times.
ARGOS	Special investigations of the JCW and in the central Skagerrak.
SHELF	Investigations of mesoscale variability and vertical distribution of fluorescent and light scattering substances in the eastern Kattegatt and Skagerrak. This special programme was repeated during SKAGEX II.
LEV TITOV	Detailed mapping of the eddy to the north of Skagen. Drifter experiments.
A VEIMER	Continuous particle countings from about 4 m depth, two sections passing the Baltic Water, some investigations in the Kattegatt along transect K.

SKAGEX IV

OCEANIA	Drifting experiments in the Norwegian Coastal Water with CTD- and optical measurements every 3rd hour. In situ and potential measurements of primary production.
ARGOS	Studies of the nitrification potential.
A TISELIUS and G M DANNEVIG	During SKAGEX IV an investigation on a subsurface chlorophyll maximum east of SKAGEN was carried out during three days. Hydrographical parameters, nutrients, chlorophyll and in situ primary productivity were measured at an anchor station surrounded by a net of stations, where hydrography, nutrients and chlorophyll were studied.
LEV TITOV	Special investigations of the Baltic Coastal Water in the eastern Kattegat and the Skagerrak.

ANNEX 5

MAIN TIME TABLE FOR THE FURTHER SKAGEX WORK

Deadline	Action and assigned persons
December 31,1991	All SKAGEX data submitted to ICES. Even data on water levels and weather conditions should be submitted by SMHI, Sweden. Invitations sent out for participation in the SKAGEX Workshop. Priority list of invited speakers/scientists to the Workshop submitted to the Convener, Dr B I Dybern.
February 1, 1992	Final tentative titles of papers to be presented at the Workshop submitted to B I Dybern.
March 31, 1992	Submission of Data Atlas to all SKAGEX participants.
May 1, 1992	Submission of a paper giving an overall picture of the Skagerrak based on the SKAGEX data. Drafting Group Physical parameters, currents and remote sensing : E Svendsen, Norway, L Talpsepp, Estonia and B Håkansson, Sweden. Chemical parameters: E Fogelqvist, Sweden. Biological parameters: L Hernroth, Sweden Secretary/rapporteur: I Olsson, Sweden Reference Group L Andersson, Sweden V Andriuschenko, Russia D S Danielssen, Norway H-P Hansen, Germany Henrik Kaas, Denmark G Karabashev, Russia W Lange, Germany M Ostrowski, Poland M Pastuszak, Poland S Sagan, Poland S Schulz, Germany Z Witek, Poland
June 15, 1992	Submission to the Convener of final titles and abstracts of papers to be presented at the Workshop.
November 3-6, 1992 (prel.)	SKAGEX Workshop. After the Workshop final summary of the principal SKAGEX findings and conclusions.

ANNEX 6

TENTATIVE TITLES OF PAPERS TO BE PRESENTED AT THE SKAGEX WORKSHOP, NOVEMBER 1992. SUGGESTIONS GIVEN AT THE SKAGEX MEETING IN GDYNIA, NOVEMBER 4-8, 1991

Cf also suggestions given at the SKAGEX Meeting in Moscow, February 1991 (attached as Annex 7)

A. Suggestions by the Physical Group

1. A case study of circulation in the outer Skagerrak: response to local and large scale wind variations.
Author(s): P M Haugan, The Nansen Environmental and Remote Sensing Center (NERSC), Bergen et al ?

2. Sensivity studies and verification of an oceanographic numerical model using the SKAGEX data:

Part I: Testing different horizontal and vertical resolutions
Part II: Necessary initialization procedures for simulation of the SKAGEX period.
Part III: The effect of various open boundary conditions (inflow of Atlantic Water, Baltic Water, rivers, surface heat flux) on simulating the SKAGEX period.

Authors: J Bernsten, B Ålandsvik, G Ottersen & E Svendsen, Institute of Marine Research (IMR), Bergen and E Martinsen, DNMI, Oslo ?

3. Modelling/simulating a strong wind-driven coastal upwelling event, and its effect on the short-term circulation and nutrient distribution.
Author: J Bernsten, IMR, Bergen.

4. Skagerrak; the semi-permanent vertical pump of nutrients and the resulting increased productivity.
Author(s): E Svendsen, J Bernsten et al ? at IMR, Bergen.

5. Testing possible steering mechanisms of the inflow of Jutland coastal water to the Skagerrak.
Authors: J Bernsten, E Svendsen, J Aure? et al?, IMR, Bergen.

6. Modelling and quantifying the variability of the different water masses entering the Skagerrak.
Authors: J Bernsten et al, IMR, Bergen

7. Organic contaminants in sediments in the Skagerrak.
Author: J Klungsöyr, IMR, Bergen.,

8. The nutrient intercomparison and its usefulness for the SKAGEX.
Author(s): L Föyn et al ?, IMR, Bergen.

9. The distribution of nutrients and its budget during SKAGEX.
Author(s): L Föyn et al ?, IMR, Bergen.

10. On water masses and biological variability in the central and eastern Skagerrak during SKAGEX-90.
Authors: L Talpsepp, J Pavelsen, T Põder, K Künnis, K Piirsod & V Porgassaar, Estonia.

11. The size structure of planktonic particles in relation to the hydrographic structure in the Skagerrak.
Authors: M Kahru & A Leeben, Estonia.

12. Contribution of mesoscale hydrodynamical processes to water exchange through the Skagerrak and the Kattegatt.
Authors: L Talpsepp, J Elken et al, Estonia.

13. SKAGEX data discussed in the light of colour index as an indicator of chlorophyll concentration.
Author: J Olszewski, Institute of Oceanology, Polish Academy of Science, Sopot, Poland.

14. Light penetration depth as a tracer of surface water masses.
Author: S Sagan, Institute of Oceanology, Polish Academy of Science, Sopot, Poland.

15. Variability of different water masses.
Authors: J Piechura & M Ostrowski, Institute of Oceanology, Polish Academy of Science, Sopot, Poland.

16. Volume scattering (on section G); a possibility of acoustic tracking of water masses in the Skagerrak.
Author: M Ostrowski.

17. A Data Atlas and presentational calculation tool for the hydrochemical data set.
Authors: M Ostrowski & S Sagan.

18. Examples of consecutive satellite pictures (surface temperature) and computations of current velocities.
Author: B Håkansson, SMHI, Norrköping, Sweden.

19. Old estimates of transports compared to measured SKAGEX currents in the Hanstholm section.
Author: Somebody at SMHI, Sweden.

20. Model studies of the Skagerrak/Kattegatt area during SKAGEX, turbulence and particle tracking.
Authors: J Svensson et al., SMHI, Sweden.

21. LANDSAT evaluation on detecting biological fronts (?).
Author: Somebody at SMHI, Sweden.

22. Studies of changes in the Skagerrak surface waters based on satellite images for long periods.
Author: U Horstmann, Institute of Marine Research, Kiel, Germany.

B. Suggestions by the Chemical Group (incl. nutrients/biology)

1. The coastal current as a source and trigger for phytoplankton blooms.
Author: O Lindahl, Kristinebergs Marinbiologiska Station (KMBS), Sweden.

2. Nitrification processes and their potential in the Skagerrak.
Authors: E Fogelqvist, S Fonselius & V Enoksson, Sweden.

3. Elements of mesoscale circulation in the western Skagerrak.
Authors: A Majewicz, M Pastuszak & A Grelowski, Poland.

4. The Jutland Current - its extent during SKAGEX I.
Authors: M Pastuszak **et al** (from SMHI; Sweden ?).

5. Short term variations in the surface layer during SKAGEX II and III.
Authors: E Svendsen & D S Danielssen, Norway.

6. Characteristics of water masses in the Kattegatt during the SKAGEX I experiment (based on currents, physical/chemical/biological data and remote sensing).
Authors: E Andrulewicz **et al** (from SMHI, Sweden ?).

7. Diurnal cycles of primary productivity.
   * Quantification of diurnal cycles
   * Internal and external factors (physical, chemical and biological) controlling the diurnal cycles
   * Correlation between day to day variations in primary productivity and nutrients (??)
   * Other aspects

Authors: G Behrends, H-P Hansen, IMR, Kiel, Germany.

8. Statistical procedures for data quality control applied to biological and chemical data of SKAGEX.
Author: H-P Hansen, Germany.

C. Suggestions by the Biological Group

1. Distribution and dynamic of phytoplankton, chlorophyll and potential production in relation to water masses.
Cordinator: S Schulz, Rostock, Germany.

2. Long- term variability along the F-section (Torungen-Hirtshals) in relation to SKAGEX data.
Coordinator: D S Danielssen, Flödevigen, Norway.

3. Subsurface chlorophyll maxima: productivity and species composition in relation to pycno- and nutriclines and entrainment.
Coordinator: O Lindahl, Kristineberg, Sweden.

4. Zooplankton energetic demands. Connections between potential primary production and secondary production.
Coordinator: Z Witek, Poland.

5. Phytoplankton as indicators of water masses.
Coordinator: L Edler, Sweden.

6. Remote sensing as a tool to estimate surface chlorophyll concentrations.
Coordinator: B Håkansson,Sweden.

7. Diurnal cycles of primary productivity.
Coordinator: G Behrends, Germany.

8. **In situ** primary production of a subsurface phytoplankton population in the northern Kattegatt in May, 1991.
Coordinator: O Lindahl, Sweden.

9. Formation and fate of a mixed flagellate bloom below the pycnocline in the Skagerrak.
Coordinator: H Kaas, Denmark ?.

ANNEX 7

EXTRACT FROM SKAGEX MOSCOW REPORT, ICES C.M. 1991/C:1, REF E

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
- Uppwelling 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.