International Council for the
Exploration of the Sea

C.M.1993/C:4

REPORT FROM THE SKAGEX WORKSHOP

Lysekil, Sweden, 3 - 6 November 1992

and

THE MEETING OF THE ICES STUDY GROUP ON SKAGEX

Klaipeda, Lithuania, 29 June - 2 July 1993

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PART I

REPORT FROM THE SKAGEX WORKSHOP

Lysekil 3-6 November 1992

Convener: Dr Bernt I Dybern, Lysekil, Sweden
Co-conveners: Dr Slawomir Sagan, Sopot, Poland
Dr Einar Svendsen, Bergen, Norway

1 OPENING OF THE WORKSHOP

The Convener of the Workshop/Chairman of the ICES Study Group on SKAGEX, Dr Bernt I Dybern, welcomed the participants. About 60 scientists had announced their participation, among them a few especially invited people outside the SKAGEX Group but working with related items. A list of the participants is given in Annex 1.

The Chairman informed about the work during the four days at disposal. During the three first days a symposium would be arranged with about 40 scientific papers and the last day should be devoted to a discussion in the ICES Study Group on SKAGEX for summing up the present position of the SKAGEX work and establishing outlines for possible future activities.

2 ADOPTION OF THE AGENDA

The meeting accepted the proposed day of order for the symposium and a suggestion for an agenda for the last day (Annex 2).

3 THE SYMPOSIUM

A number of scientists were appointed chairmen and rapporteurs of the different sessions.The scientific papers are listed in Annex 3. Abstracts were available for a number of papers.

A summarizing paper was given at the first session of the Workshop, written by the SKAGEX Drafting Group set up at the previous meeting of the ICES Study Group on SKAGEX in Gdansk, November 1991. It contained an overview of much of the present knowledge of the Skagerrak mainly based on the data obtained at the SKAGEX field phases (Skagex I-IV) 1990-1991. The contents of the rest of the papers are shown by the list in Annex 3. The symposium was rounded off with a general discussion.

During the symposium some investigation gears were demonstrated, such as the gelatine pendulum (by Joel Haamer) and the "EcoMonitor" (a device for primary production measurements; by A. Konev).

4 THE MEETING OF THE STUDY GROUP ON SKAGEX

The meeting was held on Friday 6 November 1992, starting at 0900 and closed at 1700. The agenda is shown in Annex 2.

The rapporteurs from the different sections of the symposium gave short resumés on the papers given during the symposium. In summing up the Chairman noted that the symposium had been successful with many interesting papers which had brought the knowledge of the Skagerrak and adjacent sea areas considerably forward. He also noted that most discussions had been lively and had contributed substantially to bringing the many pieces of information together. Especially, the results of SKAGEX had given much better possibilities of (1) identifying and quantifying water masses and fluxes and their spatial distributions, (2) estimating long-term and short-term variabilities and (3) understanding

the functions within the system. The increased knowledge about the Skagerrak would allow a better tracing the pathways of nutrients and pollutants.

The results from SKAGEX Project have shown the extreme complexity of the Skagerrak. A lot of work still remains before this sea area is fully understood. The meeting discussed this at length and suggested the following main lines for the further work:

- Description of the relation between meteorological and hydrobiological factors
- Further descriptions of the variability in time and space
- Studies of the vertical transport mechanisms
- Cause/effect studies, e.g. the effects on production of the ridge/pump function found in central Skagerrak, and of upwellings
- Further elaboration on different processes of importance, such as the mixing processes, the microbiological loop, entrainment and relationships between different biological factors
- Studies of the possibilities of characterizing water masses by means of physical-chemical and biological features
- Budget calculations for incoming and outgoing water masses

Some of these tasks could be elaborated by means of a general, dynamic model including both physical, chemical and biological parameters.

To get a better basis for further research it would be necessary to compile and interpret more Skagerrak data. The SKAGEX Data Atlas, being worked out by Dr. M. Ostrowski, Institute of Oceanology, Sopot, should be distributed in diskett form together with a manual to participating institutes.

A small group consisting of Drs S. Sagan, E. Svendsen, B.I. Dybern and D. Danielssen was asked to look into the possibility of getting a further person to take part on about half-time basis in the modelling work and budget calculations to be led by Norwegian scientists.

The analyses of the biological material from the field investigations still lagged behind due to uncertainties about financial resources sought from the Nordic Council of Ministers. When resources become available analyses previously carried out at the Sea Fisheries Institute in Gdynia should be continued. The results should be included in the ICES Data Base and added to the SKAGEX Data Atlas, or in other ways be sent out in the form of distribution maps etc.

It was recommended that all papers from the Workshop-Symposium should be published in the same publication, tentatively in a volume of the ICES Cooperative Research Reports. Dr L Føyn agreed to be the Editor. He would be assisted by an editorial group comprising the Convener and the both Co-conveners of the Workshop, and Drs D Danielssen and S Schulz. Any author who so wishes could also publish his/her paper in any other journal, e.g. the ICES Journal of Marine Science.

The deadline for the manuscripts to be sent to Dr Føyn was set to 1 May 1993.[1]

Decision about another meeting with the ICES Study Group on SKAGEX had already been taken at the ICES Statutory Meeting in Rostock-Warnemünde 24 September - 2 October 1992 (ICES C-Resolution 2:36). It was decided to arrange this meeting in Lithuania and Dr J. Dubra was asked to inform the Chairman soonest about the possibility of this. The best time would be at the end of June 1993.

[1]It was originally set to 1 March, but had for practical reasons to be changed after the meeting.

5 CLOSING

After finishing the meeting of the Study Group on SKAGEX the Convener of the SKAGEX Workshop, Dr B I Dybern, thanked all the participants for their most valuable contributions and interest. Dr L Føyn thanked Dr Dybern and his staff for fine arrangements, including entertainments in different forms, and also mentioned the importance of the SKAGEX work and results for the understanding of the Skagerrak and for furthering the cooperation among scientists in the Nordic-Baltic area.

ANNEX 1

LIST OF PARTICIPANTS

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ANNEX 2

FRIDAY 6 NOVEMBER

a.m. and p.m., starting at 0900: Meeting of the Study Group on SKAGEX

Chairman: B.I. Dybern

Preliminary Agenda:

1. Summary of results achieved
   a. Earlier results
   b. Through the Drafting Group meeting (Flødevigen Aug-Sept 1992)
   c. The SKAGEX Atlas
   d. During the Workshop

2. Additional viewpoints from the SKAGEX Sub-groups
   a. Physical Group
   b. Chemical Group
   c. Biological Group
   d. Other Groups

3. Future work
   a. Publication of papers from the Workshop
   b. SKAGEX Atlas
   c. Further compilation work, including modelling

4. Next meeting(s)
5. Any other business
6. Closing

BID

ANNEX 3

SKAGEX WORKSHOP, Lysekil 3-6 November 1992

LIST OF PAPERS

Aarup, T.: Remote sensing of watermass distributions in the Skagerrak as observed from CZCS imagery from 1979-1983

Ådlandsvik, B., J. Berntsen and E. Svendsen: Modelling a strong wind-driven coastal upwelling event

Andrjuschenko, V., Z. Shtukova et. al.: Photosynthetic activity of phytoplankton in some hydrodynamic areas of the Skagerrak

Andrulewicz, E., S.H. Fonselius and W. Slaczka: Characteristics of water masses in the Kattegat area during SKAGEX-90

Aure, J. and E. Dahl: Oxygen, nutrients and carbon in the Skagerrak basin water

Berntsen, J., E. Martinsen, B. Ådlandsvik and E. Svendsen: Sensitivity studies and verification of an oceanographic numerical model using the SKAGEX data

Danielssen, D.S. and E. Dahl: Seasonal and geographical variations in nutrients and chlorophyll in the Skagerrak

Darecki, M., S. Sagan, P. Kowalczuk and A. Kreizel: Application of NOAA AVHRR to study the Skagerrak area during the SKAGEX experiment

Dubra, J. and G. Griksas: Distribution of water masses and nutrients between Kattegat and Skagerrak

Edler, L. et al.: Distribution and abundance of phytoplankton in relation to water masses in the Skagerrak during SKAGEX I

Fogelqvist, E., V. Enoksson and S.H. Fonselius: Nitrogen speciation and nitrification in the Skagerrak area during the SKAGEX experiments

Fogelqvist, E., L. Føyn, H.P. Hansen and D. Danielssen: On correction of nutrient data based on intercomparison exercises during the SKAGEX I and IV experiments

Fonselius, S.: Some SKAGEX III results

Haugan, P.M.,: Circulation of Atlantic water in outer Skagerrak and upwelling along the coast of Norway

Heilmann, J.P., D.S. Danielssen and O. Vagn Olsen: The potential of the Jutland coastal current as a transporter of nutrients to the Kattegat

Håkansson, B.: Remotely sensed coastal upwelling in Skagerrak during SKAGEX I

Karabashev, G.S.: On the influence of dissolved organic matter on remote sensing of chlorophyll in the straits of Skagerrak and Kattegat

Karabashev, G.S., V. Andrjuschenko, R. Kavolite et. al.: On the relationships between concentration and fluorescense of chlorophyll in the waters of Skagerrak and Kattegat

Karabashev, G.S. and S.A. Khanaev: Some features of chlorophyll variability in the straits of Skagerrak and Kattegat

Karabashev, G.S., S.A. Khanaev and A.F. Kuleshov: The unusual and unexpected in variability of optical properties of substances dissolved and suspended in waters of the straits of Skagerrak and Kattegat

Karabashev, G.S., S.A. Khanaev and A.F. Kuleshov: Variability of "yellow substance" in the straits of Skagerrak and Kattegat according to measurements of spectral transparency and fluorescence of sea water

Korshenko, A.N. and E.B. Yastrebov: Zooplankton near the drifting buoy in Skagerrak, 10-18 June 1990

Kristiansen, S. and T. Farbrot: Nitrogen uptake during the G.O. Sars cruise in Skagerrak May-June 1990

Künnis, K.: Distribution of heterotrophic bacteria in the Skagerrak during SKAGEX between May and June 1990.

Lindahl, O., B. Andersson, D. Danielssen, L. Davidsson and L. Hernroth: Subsurface phytoplankton populations east of Skagen in May 1991: A study of structure and productivity in relation to abiotic factors

Majewicz, A., M. Pastuszak and A. Grelowski: Elements of mesoscale circulation in the western Skagerrak (SKAGEX I-90)

Mamayev, A. and S. Kirianov: Characteristics of the surface water in eastern Skagerrak in June 1990

Piechura, J. and M. Ostrowski: Variability of water masses during SKAGEX

Sagan, S.: Light penetration depth as a tracer of surface water masses

Schulz, S. and G. Breuel: Variability of biological parameters during SKAGEX-I at the CE-transect

Svendsen, E. and D.S. Danielssen: Short term variations in the surface layer during SKAGEX

Svendsen, E. and J Berntsen: Skagerrak; the semi-permanent vertical pump of nutrients and the resulting increased productivity

Svensson, J.: Modelling the Skagerrak

Talpsepp, L., J. Pavelsson, T. Poder, K. Künnis, K. Piirsoo and V. Pogassaar: Water masses and biological variability in the central and eastern Skagerrak during SKAGEX: Inflow of Atlantic water

Tiselius, P.: On secondary production in the Skagerrak - Kattegat area

PART II

REPORT FROM THE MEETING WITH THE ICES STUDY GROUP ON SKAGEX

Klaipeda, Lithuania, 29 June - 2 July 1993

1 OPENING OF THE MEETING

The Director of the Lithuanian Laboratory of Marine Research, Dr. Algirdas Stankevicius, welcomed the participants and expressed his hope for a successful meeting. The Chairman of the ICES Study Group on SKAGEX, Dr. Bernt I. Dybern introduced the preliminary agenda to the participants and gave a brief account about the planning of the meeting. The agenda was adopted and is annexed to this report (Annex 1). A list of participants is found in Annex 2.

2 ELECTION OF RAPPORTEUR

Dr. Sigurd Schulz was unanimously elected Rapporteur of the Meeting.

3 STATUS OF SKAGEX

The Chairman summarized the status of the SKAGEX project after the Workshop on 3-6 November in Lysekil, Sweden. He noted that in principle the work had continued according to the plans. Thanks to a new Grant from the Nordic Council of Ministers the analyses of the biological material had now almost been finalized. The grant had also made possible considerable success regarding the work on the SKAGEX Data Atlas and would be used for the finalization of the modelling work. More details are found in the following.

4 THE SKAGEX DATA ATLAS

Dr. Marek Ostrowski introduced the computerized SKAGEX ATLAS VERSION 3.0, issued through the Institute of Oceanology, Polish Academy of Sciences. A draft manual was distributed, and the programme and some important special features were demonstrated to the audience. The data bank contained now the complete physical and chemical data set as well as the chlorophyll data. Until the end of August 1993 also the primary productivity data will be included. Phytoplankton and zooplankton data will be added soon after completion of the analyses in Poland and an agreement has been reached on a suitable format (probably in September 1993).

The Group decided also to ask Dr. G. Karabashev to investigate if the fluorescence data of all or some ships could be included into the bank. These data should be in the form of "arbitrary units" because the conversion to chlorophyll values is problematical and in SKAGEX most ships did not do the necessary comparisons to chlorophyll.

It was recommended to still restrict the availability of the SKAGEX data for the time being. The first issue of the SKAGEX Atlas will thus only be distributed to the participating institutes and to some key persons. However, Dr. Ostrowski will present a paper to the ICES Statutory Meeting 1993 about the Atlas.

The Group thanked Dr. Ostrowski for the tremendous work he had done until now. His outstanding contribution was a necessary prerequisite for further processing of and evaluating the data set of SKAGEX.

5 THE SKAGERRAK MODEL

The Institute of Marine Research, Bergen, the University of Bergen and the Norwegian Meteorological Institute have developed the Norwegian Ecological Model (NOWECOM). Based on this a North Sea Model has been elaborated and successfully run. Dr. E. Svendsen reported that a finer scale of this model, to a great extent based on SKAGEX data,

was now under development in Bergen. This Skagerrak model, adjusted to a 4 km scale grid, was already in an advanced state.

The goal of the modelling work was among other things to identify and quantify the short term variability in the transport of different water masses into and out of the Skagerrak, to model primary production, to identify physical-chemical processes important for the primary production, and otherwise for answering different interdisciplinary questions.

6 COMPILATION OF THE BIOLOGICAL DATA

Chlorophyll, Primary production:

Dr. Lars Edler reported that the chlorophyll and primary production data were now included in the ICES data bank. However, they were not yet in the right format for inclusion in the SKAGEX Atlas. Until the end of August Dr. Ostrowski should have adapted the format so that the data could be included.

Phytoplankton:

All phytoplankton samples that have been analysed had been punched into Dr. L. Edlers data bank. The Polish sorting center would finish the work with the samples until August. Remaining work was to punch in the last set of data and edit the whole raw data set, which could be ready for the SKAGEX Atlas by October (a format was agreed upon with Dr. Ostrowski).

Zooplankton:

Dr. Lars Hernroth reported that the work with the determination and counting of the zooplankton was progressing fast. The analyses of the zooplankton samples would be finished in August. It was decided to transfer the data to the SKAGEX Atlas in an agreed format. This could be done by September.

7 PUBLICATIONS FROM THE SKAGEX WORKSHOP, 3-6 NOVEMBER 1993, LYSEKIL

Dr. D. Danielssen reported that of the papers presented at the Workshop in Lysekil, 21 manuscripts (Annex 3) had been received by the Editor, Dr. L. Føyn, for recommended publication in the ICES Cooperative Report Series (see recommendation, part 12.). Some other papers were still expected, among them a survey paper produced by the SKAGEX Drafting Group. The editorial board set up at the SKAGEX Workshop in Lysekil in 1992 had started the work on reviewing the papers. Some authors had announced that they would like to send in the article also to other scientific journals. A few papers had been directly published in other journals. In the latter case the meeting decided that, if possible, abstracts should be inserted in the Cooperative Research Report. As new deadline for papers not yet sent in, **1 September 1993** was set.

8 FUTURE ACTIVITIES

It was decided that the work using the unique SKAGEX data set should be continued. This was considered extremely important for the biological parts, since only now plankton data were approaching completeness. But also in the physical and chemical fields several additional items remained. The work should be concentrated on the following items:

1. Completion of the SKAGEX Atlas, including versions for IBM and McIntosh.

2. The Skagerrak Model

    1) verification of the model

    2) using the model for integration of physical, chemical and biological parameters to describe horisontal and vertical distribution patterns during SKAGEX I.

3) using the model for identifying and quantifying specific processes considered to be important for primary production during SKAGEX I.

   a) comparisons between the model and measured horizontal and vertical distributions of salinity, temperature, nutrients (N, P, Si), chlorophyll *a*, diatoms and flagellates.

   b) estimations of the general horizontal transport of water, nutrients (N, P, Si), diatoms and flagellates through the SKAGEX sections on every obligatory day, using the depth intervals 0-30 m, 30-50 m, 50-100 m, > 100 m in the Skagerrak and above/below the pycnocline in the Kattegat, and the transport of the Jutland Coastal Water and Norwegian Coastal Water (and nutrients) through the SKAGEX sections.

   c) estimation of the vertical transport of nutrients (N, P, Si) through the 50, 40, 30, 20 and 10 m layers along the SKAGEX sections for every obligatory day during the SKAGEX field phases, the vertical distribution of light and primary production (total, diatoms, flagellates) along the SKAGEX sections for every obligatory day, and calculation of the integrated primary production (horizontal mapping) on every obligatory day.

Preliminary time schedule for the model work:

Specify variables to be studied	March/June 1993
Adjustment of NORWECOM to 4 km scale	April/June 1993
Arrange output and run the model	August/October 1993
Arrange similar data output	October/November 1993
Evaluate model versus data	September/December 1993
Calculate water masses and nutrient budgets	October/December 1993
Publication	December 1993 - January 1994

3. Physics/chemistry

Subsurface production/chlorophyll maxima:

- Quantification of the vertical nutrient transport
- Circulation causing subsurface convergence of phytoplankton
- Mixing processes and nutrient distribution

Upwelling and nutrients:

- Quantification of vertical nutrient transport in coastal upwelling
- Quantification of vertical nutrient transport related to the ridge
- Further analysis of the ridge

Jutland Coastal Water (JCW):

- Study the mechanism causing the pulsations of JCW into the Skagerrak
- Quantify the nutrient transport in the JCW in comparison to the other nutrient sources in the Skagerrak

Frontal Zones:

- Estimate the horizontal turbulent diffusion coefficient at different frontal structures (eddies, meanders, etc.)z
- Study the general circulation in relation to distribution of indicator organisms and communities
- Evaluate the Atlantic Water inflow during SKAGEX in relation to extreme measurement data in the North Sea in 1990 and to historical data

4. Biology

Distribution patterns of organisms and properties:

- Basic assessment of distribution and variability during SKAGEX for phytoplankton, chlorophyll *a*, primary production and zooplankton

- Identification of indicator organisms
- Ecological importance of frontal zones in eastern and central Skagerrak

Subsurface Fluorescence Maxima:

- Origin of the chlorophyll maxima: growth or concentration
- Relation to the pycno- and nutriclines
- Variability in the species composition
- Fine scale structure of phytoplankton

Other items:

- Nitrification potentials
- Number of saprophytic bacteria in relation to phytoplankton, salinity and temperature
- Phytoplankton activity in thin surface layers

Most future work of the SKAGEX Study Group should be carried out by correspondence, but smaller project groups might have to come together to render it more effective and streamlined. In a later phase combined meetings of different groups might be arranged for more interdisciplinary approaches and deeper understanding of the ecological processes.

Drs. E. Svendsen, D. Danielssen and L. Hernroth agreed to take on a catalyst function to assist in getting scientists active in relation to the mentioned tasks. Also scientists outside the SKAGEX group should be welcome to take part. The SKAGEX Atlas contains a wealth of data which, for instance, could be the basis for a number of student projects at universities.

9 REPORTS

The Meeting discussed the reporting of the activities of the ICES Study Group on SKAGEX. The present report would be presented to the next Statutory Meeting, attached to paper C.M. 1993/C.4 the first part of which contains a report from the SKAGEX Workshop, Lysekil 3 - 6 November 1992.

The Nordic Council of Ministers have given substantial support to SKAGEX and has demanded a comprehensive final report from the project. It was agreed that it was yet too early to issue such a report but that it should be compiled soonest after publication of the SKAGEX papers in the ICES Cooperative Research Report Series, at a time when the SKAGEX Atlas and the Skagerrak Model have also been finalized.

10 ANY OTHER ITEMS

Since much work still was needed to complete and finalize the SKAGEX project it was unanimously recommended that the ICES Study Group on SKAGEX should continue for the time being, under the chairmanship of Dr. B.I. Dybern. No meeting for the whole SG was foreseen for the next year. However, as mentioned, special purpose meetings with smaller groups of scientists might be realized.

The Group congratulated the Chairman Dr. Bernt I. Dybern subsequently to his 65th birthday, which he celebrated in the beginning of June. The Group expressed its gratitude for all the efforts he had spent in organisation and outstanding support for making SKAGEX to a successful international experiment.

11 CLOSING

At the closing of the Meeting, Dr. B.I. Dybern thanked Dr. A. Stankevicius, Director of the Lithuanian Marine Research Laboratory, Dr. J. Dubra, Vice-Director of the same Institute, and their staff for the excellent arrangements at and around the Meeting. All participants had very much appreciated to have it in Klaipeda and honoured the great contribution to the SKAGEX work by Lithuanian scientists.

12 RECOMMENDATION

It is recommended that the papers from the SKAGEX Workshop, Lysekil, Sweden, 3-6 November 1992, be published in the ICES Cooperative Research Report Series, under the editorship of Dr. Lars Føyn, Norway.

ANNEX 1

SKAGEX MEETING IN LITHUANIA 29 JUNE - 2 JULY 1993

Preliminary Agenda

1. Opening of the meeting
2. Election of Rapporteur
3. General information of the status of SKAGEX
4. The SKAGEX Atlas
5. The Skagerrak Model
6. Compilation of the biological data
   a. Chlorophyll, primary production
   b. Plankton
7. Publication of papers from the SKAGEX Workshop, Lysekil
8. Future activities
   a. the biology
   b. the Model
9. Final reporting
   a. to ICES
   b. to Nordic Council of Ministers
10. Any other item
11. Closing

ANNEX 2

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the ICES Study Group on SKAGEX, Klaipeda, Lithuania, 29 June - 2 July

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ANNEX 3

Preliminary list of papers to be published in the ICES Cooperative Research Report Series

Aarup, T: Remote sensing of watermass distributions in the Skagerrak as observed from CZCS imagery from 1979-1983.

Andrjuschenko, V.V., G.S. Karabashev and P. Kavolite: On the relationship between concentration and fluorescence of chlorophyll in waters of the Skagerrak and the Kattegat.

Andrulewicz, E., S. Fonselius and W. Slaczka: On the exchange of water masses between Kattegat and Skagerak during the SKAGEX I, 1990.

Aure, J. and E. Dahl: Oxygen, nutrients, carbon and water exchange in the Skagerrak basin. Coastal current as a transporter of nutrients into the Kattegat.

Darecki, M., P. Kowalczuk and S. Sagan: Chlorophyll vs AVHRR satellite data during SKAGEX experiments.

Dubra, J: Spreading of water masses between Kattegat and Skagerrak.

Enoksson, V., E. Fogelqvist and S. Fonselius: Nitrogen speciation and nitrification potential in the Skagerrak area during the SKAGEX IV experiment.

Fogelqvist, E., L. Føyn, H.P. Hansen and D.S. Danielssen: On correction of nutrient data based on the intercomparison exercises during the SKAGEX I and IV experiments.

Fonselius, S: Nutrient measurements by R/V Argos at section G during the winter expedition, SKAGEX III, in January 1991.

Heilmann, J.P., D.S. Danielssen and O. Vagn Olsen: The potential of the Jutland coastal current as a transporter of nutrients into the Kattegat.

Karabashev, G.S. and S.A. Khanaev: Some features of chlorophyll variability in the straits of the Skagerrak and the Kattegat.

Karabashev, G.S: The unusual and unexpected variability of optical properties of water in the Skagerrak and the Kattegat.

Korshenko. A. and E. Yastrebov: Zooplankton near the drifting buoy in Skagerrak i June 1990.

Lindahl, O., B. Andersson, D.S. Danielssen, L. Davidsson and L.Hernroth: Subsurface phytoplankton populations east of Skagen in May 1991: A study of structure and productivity in relation to physical factors.

Majewicz, A., M. Pastuszak and A. Grelowski: Elements of mesoscale circulation in the western Skagerrak - SKAGEX I-90.

Mamaev, A., S. Kirianov and D. Ivanov: Characteristics of the surface water in the eastern Skagerrak in June 1990.

Rydberg, L: Current measurements in the northern Kattegat during SKAGEX in May-June 1990.

Schulz, S. and G. Breuel: Variability of biological parameters during SKAGEX I.

Skov, H., J. Durinck and P. Andell: The distribution of planktivorous seabirds in relation to surface fronts and pycnocline topography in the Skagerrak.

Stryuk, V.L: Suspended matter and minor elements distribution in the Danish Straits.

Wickerts, S: Measurement of ocean current, waves and turbulence using a matched illumination multifrequency forward scatter sonar system.