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REPORT OF THE STUDY GROUP ON SKAGEX

Kiel, 31 October - 2 November 1989

and

Gdynia, 6 -9 March 1990

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T A B L E   O F   C O N T E N T S

ANNEXES

REPORT OF THE STUDY GROUP ON SKAGEX

Kiel, 31 October - 2 November 1989 & Gdynia, 6 -9 March 1990

1. INTRODUCTION

This report contains the final conclusions reached during the course of two meetings to discuss the detailed planning of the multi-national experiment SKAGEX. These meetings were held in Kiel,Federal Republic of Germany, from 31 October - 2 November 1989, and in Gdynia, Poland, from 6-9 March 1990. A final coordinating meeting took place in Arendal, Norway, May 9-10, 1990.

A first planning meeting for a Joint International Skagerrak Expedition took place in Lund, Sweden, 7-9 February 1989. Already at this meeting some decisions could be taken on the aims of the investigation, on the practical performance etc. Whenever relevant, the decisions of the meeting in Lund are included in this report.

1.1 Opening

The Kiel meeting (KM) was opened at 10.00 on 31 October 1989 in the building of the Institut fur Meereskunde by the chairman of SKAGEX, Dr B. I. Dybern, Sweden, who welcomed all participants. On behalf of the head of the institute, Prof. J.C. Duinker, Dr H.-P. Hansen wished all the participants all success in the work of the Study Group.

The meeting i Gdynia (GM) was opened by Dr Dybern at 10.00 on 6 March 1990 in the Sea Fisheries Institute and the participants were welcomed to the institute by its Director Dr Z. Karnicki, who stressed that the investigations in the Skagerrak would be of great importance also for the Baltic countries.

1.2 Participants

A full list of the participants at the meetings in Kiel and Gdynia is provided in Annex 1.

1.3 Adoption og Agenda and Appointment of Chairman and Rapporteur

Both agendas (Annex 2) were adopted without modification.

Dr Dybern and Prof. J. Dera, Poland were appointed chairman and vice chairman respectively of the two meetings, while Dr I. Olsson, Sweden, was appointed rapporteur with Dr W. Matthäus, GDR, as substitute.

substitute.

During both the meetings of the Study Group it worked partly at plenary sessions and partly in small working groups.

2. BACKGROUND INFORMATION AND DOCUMENTATION

2.1 Introduction

The Skagerrak is a transitional area between the Baltic and the North Sea, and as such of great importance not the least for the Baltic countries. It is in a key position and may be regarded as a valve between the Kattegatt and the North Sea. Some authors have stated that the anticlockwise water circulation in the North Sea gives rise to a situation in which the major part of the continental coastal water takes a turn into the Skagerrak before being exported from the North Sea.

There is a high production of fish in the Skagerrak, up to 70 kg fish/hectare/year, or almost double compared to that of the North Sea. At present the annual yield in the Skagerrak is about 400 000 tonnes. Furthermore the Skagerrak is a breeding area for about two thirds of the bulk of the North Sea herring. It is also an area where masssive algal blooms seem to be more and more frequent.

The Skagerrak is probably the poorest known sea area in the Nordic region and there is a great deal of controversy regarding the exchange of water with the North Sea, the internal circulation and the general ways of transport of substances.

The idea of a special international investigation of this important, transitional area between the North Sea and the Baltic Sea has recently come up in the Danish-Norwegian-Swedish Committee on Fisheries and Environmental Investigations in the Skagerrak/Kattegatt area. In that context it was thought that the experience gained by many institutes and scientists in the Patchiness Experiment (PEX-86) in the Baltic could be used. It was further argued that a comprehensive exercise would give a background situation of a still relatively normal sea area, thus giving a reference point if the sea would undergo a deterioration. At present the situation in the Kattegatt is much more serious with temporary oxygen deficit conditions in the southern bottom waters.

2.2 Hydrographical and Chemical Conditions

The Skagerrak is mainly characterized by a counter-clockwise <u>circulation</u> <u>pattern</u> both at the surface and at greater depths. The anti-clockwise circulation favours an upwelling in the central area - the dome area. Blocking of water, vertical and horisontal fronts, lenses of special water and outbreak-phenomena are also typical. Another typical, hydrographic feature is the comparatively small amount of freshwater supply.

space in a manner, that no other data collection programme has done hitherto (A. Svansson, C.M. 1989/C:12). In the paper "The large-scale circulation in the Skagerrak; interpretation of some observations" J. Rodhe observed that the mean currents showed a cyclonic pattern. Apart from a narrow baroclinic, coastal current, the mean velocities generally increased towards the bottom. Here the mean velocities were highest close to and below the sill depth. In the upper layers, the direction of the circulation occasionally changed, whereas in the deeper layers the cyclonic pattern was present in all the observations.

The main currents in the Skagerrak are the Jutland current with two branches, the Baltic current, the Norwegian coastal current, the Dooley-current and the deep Atlantic current, considered to be reponsible for the main contribution of water. The doming pattern may be caused by some pulsating mechanism in the inflowing, Atlantic water. The ingoing deep water current exhibits a remarkably high stability at a depth of 300 - 400 m close to the Danish side. Norwegian measurements have revealed a tendensy of a topographically steered southward flux of high salinity water rather close to the Norwegian coast in the Skagerrak.The importance of the Dooley-current for the Skagerrak is at present under discussion.

At present there are two modelling projects dealing with the water exchange in the Skagerrak. One project means to simulate the circulation in this area and in the Kattegatt. The other project is more linked to biological processes and should answer the question of the transport of different substances of importance to the fishery.

As indicated above there are several pathways for nutrients into and from the Skagerrak. In connection with the *Chrysochromulina polylepis* bloom in 1988 high amounts of nutrients were observed in the Jutland current, probably originating from the German Bight. Inconsistencies in the transport have, however, been observed in this current at Hanstholm. The contribution of nutrients emanating from the Baltic have been considered to be small. Concerning the Kattegatt it has been calculated in a nutrient budget, mainly for nitrogen, that the deep water supply was 52 %, the local supply 35 % and the supply from the Baltic 12 %. Statistically significant increases of dissolved inorganic and total nitrogen, and of total phosphorus have been observed in the Kattegatt, while only total nitrogen has exhibited a statistically significant increase in the Skagerrak.
It has been observed that the edges of the dome are giving nutrients to the surface water here. Along the vertical fronts in the Skagerrak processes of entrainment seem to be of special importance.
Some recent measurements presented at the meeting in Gdynia indicated that there had been observed an increasing trend of the concentration of NO3 at a depth of 400 m in the Skagerrak. Furthermore there had been noted a decreasing concentration of oxygen at a depth of 60m with a minimum of 4.5 ml/l in early autumn but at a depth of 400 m no decrease had been registered.

According to the paper "Hydrographic variabilities in the Skagerrak Surface Water", C.M. 1989/C:35 by S. Fonselius many routine cruises in the Skagerrak have demonstrated that the surface condicruises in the Skagerrak have demonstrated that the surface conditions here change very rapidly.During the winter the currents can easily be traced by help of their nutrient content, but during the summer the surface water is stripped of nutrients and only the salinity and the temperature can be used as indicators.It is concluded that a denser network is needed for a better understanding of the hydrographic situation and so is also an intensive, synoptic campaign like SKAGEX.

2.3 Biological conditions

There are three areas of special interest as to the phytoplankton production in the Skagerrak, i.e. the frontal area with its high production between the Skagerrak and the Kattegatt, the areas along the coastal currents where also fronts are formed and the dome area. The edges of the dome are giving nutrients to the surface water and along the vertical, coastal fronts processes of entrainment seem to be of special importance. In principle there are very few data on the doming effect on the phytoplankton production. During the Chrysochromulina bloom in 1988 it was found that high salinities favoured massive blooms and that the species in question turned out to be more toxic in the northern part of the Skagerrak than more southwards. According to the paper "Phytoplankton Distribution and Activity in the Skagerrak; A Review (C.M. 1989/L:24) by K. Richardson nanoflagellates have been found to dominate at strongly stratified stations in the Skagerrak in the dome area, while diatoms dominate along the periphery. Copepod fecundity increased linearly with the concentration of phytoplankton > 8 um and was therefore greatest at the turbulent stations, where diatoms were dominating the phytoplankton flora.

There exists substantial knowledge on zooplankton in many local regions in the Skagerrak. This knowledge has gradually increased from the 1960s, when mainly ichthyoplankton was studied, to the 1980s with its more complete studies on zooplankton ecology. The transport factor is of great importance and e.g. the copepod Calanus finmarchicus and the krill Meganyctiphanes norvegica are transported into the area. Key questions are the transport mechanisms, the productivity and the composition of zooplankton. There are very strong evidences for the existence of three areas with fronts with high zooplankton production, i.e. to the north, north-west and east of Skagen. A low secondary production has been observed in the dome area.

Recent investigations of the macrobenthic fauna in the Skagerrak have indicated an increase of the total biomass (Rosenberg **et al.**, 1987). Most of this change was due to a highly significant increase of worms, notably polychaetes, and a significant increase of ophiuroid and echinoid echinoderms. Similarity values in terms of biomass suggested that community composition had changed considerably over a 70-yr period, in particular in the inner and central Oslofjord but also in the outer Oslofjord and the Skagerrak. It was suggested that a general organic enrichment had taken place in the Oslofjord.

2.4 Remote sensing

Several satellite image features exhibit good agreement with the charts of surface currents at various wind conditions presented by Dietrich in 1951. On several occasions the Jutland current has turned out to be quite distinct, even if it has been small,and influences from the Skagerrak on the Kattegatt has been recognized.Comparisons have been made between satellite data and Danish vessel data. The similarities have often been striking concerning the distributions of temperature, particles, chlorophyll etc.

Swedish results from interpretations of satellite images produced by LANDSAT and NOAA with a geometric resolution of 30 and 1100 m respectively indicate that in the eastern part of the Skagerrak there are three very stable front systems, where the average geographical positions have been figured out.

2.5 Other information

A theme session on the variability in the Skagerrak was held at the 77th statutory meeting of ICES in the Hague 1989. Three scientific papers were presented at the Session, two of which reviewed the status of hydrographic knowledge in the area (Docs. C:12 and C:35) while the other addressed biological problems (Doc. L:24). Three other papers dealt with a) the report of the Working Group of the Baltic Marine Environment (Doc. E:6), which recommended that Skagex be an ICES project with Secretariat support; b) the report of the Study Group on Patchiness in the Baltic (PEX) (Doc. C:5), which had considered the outcome of an informal meetimg on SKAGEX held in Lund, Sweden in February 1989; and c) the report of the Workshop on *Chrysochromulina polylepis* Bloom (Doc. L:18), which had been held in Bergen in February 1989 to establish a consensus on the causes of a damaging bloom that had effected the Skagerrak the previous spring.
The scientic papers presented to the session draw attention to the fact that there are large gaps of fundamental knowledge on the Skagerrak concerning current systems, water exchange, the transport of nutrients etc.

At the meeting of the Study Group in Kiel the Group took notice of an ICES hydrographical data base covering the period 1960 - 1985 and including about 16 000 stations. The data of this base seemed to be nicely distributed in season and of an acceptable quality. At this meeting the outcome of an information retrieval based on ASFA (Aquatic Sciences and Fisheries Abstracts) and with the key word "Skagerrak" was presented. A total of about 200 references had been obtained. A rough classification of the titles indicated that most papers, reports etc. could be referred to geology, geophysics or sediments, hydrography, circulation or water exchange and fish stocks or fishing. Only one paper dealt with the whole ecosystem, however incomplete as to sediments.

2.6 ICES resolution

At the ICES Statutory Meeting in the Hague, 5 - 13 October 1989, the Council decided a joint international investigation in the Skagerrak, the Skagerrak Experiment (SKAGEX) to be carried out (C. Res. 1989/4:1). According to the Council Resolution 1989/2:28 the Study Group on SKAGEX should plan, coordinate the field work, and work up the results of the expedition concerned.

SKAGEX will be conducted with the following objectives:

a) to identify and quantify the various water masses entering and leaving the Skagerrak area, and their variations over time;

b) to investigate the mechanisms that drive the circulation in the area, and its links with biological processes;

c) to investigate the pathways of contaminants through the Skagerrak.

The ICES Secretariat will be designated the project data center to receive all data obtained during this experiment and prepare inventories and summary products.

At the meeting of the Study Group in Kiel it was summarized that the broadest aim of SKAGEX should be to quantify the transports of different water masses, hopefully giving a pattern of typical behaviour of the Skagerrak. The elaboration of a nutrient budget was also considered to be an urgent matter.

3. AVAILABLE EQUIPMENT

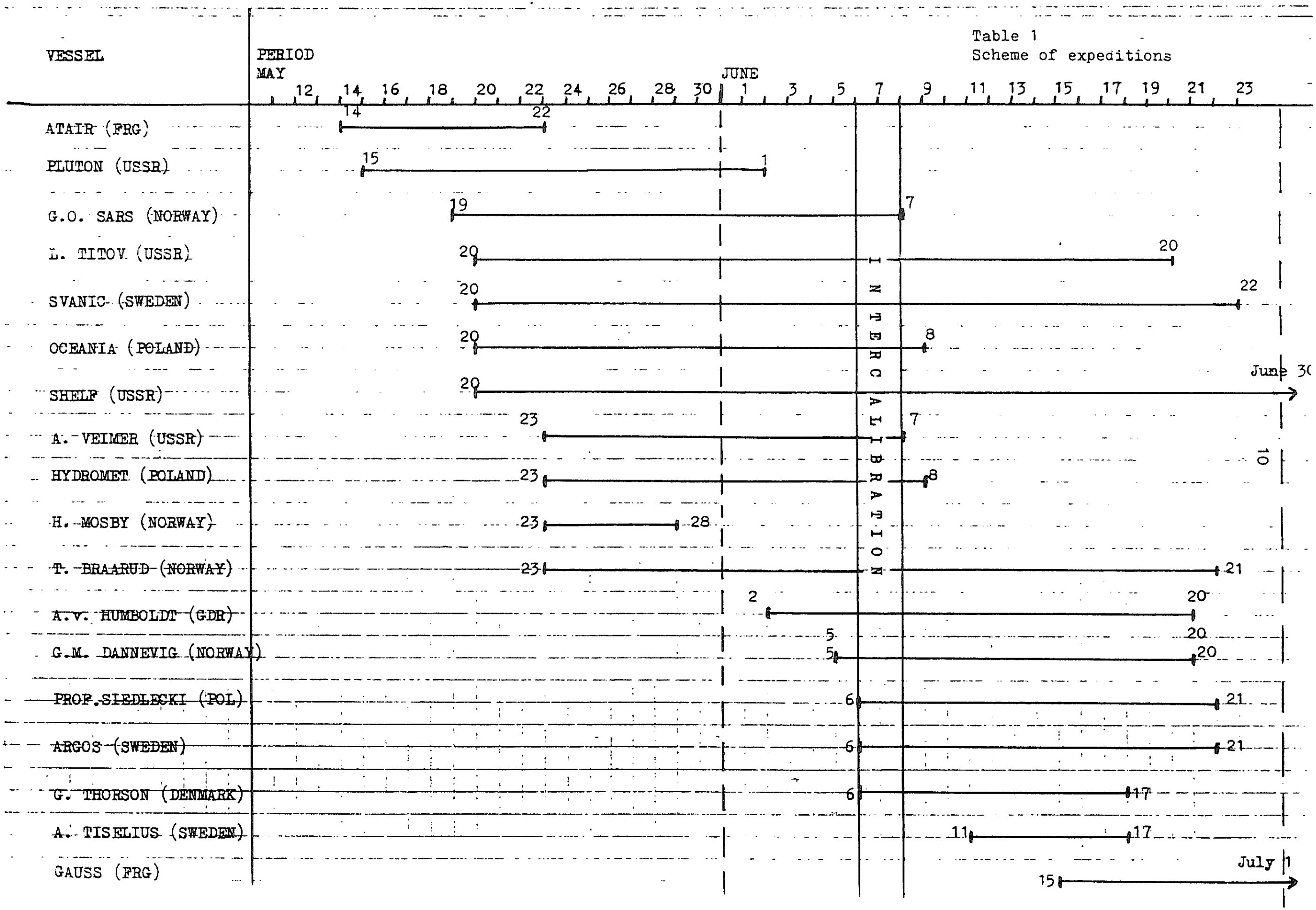
3.1 Ships and their availability and capacity

As indicated in Table 1 " Scheme of expeditions" a total of 17 research vessels are foreseen to participate in the synoptic part of SKAGEX from May 24 to June 20. The nationalities of the vessels exhibit the following distribution: Denmark 1 (G. Thorson), Federal Republic of Germany 2 (Atair and Gauss),German Democratic Republic 1 (A. von Humboldt), Norway 3 (T. Braarud, G.M. Dannevig and G.O.Sars), Poland 3 (Hydromet, Oceania and Prof. Siedlecki), Sweden 3 (Argos, Svanic and A. Tiselius)and USSR 4 vessels (Pluton, Shelf, L.Titov and A. Veimer). Originally the vessel Alkor from FRG and the vessel Håkon Mosby from Norway had also planned to participate but they have had to withdraw their plans.

As can be seen in Table 1 there are ten vessels covering the first part of the exercise but three of them will also take part in the second synoptic part. This implies that there during the two subperiods will be a total of ten fully equipped ships. It should,however, be observed that the vessels ATAIR and GAUSS will mainly be engaged in the work of disposal and collection of moored equipment.

The logistics of the 17 vessels and the parameters that can be measured are given in Table 2. All parameters are indicated, i.e.

Table 1
Scheme of expeditions



expressed that a maximum working period per day would be 15-16 hours between 0500 and 2100. The Study Group in this connection also discussed the number of hydrographical stations per section which could be sampled per day within a period of time of 16 hours. It was noted that within the current monitoring programmes at the sections E, F and G 12 - 13 stations were sampled per day. For the deeper stations a sampling time of at least **one hour** was considered to be necessary. In case of lack of time the Study Group recommended the following ranked reductions:

a) Reduction of biological sampling
b) Reduction of chemical sampling in the central part of the Skagerrak, where the conditions may be considered as more homogeneous.
c) Reduction by skipping a whole station.

As is indicated below in the paragraph dealing with biological parameters, the stations meant to be sampled for zooplankton have been ranked.

3.2 Equipment for obligatory and voluntary parameters

The agreed obligatory and voluntary parameters are indicated in following paragraphs.

During the meeting in Gdynia it was finally decided to establish two sections for current measurements with moored instruments. A total of 62 recording current meters (RCM) were estimated to be available. After this meeting discussions between Denmark and Sweden indicated that the current meter programme could be enlarged due to the fact that "Danmarks Miljöundersögelser" could offer another 10- 15 RCM. At the meeting in Kiel it was,however, announced that some of the originally available current meters would not be available, but on the other hand could now a total of nine Norwegian Anderaa-meters from the Geophysical Institute of the University of Bergen be supplied and deployed implying that the originally planned measurements could be fulfilled.

The Study Group noted at the meeting in Gdynia the needs of some chemicals for nutrient analyses etc presented by some vessels. The chemicals concerned would be collected and distributed in due time before the start of SKAGEX.

Sweden undertook at the Gdynia meeting to list and supply the needs for biological equipment during the exercise. The needs referred to measurements of chlorophyll (mainly filters), primary productivity ("ICES incubator", carbon-14 solution, filters and scintillation vials) and material for the phytoplankton studies.

Some vessels now also announced a need for zooplankton nets (WP-2 net)
It was further noted that some vessels needed some computer expertise to be able to handle all the data collected during SKAGEX.

3.3 Personnel

Table 2. Specification of vessels and parameters that can be measured.

VESSEL / PARAMETER	G.THORSON (Denm.)	ATAIR (FRG)	GAUSS	HUMBOLDT (GDR)	T. BRAARUD (NORWAY)	G.M. DANNEVIG	G.O. SARS	HYDROMET (POL)
Disp (tons)	868	950	1600	1271	106	171	1600	210
Length (m)	56	51.5	68.9	64.23	21.4	27.85	70	32.57
Call Sign	OWPB	DBBI	DBBX	Y3CW	LMFA	LINW	LLZG	SPIC
ICES code	13	41	34	44	09	16	15	06
No. scient.	10	6	12	13	3-4	5	20	13
Dur. (days)	12	9	17	19	30	16	20	17
Day & night	X		X				X	X
Meteorology	X	X	X	X	X	X	X	X
CTD	X	X	X	X	X	X	X	CSTD
Rosette	X	X	X	X	X	X	X	
Auto-analyser	X				X	X	X	
Cur. meters		X	X	X	ADCP		ADCP	X SACM
Quanta meter	On request		X				X	
Secchi Disk	X		X	X	X	X	X	X
Oxygen	X		X	X	X	X	X	X
PO4-P	X		X	X	X	X	X	X
NO3+NO2	X		X	X	X	X	X	X
pH (14 only)	X		X				X	on request
Alkal. (C14)			X				X	on request
Chlorophyll	X		X	X	X	X	X	X
Fluorescence	X			X	X	X	X	
Prim. prod.	X		X	X			X	X ?
Plankton samp	X		X	X	X	X	X	X
NO3	X					X	X	X
NO2	X					X	X	X
Si	X				X	X	X	X
Tot-P	X						on request	on request
Tot-N	X						on request	on request
Zooplankton	X		X	X	X	X	X	X
Microstruc.								
Sediment trap	X							
Part. Counts	X							
Other (s)		Nansen-bottles for water samples	Glass-sampler					

VESSEL / PARAMETER	OCEANIA (POL)	PROF. SIEDLECKI	ARGOS (SWEDEN)	SVANIC	A. TISELIUS	PLUTON (USSR)	SHELF	L. TITOV	A. VEIMER
Disp (tons)	370	2798	961	150	164	2050	230.8	1124	2140
Length (m)	50	89.34	61	31	25	81	33.9	55.63	76
Call Sign	SQOC	SQAC	SEPI	SMJU	SDBF		UMZS	UBFN	UWEP
ICES code	21	16	14	15	CB	PP	PQ	49	47
No. scient.	15	35	12	5	8	8	7	13/14	20
Dur. (days)	20	16	16	34	7	17	42	19	16
Day & night	X	X	X	Day	X ?			Day	X
Meteorology	X	X	X	X	X	X	X	X	X
CTD	X	X	X	X	X			X	X
Rosette	X		X	X	X				X
Auto-analyser			X	X	X				X
Cur. meters			X	X		X			X
Quanta meter	X and other equipment		X						X
Secchi Disk		X	X	X	X			X	X
Oxygen	X	X	X	X	X			X	X
PO4-P	X	X	X	X	X			X	X
NO3+NO2	X	X	X	X	X			X	X
pH (C14 only)	X	X	X		X			X	
Alkal. (C14)	X	X	X						
Chlorophyll	X	X	X		X	Submersible and shipborne fluorometers		X	X
Fluorescence	X		X		X				X
Prim. prod.	X	X	X		X			X	X
Plankton samp	X	X	X		X			X	X
NO3	X	X	X		X			X	X
NO2	X	X	X		X			X	X
Si	X	X	X		X			X	X
Tot-P	X		X		X				on request
Tot-N	X		X		X				
Zooplankton	X	X	X		X			X	X
Microstruc.	X								
Sediment trap					X				
Part. Counts			X ?		X				X
Other (s)			Particulate org. carbon						

3.3 Personnel

At the meeting in Gdynia the participating vessels presented their numbers of available scientists onboard during the synoptic part of Skagex. Some vessels indicated that there would be space for **additional** persons as follows:

A. von HUMBOLDT: 1 scientist
HYDROMET: some scientists (biologists)
OCEANIA: 4 scientists (chemists and biologists from Institut fur Meereskunde in Kiel,as ALKOR will not participate)
PROF: SIEDLECKI: some scientists
ARGOS: 2-3 scientists
A. TISELIUS: 3 scientists
L. TITOV: Some scientist(s)
A. VEIMER: Some scientist(s)

4. TRANSECTS AND TIMING OF THE INVESTIGATION

At the meeting in Gdynia the preliminary transects, recommended at the Kiel meeting were further discussed. A lengthy discussion was devoted to the question of longitudinal section(s) crossing the transects, where e.g. the vessels H. Mosby, Shelf and Pluton could perform measurements of different parameters. There was a general consensus on taking due consideration to the fact of having longitudinal section(s) in the following discussion on the transects.
The Study group finally decided the vessels to conduct obligatory measurements along 7 transects, marked A,B,C,D,E,F,H and K in Fig. 1. The sections B and K are to be considered as special obligatory sections with special investigations, while the northernmost part of the section H will be sampled when possible.
The coverage of the respective section by the respective vessels during the two sub-periods is indicated in Fig. 2 and 3. To be able to cover the whole transitional area between the Kattegatt and the Skagerrak during the first period it was agreed having the vessel L. Titov sampling the eastern part of section C and the southern part of section E. The vessel A. Veimer has the section F as its main section but it will, however, perform measurements of physical and chemical parameters during night-time at the northern part of section E. The outer part of section C will not be sampled this time. During the second part of the synoptic period the vessel A. von Humboldt will cover the same sampling area as L.Titov, while the vessel G. Thorson covers the remaining parts of the sections C and E.
As is indicated in Figures 2 and 3 the D-section will be covered by the vessel T. Braarud during both parts of the synoptic period.

The timing of the sampling of the different vessels is indicated in Table 1. The whole, synoptic investigation period will last from May 24 - June 20 1990. During the following days obligatory measurements will be carried out i.e. every 3rd day:

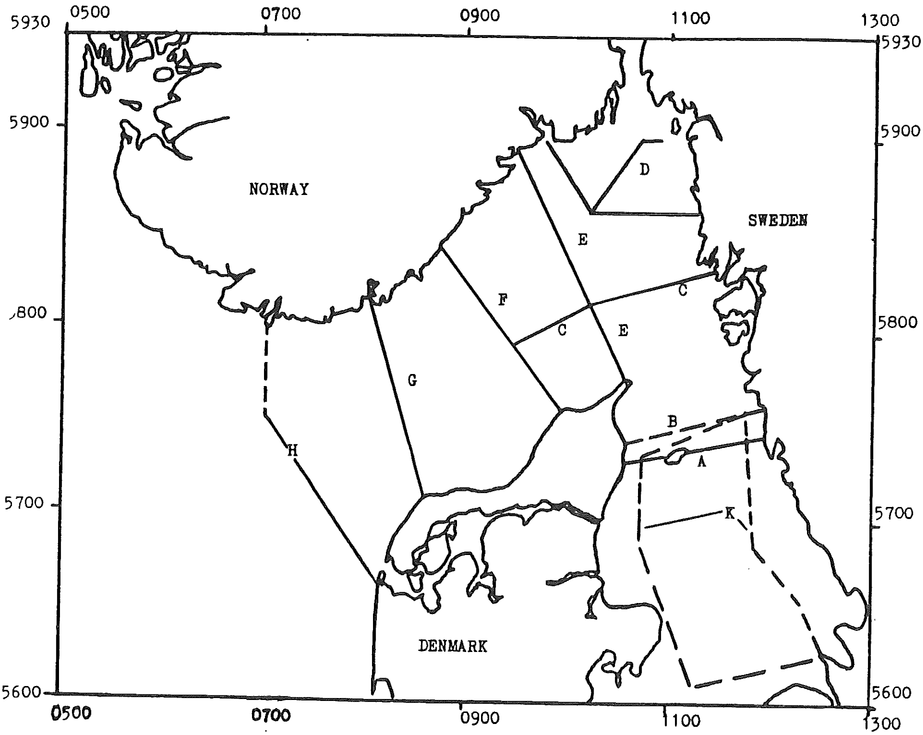
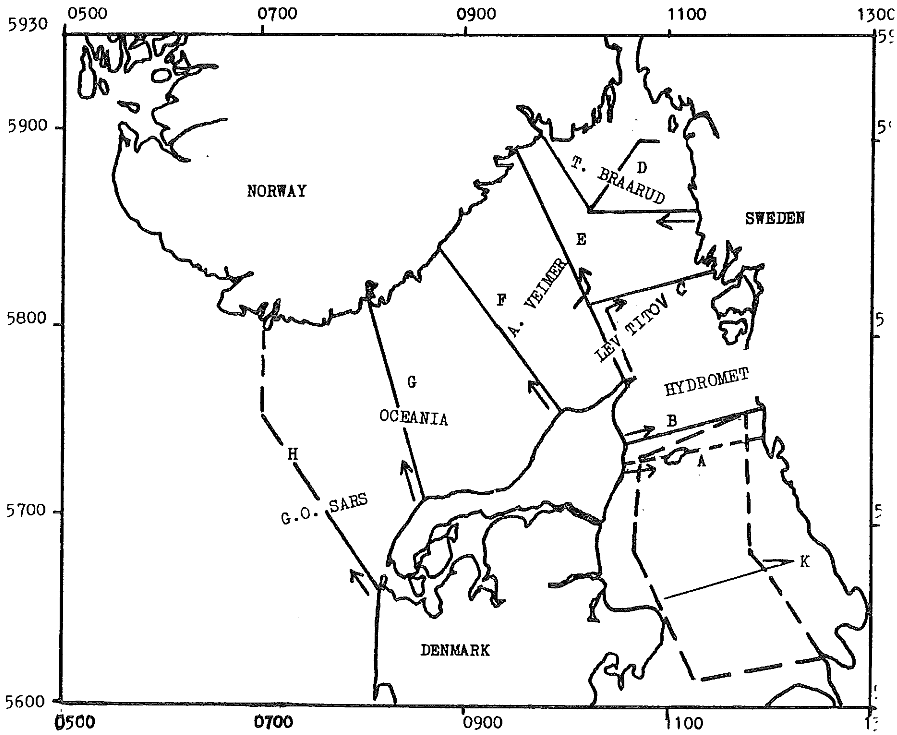


Fig.1 Transects during SKAGEX

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

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

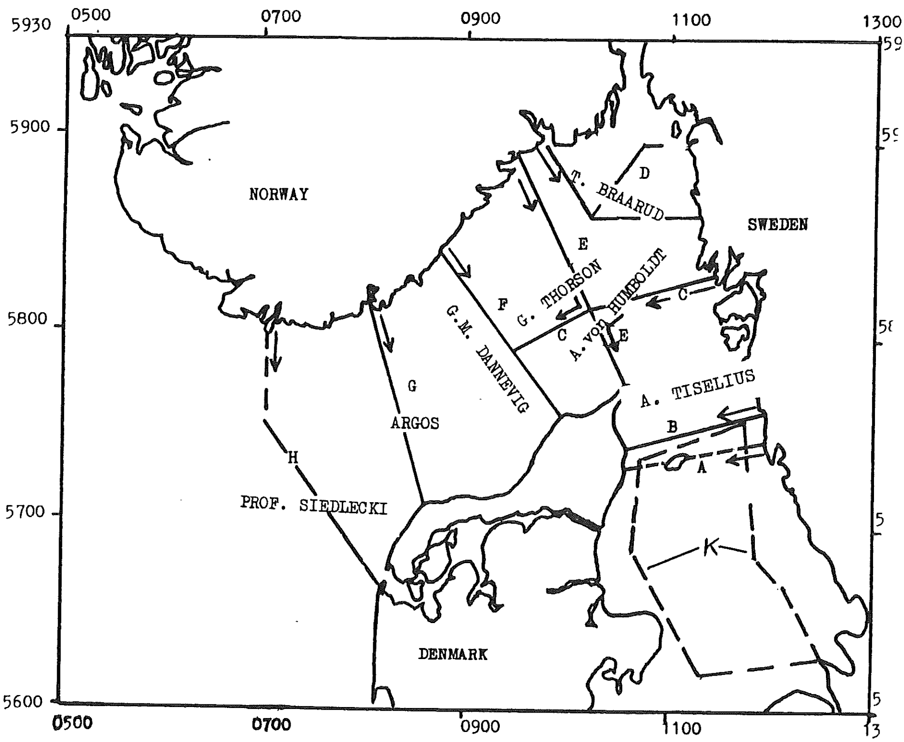
Fig.2 FIRST PART OF THE SYNOPTIC PERIOD



Remarks

1. Days for obligatory measurements: May 24, 27 and 30, June 2 and 5.
2. The vessel A. VEIMER has section F as its main section but it will carry out measurements of physical and chemical parameters during night-time at section E.
3. In case of bad weather conditions the vessels G.O. SARS and OCEANIA may change sections.

Fig.3 SECOND PART OF THE SYNOPTIC PERIOD



Remarks

1. Days for obligatory measurements: June 8, 11, 14, 17 and 20.
2. If the vessel PROF. SIEDLECKI cannot take part due to repairing works, the vessel ARGOS will undertake measurements of physical and chemical parameters during night-time at section H.
3. During non-obligatory days G.M. DANNEVIG will carry out measurements at section A.

<u>May:</u> 24, 27 and 30

<u>June:</u> 2, 5, 8, 11, 17 and 20

An intercalibration exercise will take place in Arendal, Norway, June 6-7.

It was furthermore decided to in principle establish the following starting scheme for the indicated sections:

<u>1st period:</u>
Section A and B; starting from the west (Danish side)
Section E-H; starting from the south (section C included).
Section D; cross section starting from the Swedish side;longitudinal section can start anywhere.

<u>2nd period</u>
Section A,B and C; starting from the east (Swedish side)
Section E-H; starting from the north
Section D; cross section starting from the Norwegian side; longitudinal section can start anywhere.

5.CURRENT MEASUREMENTS WITH MOORED EQUIPMENT

5.1 Introduction

Synoptic measurements of currents is an obligatory parameter during SKAGEX and as such of fundamental importance in order to investigate the water exchange, the response patterns of mass and velocity fields and how the dynamics affect the distribution of chemical parameters and biological processes.
The Study Group decided in view hereof at the meeting in Gdynia to establish two main sections with moored equipment.

5.2 Mooring stations

Recording current meters will be stationed at the sections A, G and F as indicated in Figure 4. At section A the number of stations amounts to 7 and at section G t9o 11 with one additional station to the east of Hanstholm (position 57.10,0(N),08.35,0(E) or the same as the hydrographical station?). At section F the USSR research vessel PLUTON will deploy 4 RCM at another two stations, which implies an increased coverage of the Jutland Current. A total of about 70 RCM will be deployed.The number of RCM per station and their country of origin are also indicated in Fig.4.

In Table 3 a specification of the deployment of the Recording Current Meters is presented. The vessels ATAIR, GAUSS and SVANIC will, as can be seen, be responsible for most of the work of the disposal and collection of the current meters.

In Fig. 5 there is a principle example of a Recording Current Meter Rig, stationed at station 2 of the G-section with a total

The Låsö-section

Station	Latitude (N)	Longitude (E)
1(7)	57.20.7	11.49.5
2(6)	57.19.8	11.42.6
3(5)	57.18.9	11.34.3
4	57.18.0	11.26.2
5(3)	57.17.2	11.18.0
6(2)	57.15.4	10.45.2
7(1)	57.15.6	10.40.0

Note
Former station numbers within bracket

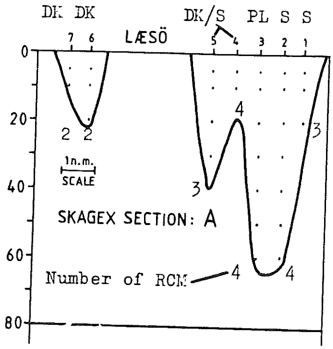
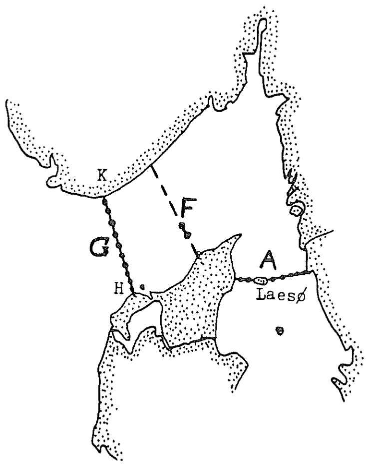
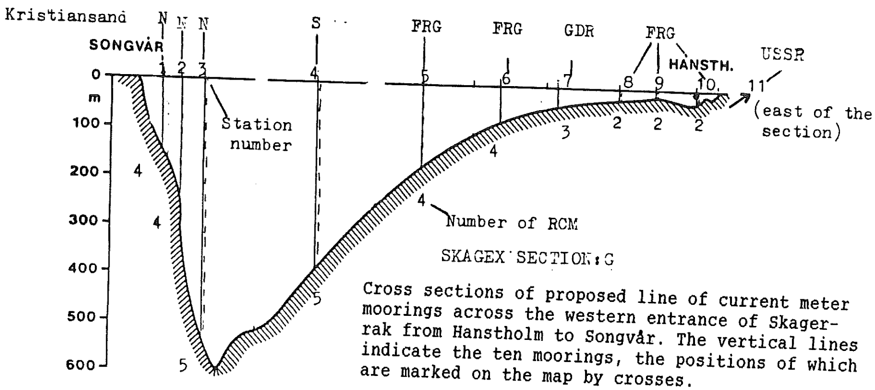


Fig 4 Mooring stations



The section Kristiansand - Hanstholm

Station	Latitude (N)	Longitude (E)
1	58.00.7	07.52.9
2	57.58.5	07.54.7
3	57.56.4	07.56.7
4	57.45.5	08.05.3
5	57.35.8	08.12.8
6	57.28.5	08.18.5
7	57.23.0	08.22.9
8	57.16.7	08.27.9
9	57.13.3	08.30.5
10	57.09.4	08.33.6
11	57.52.0	09.30.0



Cross sections of proposed line of current meter moorings across the western entrance of Skagerrak from Hanstholm to Songvår. The vertical lines indicate the ten moorings, the positions of which are marked on the map by crosses.

Vertical exaggeration 92.6

Table 3

LAESÖTRANSECT (section A)

	CURR.MET OWNER DOWN BY	UP BY
1 (7).	SWEDISH SVANIC	SVANIC
2 (6).	SWEDISH SVANIC	SVANIC
3 (5).	POLISH HYDROMET	SVANIC
4.	DANISH/SWEDISH SVANIC	SVANIC
5 (3).	DANISH/SWEDISH SVANIC	SVANIC
6 (2).	DANISH SVANIC	SVANIC
7 (1).	DANISH SVANIC	SVANIC

Period of deployment: 20 24 28 1 5 9 13 17 21

May June

HANSTHOLM - KRISTIANSAND - TRANSECT (section G)

	CURR.MET OWNER DOWN BY	UP BY
1.	NORWAY NORW. VESSEL	NORW.VESSEL
2.	NORW. (GEOPH.INST) G.O. SARS	NORW.VESSEL
3.	NORW. (GEOPH.INST) G.O. SARS	NORW.VESSEL
4.	SWEDEN (SMHI) ATAIR	ARGOS
5.	FRG ATAIR	GAUSS
PLUTON		
6.	FRG ATAIR	v.HUMBOLDT
PLUTON		
7.	GDR ATAIR	GAUSS
8.	FRG ATAIR	GAUSS
9.	FRG ATAIR	GAUSS
10.	FRG ATAIR	GAUSS
11.	ESTONIA VEIMER	VEIMER

Comments

- Observe that the original station numbers at section A have been changed
- Dashed line indicates the work of putting out and taking in the instruments
- The instruments moored by the vessel PLUTON will be stationed to the east of section G at section F.

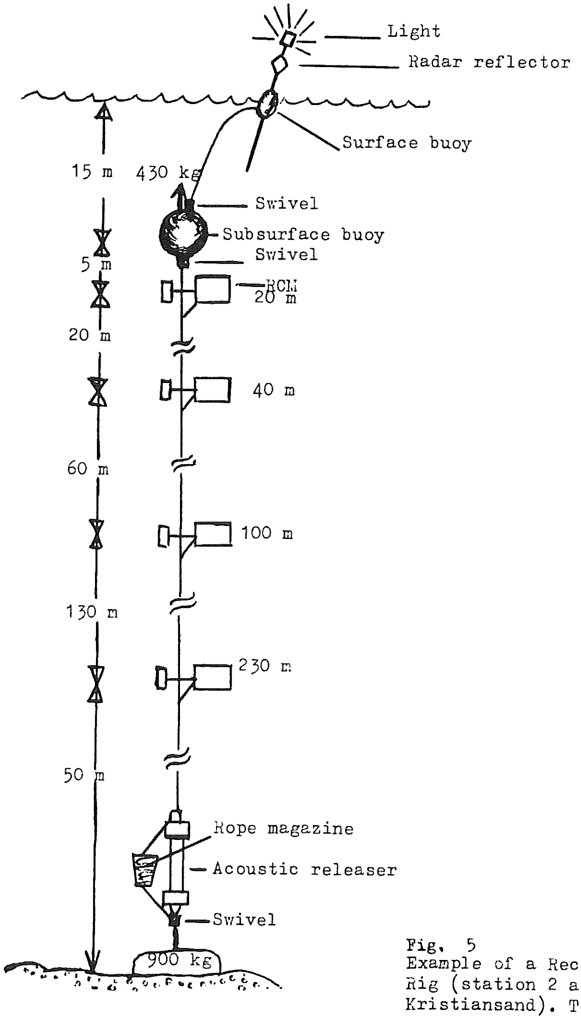


Fig. 5
Example of a Recording Current Meter Rig (station 2 at the section Hanstholm-Kristiansand). Total depth is 280 m.

depth of 280 m.

5.3 Intercalibration and models.

The Study Group stated that the moored current meters should be calibrated by the respective owners.

At the Meeting in Kiel it was decided that Dr O Andrejev should continue his work to develop models for the Skagerrak. SMHI, Sweden, has supplied him with additional data from that area.

6. MEASUREMENTS AT THE SECTIONS A,B,C,D,E,F,G AND H

6.1 Hydrographical stations

The positions of the hydrographical stations of the respective section are indicated in Annex 3.

6.2 Current measurements on the route

Obligatory current measurements meant to be undertaken by the participating vessels on the route are indicated in Table 4. The vessels will for these measurements,as can be seen, use Conductivity-Temperature-Depth-Recorders (CTD), Acoustic Doppler Current Profiler-meters (ADCP) and gelatine pendulum current meters. Vessels not having CTD will measure salinity and temperature (S and T).

Table 4 Vessels carrying out current measurements **en route**

PERIOD	VESSEL	CTD	ADCP	CP
May 24 - June 6	ATAIR	x		
	G.O.SARS	x	x	
	L. TITOV	x		
	SVANIC	x		x
	OCEANIA	x		
	A.VEIMER	x		x
	Hydromet	CSTD		
	T.BRAARUD	x	x	
June 8 - 20	SVANIC	x		x
	T. BRAARUD	x	x	
	A.v. HUMBOLDT	x		x
	G.M. DANNEVIG	x		
	PROF. SIEDLECKI	x		
	ARGOS	x		
	G.THORSON	x		
	A. TISELIUS	x		
	GAUSS	x		

Acronymes

CTD = Conductivity-Temperature-Depth Recorder

ADCP = Acoustic Doppler Current Profiler-meter

CP = Current profile measured by means of gelatine pendulum current meters

6.3 Calibration of CTD

6.3.1 Calibration

The following presentation is a short version of SCOR WG 1 Report dealing with T, P and C sensors.

Preliminary remark: as of 1st Jan 1990 the temperature scale has been changed by the International Committee for Weights and Measures, viz.:

$$T_{68} = 1.00025 * T_{90}$$

If you get your calibrations done by third party agencies please check with them which scaling has been used. Under Skagerrak conditions the salinity will be calculated wrong by ~.003 if the new temperature scale is used as input to the PSS78 salinity calculation. In calculating derived quantities , e.g. density you have to transform back to T_{68} anyway.

Calibration is usually carried out under static (atmospheric) pressure. This seems to be sufficient, since most CTD thermometers are not directly exposed to pressure; otherwise a truly strainfree thermometer would give a pressure induced misreading of ~0.04 K/km depth. The conductivity cell of CTDs is usually at hydrostatic equilibrium with its surroundings.

The laboratory calibration procedure as described in this report and used at Woods Hole (WHOI) is as follows.

The use of a reference unit which is fully calibrated at a standards laboratory is required. The CTD to be calibrated is set into a temperature controlled bath where the reference unit is already located. The bath contains saltwater of approx. 35‰ salinity. The water in the bath is stirred well and special care is taken, that water is flowing through the conductivity sensor. The temperature of the bath is changed slowly from the lowest value desired to higher values, thus changing conductivity as well. Temperature and conductivity readings are taken from both instruments. According to the deviations found corrections to the readings of the instrument under calibration are applied, usually in form of a polynomial of moderate order to give the best fit in a least squares sense.
The instrument's absolute temperature error can be checked at the triple points of several substances, e.g. water ~0^{0}C Phenoxybenzene ~28^{0}C and Ethylene Carborate at ~36^{0}C.
The pressure sensor is calibrated by means of a deadweight tester.

<u>These calibrations should be carried out before and after each cruise</u>.

During each station salinity samples should be taken by rosette samplers or at least by one bottle attached closely (~2 m) above the CTD probe on the CTD wire. These samples should be taken at depths with low variation in salinity and temperature. The bottle

salinities are converted to in situ conductivities and compared to the CTDs readings. Note that salinity determinations aboard a ship are often not as accurate as when done in a shore based laboratory, because the laboratories air temperature is usually "poorly" controlled aboard ships.
Temperature readings should be controlled as well, but the only mercury thermometers that can be read to approximately the same accuracy as a CTDs thermometer are the $-2\,^{\circ}C$ to $+2\,^{\circ}C$ range thermometers. Hence the recommendation is to have 2 independent thermometers built into the CTD.

Following these rules strictly one can determine slow drifts of the sensors in time.

Avoid calibrating the analog electronical devices in the probe, unless a new sensor is mounted.

The full title of the UNESCO report is:

UNESCO Technical Papers in Marine Science, No. 54, The acquisition, calibration and analysis of CTD data, a report of SCOR Working Group 51, Paris 1988.
This report is available from Division of Marine Sciences, Unesco, Place de Fontenoy, 75700 Paris, France.

6.3.2 Remarks

The salinity range to be expected during SKAGEX is from 35.4 to about 20, with values < 25 to be found south of the line Skagen - Göteborg and in nearshore waters. It is recommended not only to use the Wormley Water of the K series at salinity 35 bur also L series water with salinity 30.

PEX showed that there were no major difficulties with salinity determination. A salinity intercalibration would at best establish the same fact. If good laboratory practice is exercised and check measurements are carried out often and regularly with Standard Seawater, a quality check is provided for the absolute accuracy of the measurements.

All bottle salinity values should be reported together with associated uncorrected and corrected CTD readings, to enable assessment of the accuracy of salinity determination. The control measurements of standard water for salinometer drift checks are to be submitted too.

Standard Seawater for the laboratory calibrations can be bought from NCM, Copenhagen, or from Ocean Scientific International Ltd, Brook Road, Godalming, Surrey GU-5-UB, United Kingdom.

At the meeting in Gdynia the Study Group further discussed the possibility of having a common CTD comparison exercise just outside Arendal, at a depth of 300-400 m and then compare the results at the intercalibration exercise 6-7 June 1990. It was decided to carry out such a CTD exercise. The CTD shall be lowered when the respective vessel is passing into Arendal (June 5-6) at the station F3 (58.16.00 N; 8.59.00E), where the depth amounts to 400 m. The deep parts of the salinity and temperature curves are to be compared with the curves form other ships at Arendal at the chemical intercalibration.

6.4 Particle counting and investigations of the water colour

Since at least four of the participating vessels had announced that they had equipment for particle counting the Study Group discussed at the meeting in Gdynia the performance of such counting. It was ,however, recommended to have this parameter as a voluntary one.

At the same meeting Mr F. Beyer, Norway, presented a method for the measurement of the colour of oceanic water. He then referred to the paper "Colour of the ocean as an indicator in photosynthetic studies" by N. Höjerslev, N.G. Jerlov and G. Kullenberg and published in J. Cons. int. Explor. Mer, 37(3): 316-318 (Annex 4).

This parameter could in a relativly simple way give information on compensation depth, the characteristics of a water mass etc and should be especially relevant to correlate to remote sensing results. The Study Group took note of the fact that adequate instrumentation had to be delivered to all vessels that wanted to investigate the water colour according to this method.

6.5 Sea level stations

At the meeting in Kiel it was recommended to establish 8 tide gauge stations at the Norwegian and Swedish coasts during the synoptic period of SKAGEX. Later on it has been cleared out that gauge stations will also be established along the Danish coast. The sites of the stations are to be found in Annex 5 .

6.6 Chemical parameters

6.6.1 Introduction

The Study Group has noted that the measurement of chemical parameters will enable them to identify the various water masses in the Skagerrak and their variation in time, fulfilling objective a) of the ICES resolution.It has also been stressed that another aim of the chemical investigations would be to produce a nutrient budget. This budget could elucidate the transports between the Skagerrak and the adjacent water areas.

At the meeting in Kiel Dr M. Pertillä, Finland, gave some preliminary information about the results of the ICES intercalibration on nutrients etc. Totally 84 laboratories had been engaged, while 65 had responded. The results seemed to be relatively good as to nutrients. At the meeting in Gdynia, thus after the meeting of the Marine Chemistry WG, 12-16 February 1990, Mr K. Jancke, ICES, gave some more information about the exercise. One result noted was that data were consistent with time with reference to ship.

The Study Group took at the meeting in Gdynia note of an invitation from Dr D. Kirkwood, Ministry of Agriculture, Fisheries and Food, Fisheries Laboratory, Lowestoft, to take part in a nutrient intercalibration exercise to be arranged in the United Kingdom in 1990. It was recommended that those who wanted could participate.

6.6.2 Depths

The depths to be used are the ICES standard depths, where 1m and 5m have to be taken separately at the deeper stations, as there are only 10 to 11 water bottles on the Rosette sampler.
Then the depths are:
10, 20, 30, 50, 75, 100, 125, 150, 200, 250, 300, 400, 500, 600, 700 m and the last one close (10 m at the deeper parts) to the bottom.
The depths to be ignored at the deeper stations are with priority the following: (1) 250m, (2) 125m, (3) 75m, (4) 150m and (5) 500m.

At the more shallow stations it is recommended that those who can sample more than the standard depths, should try to describe the vertical profile in more detail, especially in the pycnocline.

6.6.3 Nutrients to be analyzed

The samples should <u>not</u> be filtered prior to analysis.

1.	Phosphate, PO_4,	Mandatory for all ships
2.	Nitrate & nitrite, NO_3+NO_2	" " " "
3.	Nitrite, NO_2	Voluntary but preferable
4.	Silicate, Si	Mandatory for all ships
5.	Ammonia, NH_3	Voluntary
6.	Total phosphorus, tot. P	Voluntary for ships analyzing this on a routine basis
7.	Total nitrogen, tot. N	Voluntary for ships analyzing this on a routine basis
8.	Dissolved oxygen, O_2	Voluntary, but preferable on cross sections

6.6.4 Intercalibration of nutrients

Standard solutions for PO_4, NO_3, NO_2 and Si will be prepared by Dr H.P.Hansen, Kiel, and delivered to the participants from the Baltic countries prior to the start of the cruises.

Chemicals, P.A. quality, for standardization purposes, will be distributed to the participants from the Baltic countries by Mr L. Föyn, Norway.

The intercalibration will take place in Arendal, Norway, June 6-7 1990. Samples from some stations (full vertical profile) representing the various regimes in the Skagerrak/Kattegatt (at least three from each area) will be collected by R/V G.O. Sars (L. Föyn). The samples will be analyzed immediately on board. Samples from the dedicated stations will be stored and delivered to each participating ship in Arendal upon arrival in the morning of June 6.

A volume of 0.5 l will be delivered to those analyzing after manual methods and 0.1 l of water to those performing automatic analyses.

The intercomparison samples have to be treated on a routine procedure. The results shall be plotted as vertical plots by each analyst. Forms for plotting and reporting the results will be delivered together with the samples, as will also be the salinity and temperature values for the stations.

The results from the intercomparison will be discussed in a meeting for the participating chemists. A preliminary treatment of the results will be reported as soon as possible. Later on a statistical treatment of the results from the intercomparison exercise will be left to ICES.

The denomination for nutrients should be umol/cubicdecimeter.

6.6.5 Preparation of the nutrient results

The responsible chemist should work up the data and plot them on standard profiles provided each participating vessel prior to SKAGEX (cf. Annex 11). The chemist should also draw the isolines on the plots, using 1 umol/cubicdecimeter difference for NO3 and Si, and 0.1 umol/cubicdecimeter for PO4 and NO2.

For the reporting of the results to ICES, participants will be provided with an ASCI-format by ICES.

6.6.6 Other calibrations

For the calibration of oxygen the method was recommended which is used by HELCOM in the Baltic (ICES-method).

6.7 BIOLOGICAL INVESTIGATIONS

6.7.1 In situ fluorescence

In situ fluorescence should be measured at every obligatory station from surface down to at least 30 m depth in order to look for subsurface concentrations of phytoplankton. The relative fluorescence signal should be calibrated against chlorophyll measurements of discrete samples.

It is recommended to profile fluorescence in the same way at the non-obligatory stations.

6.7.2 Chlorophyll

In order to scale the fluorescence signal five (5) chlorophyll samples should be taken at every station. The depths for these samples are:

1 m,
5 m,
10 m,
in the flourescence peak (if there is no peak, the sample should be taken from the pycnocline),
at the first standard depth below the peak sample/pycnocline sample.

Samples for chemical analyses should be taken from all the depths sampled for chlorohpyll a.

Chlorophyll a and sea surface temperature (SST) and salinity measurements should be carried out half-way between the hydrographic stations, at least those days when there is a satellite passage.

It is recommended to obtain chlorophyll samples in the same way at the non-obligatory stations.

The depth accuracy is of importance in order to compare the chlorophyll value with the fluorescence signal.
The chlorophyll sample should be filtered through a glass fiber filter, Whatman GF/C, or a membrane filter. The analysis should be performed according to the normal procedure of the laboratory in question. This may mean that different amounts of water need to be filtered depending on the use of spectrophotometric or flourometric analysis. Different solvents may also be used.

As there will be an intercalibration exercise in Arendal (see above) it was felt that differences in the procedure between the laboratories is a better way of achieving data of a good quality, than if many laboratories have to adopt an unknown procedure for the chlorophyll analysis.

Chlorophyll a should be calibrated during the calibration meeting in Arendal, Norway, 6-7 June 1990.

6.7.3 Phytoplankton

Samples for phytoplankton counts should be taken at every obligatory station. The depths are the same as for the chlorophyll samples, i.e.:

1 m,
5 m,
10 m,
in the fluorescence peak (if there is no peak the sample should be taken from the pycnocline)
at the first standard peak below the peak sample/pycnocline sample.

The sample volume should be set so that scanning onboard can be performed in addition to the standard analysis.

In order not to loose species that may be of importance, duplicate samples should be taken from every depth. One sample should be preserved with acidified Lugol's solution and the other with neutralized formalin (to preserve coccolithophorids).

The formalin solution should be of a strength of 20 % and neutralized i.e. 0.5 l of 40 % formalin, 0.5 l of destilled water and 100 g of hexamethylenetetramine. The solution should be filtered. 2 ml of the filtered solution should be added to a 100 ml brown bottle to get 0.4 % formalin solution in the phytoplankton sample.

One ml Lugol's solution should be added to each 100 ml sample. The samples should be kept in darkness.

It is important that phytoplankton samples are scanned immediately on board the ship, to get an overview of the plankton flora. The results should be quickly exchanged with other participants in SKAGEX. When having this overview it will later be possible to decide about the samples that will need a full analysis. This decision will be taken in Lysekil immediately after the synoptic part of SKAGEX.

For microscopic analysis on board the three samples from 1 m, 5 m and 10 m should be mixed, giving a mean from the upper 10 m of the sea. In addition one counting from the fluorescence maximum layer should be conducted to give an overview during the cruise.

Scanning procedure:
If an inverted microscope is not used a Palmer/Mallony (0.1 ml), Sedgwick-Rafter (1 ml) or any approriate chamber may be used. If not available, centrifugation of water samples may also be carried out in order to get an idea of the plankton flora.

Recommendations on the microscopic examinations will be given later on in a special manual.

As non-obligatory addition, net samples, using 20 um net, should be taken.

It is recommended to obtain phytoplankton samples in the same way at the non-obligatory stations.

6.7.4 Primary productivity

Potential primary productivity should be measured at every station at all the obligatory transects. A few ships will not be able to perform such measurements. Three parallel light bottles and one dark bottle from a mixed sample from 1 m, 5 m and 10 m should be incubated. Each bottle should be spiked with 0.2 ml of Carbon 14 (10 uCi/ml) and incubated for 2 hours in the "ICES-incubator", which will be delivered by Dr L. Edler,Sweden. The light level in the incubator should be 350 uEinstein/m2 s, and the temperature should be equal to the sea surface temperature.

After incubation the samples are filtered through 25 mm diameter glass fiber filters, Whatman GF/C, which are then placed in properly marked scintillation vials. Addition of cocktail and analyses will take place later on at one laboratory.

It is recommended to measure primary productivity in the same way at the non-obligatory stations.

Filters for the determination of chlorophyll a and for the primary productivity measurements and the Carbon-14 ampoules will be delivered to each participating vessel.

6.7.5 Zooplankton

Zooplankton samples should be taken on all obligatory sections on the following dates:

May: 24
June: 2,8 and 17.

One haul with WP-2 net (200 um mesh) should be made from 150 m depth (at the vicinity of the bottom if the depth is less than 150 m) and closed at the lower level of the pycnocline without stopping the winch.
Another haul should be made from the lower level of the pycnocline to the surface.

Due to lack of time it will probably be impossible to take zooplankton samples at every station during daylight. The hours of good daylight suitable for biological sampling will be from about 03.30 GMT to about 19.00 GMT in the beginning of the synoptic period, and from about 03.00 to about 19.30 GMT in the end. This means that there will be a period of about 16 hours of good daylight.

It has been agreed that the hydrographical measurements should be given the highest priority. If time is running short (e.g. due to technical problems or weather conditions) one may have to leave out zooplankton sampling from one or more stations in order to be able to complete the section within dusk. Since zooplankton sampling is supposed to be of greater importance on some stations than on others, a preference ranking list for zooplankton sampling is given below for each of the sections. The stations within each section that are considered to be of greatest importance with respect to zooplankton are listed first

Section A: 7, 1, 3, 5, 2, 6 and 4.

Section B:1(GF4), 6(GF9), 4(GF7), 3(GF6), 5(GF8) and 2(GF5).
Section C-E (vessel one):E12, E11, C1, C3, C6, C4, E9 and E10.
Remaining stations may be taken without any ranking.

Section E (vessel two): 1, 2, 6 and 3.
Remaining stations may be taken without any ranking.

Section D: Sub-section Stt 1-10: 9, 3, 5, 10, 1 and 7.
Sub-section Stt 11-16: 15, 16, 13 and 11.
Remaining stations may be taken without any ranking.

Section F: 12, 1, 2, 10, 6, 11 and 8.
Remaining stations may be taken without any ranking.

Section G: 11, 2, 10, 4, 9, 5 and 7.
Remaining stations may be taken without any ranking.

Section H: 15, 14, 6, 12, 8, 10 and 7.
Remaining stations may be taken without any ranking.

The WP-2 nets should not be stained.

The nets should be closed just at the lower end of the pycnocline. If there is no pycnocline the net should be hauled up to the surface.

Measurements of the potential, secondary production will be carried out as voluntary investigations.

A workshop on the technique for those measurements will take place at Kristineberg Marine Biological Station in April 1990.

It is recommended that the measurements of the secondary production be carried out in the frontal zones on the 3rd day after the day of obligatory measurements. The secondary production measurements should be conducted in daytime in combination with the measurements of the potential primary production.
The following vessels are foreseen to undertake measurements of the secondary production in the indicated areas:

Synoptic period one:
Skagerrak-Kattegatt: A. Veimer and L. Titov.
Skagerrak/North Sea: G.O. Sars

Synoptic period two:
Skagerrak-Kattegatt: A.Tiselius or Argos, A. von Humboldt and G.Thorson.

Skagerrak/North Sea: Argos or Argos and Prof. Siedlecki.

The decision on which samples to be counted should be taken in Lysekil immediately after the completion of the synoptic period. It is recommended that some microscopic inspection of the zooplankton samples should, if possible, be undertaken on board the vessels to obtain a rough idea of the species composition.

Displacement volumes, dry weight etc. should be measured on land after the synoptic exercise. All samples should be divided into two parts.One part should be stored for general use by SKAGEX participants.

A species list will be given later on to ICES so that a Robin code can be worked out.

It has been informed that an analysis of a zooplankton sample at the Polish Sorting Centre in Szcsecin will cost about 40$.

6.8 REMOTE SENSING ACTIVITIES

6.8.1 Historical satellite data

The remote sensing group will provide each participating group with a compilation of NOAA, AVHRR sea surface temperature images of the Skagerrak area for the period 1980 to 1989. The compilations will be distributed according to agreed mailing list before 1 May (responsible: U. Horstmann, IFM).

6.8.2 Pre- SKAGEX satellite data

The Skagex management and coordination group will be provided with AVHRR infrared and occasional visual images from 7 May to the start of the experiment. The images will be mailed daily to the members of the group. If interest is expressed, images that are judged to be particularly interesting may also be mailed to a limited number of group leaders according to agreed mailing list (responsible: Thompson/Håkansson, SMHI).

6.8.3 Real time satellite data

It is assumed that the Skagex co-ordination group will be located at the Marine Forecasting Services at SMHI in Norrköping. The group will have access to all satellite information received in real time. The most useful information will be the NOAA AVHRR data where information from 5 channels can be processed.

In most cases only orbits with an elevation higher than 60 degrees above the horizon will be processed for SKAGEX and this will imply 2 - 4 passages per day. These data will be stored for later use within the project. The area will be 55,30 - 59,30 degrees N and 05 - 13 degrees E. In situations with favourable cloud conditions a larger area including most of the North Sea and southern Baltic will be stored.

6.8.4 SST and surface pattern maps

Based on the AVHRR information and **in situ** observations received in real time from coastal stations and ships SST-charts will be prepared.
If useful information on e.g. colour patterns and algal blooms can be obtained from the visual channels also these will be drawn on maps.
The SST- and surface pattern maps will be transmitted to all ships having expressed their interest and having NMT and connected fax.

6.8.5 Aircraft data

The Swedish Coast Guard may be prepared to fly their maritime surveillance system on several occasions provided not in conflict with other priority operations. The aircraft is equipped with:

1. SLAR with a ground resolution of 75x75 m and swath widths up to 2x80 km.
2. IR scanner, ground resolution 2 meters and better than 0.5 degrees C. Swath width: 2 x flight level.
3. UV scanner
4. Microwave scanner 35 GHz
5. Camera systems

The SLAR data may provide useful information about water masses, current shear zones and other processes that affect the capillary wave pattern.
The IR scanner may be used for mapping detailed features of the SST.
The microwave scanner may provide information on SST and surface winds but the experiences with this instrument is limited in Sweden today. It may, however, be useful to try one or two swaths for a possible later use.
The data will be recorded on tape and further processed after the experiment. No real time use of the data is envisaged.

A very interesting Synthetic Aperture Radar (SAR) has recently been developed in Denmark and flown on a Danish Airforce jet aircraft (Gulfstream). Contacts will be taken with the Electromagnetic Institute at the Technical University of Denmark to find out if this SAR can be flown over the SKAGEX area. The SAR has a resolution of 2 m and may provide information on the same parameters as the SLAR but of a superior quality.

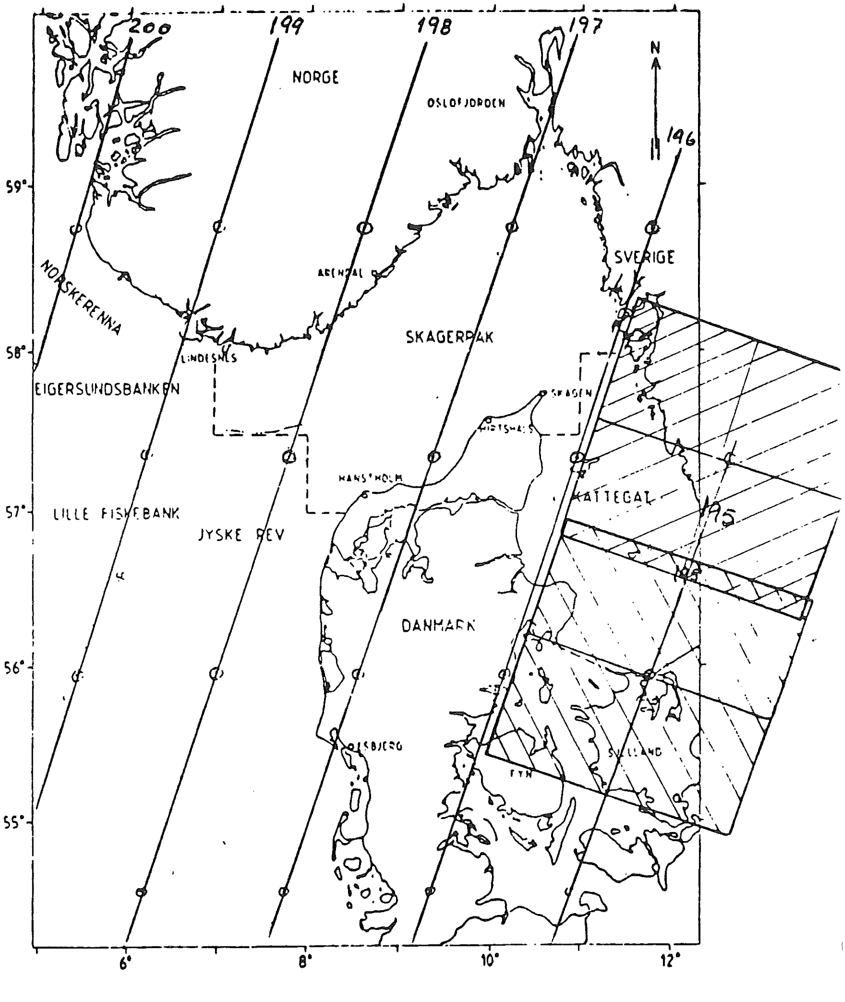
6.8.6 High resolution LANDSAT data

LANDSAT 5 will pass over the SKAGEX area 15 times during the period 17 May - 29 June giving 70 possible TM scenes of the size 50 x 50 nm. How many of these will be useful for the experiment will depend on the cloud situation at the time of the passage. Maps showing the dates and the coverage for each orbit is given in Figures 6-10. By overlaying these on the maps showing the expedition scheme it can be seen which ships will be under the LANDSAT cover the actual dates. It is important that these ships be equipped to measure the following parameters:

a. the depth of the photic zone (secci disk depth),
b. the chlorophyll concentration at several depths (surface, 5m, and 10m),
c. humus at several depths,
d. total suspended matter (TSM) at several depths (surface to 20m)
e. SST

A list of potential ships for making the above measurements is given in Table 5. Tha table also gives the actual dates and the area of satellite cover.
After SKAGEX, SMHI will analyse the cloud conditions from quick look images and list the number of useful scenes. SMHI will, within the framework of an ongoing chlorophyll project, purchase and process 2 or 3 TM (Thematic Mapper) scenes. These scenes will be a valuable base on which to decide on the usefulness of the

Fig 6



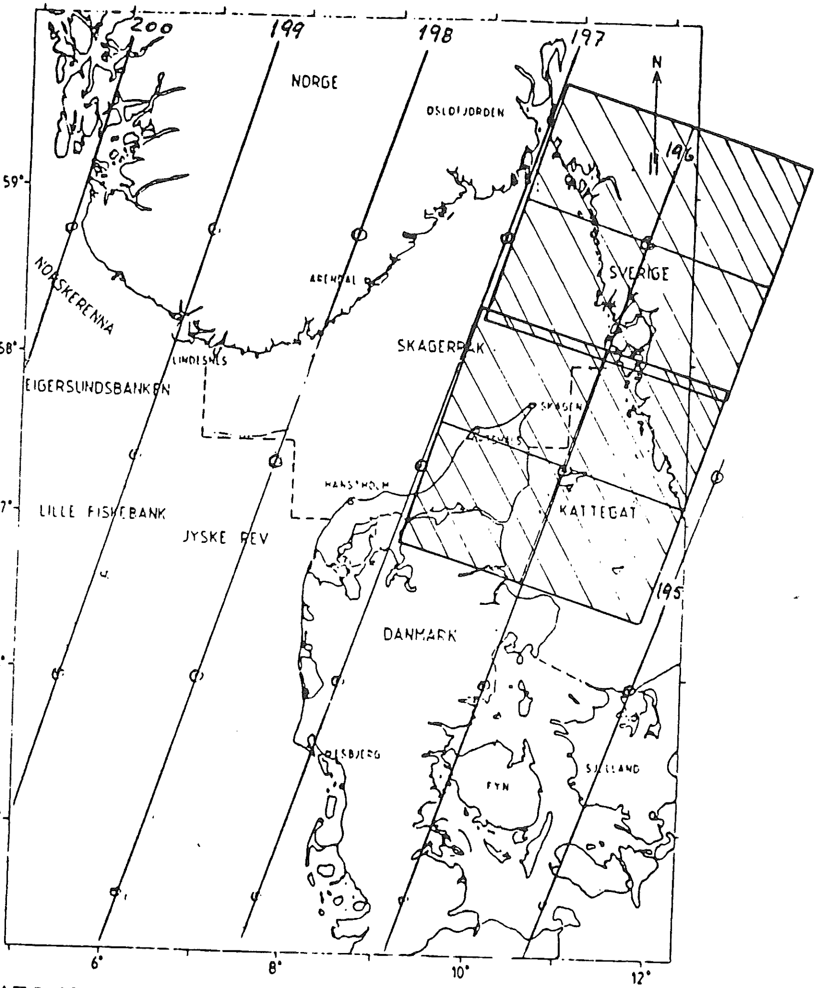
LANDSAT 5 Nominal Scene area and Paths over Kattegat, Skagerrak and North Sea

Date of passes during spring 1990: (preliminary)

Track: 195 Dates: 21 May, 6 June, 22 June

The circles along the paths indicate the centre of a scene of the size 185 by 185 nm. The nominal scene is divided into 4 TM scenes. The cost of a TM scene is approximately 14.000 SEK.

Fig 7



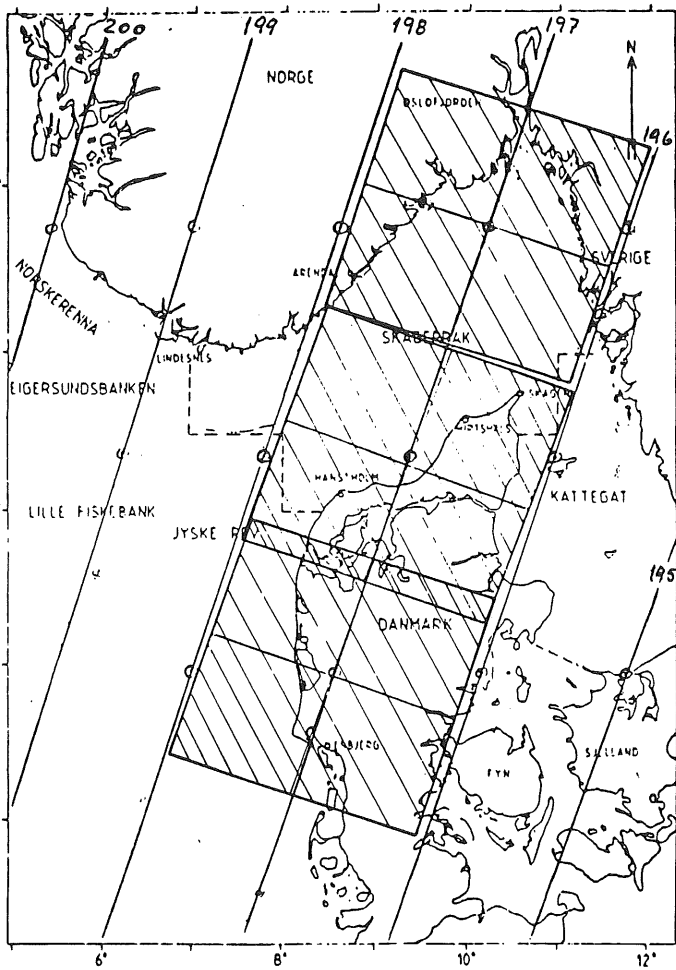
LANDSAT 5 Nominal Scene area and Paths over Kattegat, Skagerrak and North Sea

<u>Date of passes during spring 1990:</u> (preliminary)

Track: 196 Dates: 28 May, 13 June, 29 June

The circles along the paths indicate the centre of a scene of the size 185 by 185 nm. The nominal scene is divided into 4 TM scenes. The cost of a TM scene is approximately 14.000 SEK.

Fig 8



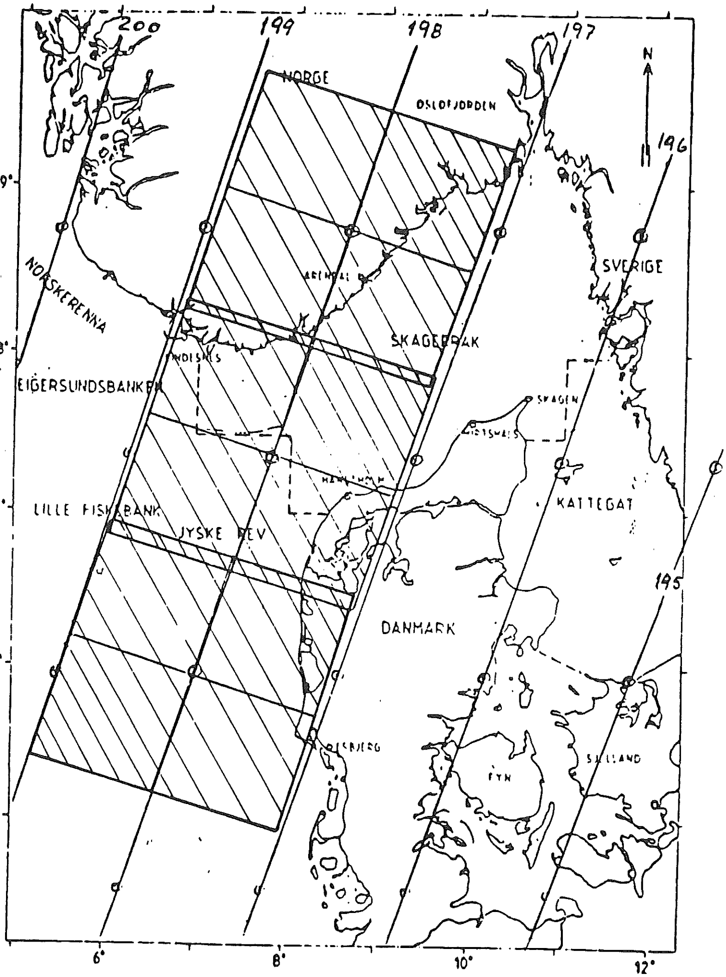
LANDSAT 5 Nominal Scene area and Paths over Kattegat, Skagerrak and North Sea

Date of passes during spring 1990: (preliminary)

Track: 197 Dates: 19 May, 4 June, 20 June

The circles along the paths indicate the centre of a scene of the size 185 by 185 nm. The nominal scene is divided into 4 TM scenes. The cost of a TM scene is approximately 14.000 SEK.

Fig 9



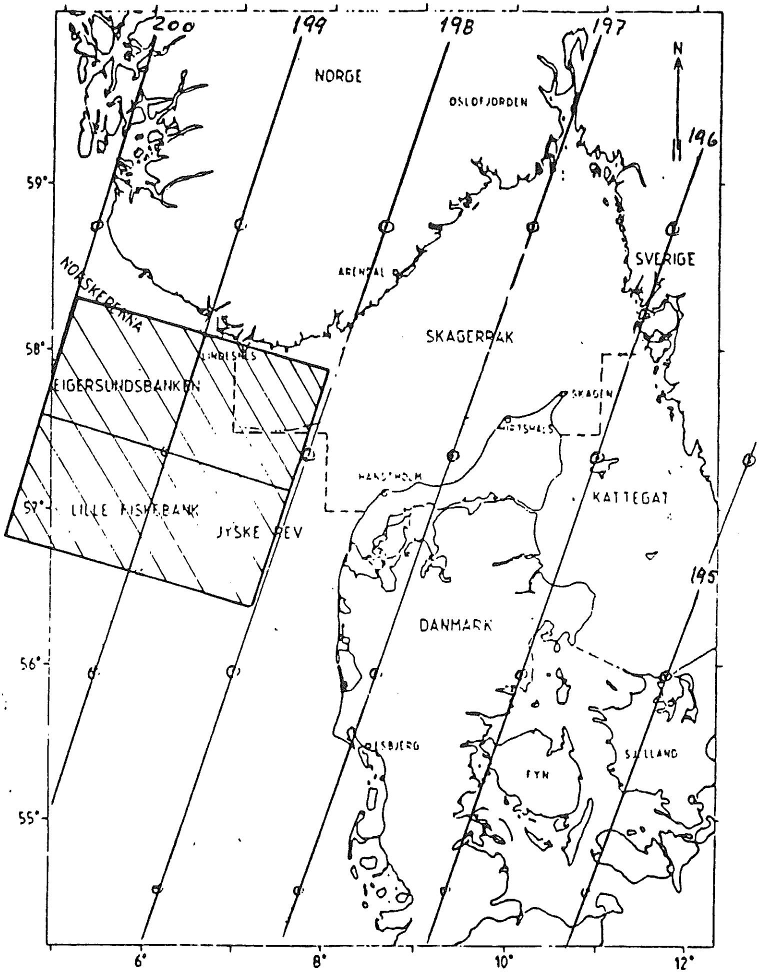
LANDSAT 5 Nominal Scene area and Paths over Kattegat, Skagerrak and North Sea

<u>Date of passes during spring 1990:</u> (preliminary)

Track: 198 Dates: 26 May, 11 June, 27 June

The circles along the paths indicate the centre of a scene of the size 185 by 185 nm. The nominal scene is divided into 4 TM scenes. The cost of a TM scene is approximately 14.000 SEK.

Fig 10



LANDSAT 5 Nominal Scene area and Paths over Kattegat, Skagerrak and North Sea

Date of passes during spring 1990: (preliminary)

Track: 199 Dates: 17 May, 2 June, 18 June

The circles along the paths indicate the centre of a scene of the size 185 by 185 nm. The nominal scene is divided into 4 TM scenes. The cost of a TM scene is approximately 14.000 SEK.

Table 5

Sections	Name of section	1st period MAY 24	27	30	JUNE 2	5	2nd period 8	11	14	17	20
H	Limfjord	–	198 26 GOS	GOS	199 $\boxed{\text{GOS}}$	GOS	SIE	198 $\boxed{\text{SIE}}$	SIE	SIE	199 18 SIE
G	Hanstholm	OCE	198 26 OCE	OCE	OCE	OCE	ARG	198 $\boxed{\text{ARG}}$	ARG	ARG	ARG
F	Hirtshals	AV	198 26 AV	AV	AV	AV	GDA	198 $\boxed{\text{GDA}}$	GDA	GDA	GDA
E	Skagen- E 8	LT	LT	196 28 LT	LT	197 4 LT	AVH	AVH	196 13 AVH	AVH	197 $\boxed{\text{AVH}}$
E	E 8-Norway	(AV)	(AV)	(AV)	(AV)	197 4 (AV)	GT	GT	GT	GT	197 –
C	E 8-Hållö	LT	LT	196 28 LT	LT	197 4 LT	AVH	AVH	196 13 AVH	AVH	197 $\boxed{\text{AVH}}$
C	E 8-Hirtsh.S	–	–	–	–	197 4 –	GT	GT	196 13 GT	GT	–
D	Oslo	B	B	196 28 B	B	197 4 B	B	B	196 13 B	B	197 $\boxed{\text{B}}$
A	Laesø	HYD	HYD	196 28 HYD	HYD	HYD	T	T	196 13 T	T	197 $\boxed{\text{T}}$
B	Laesø	T/S	T/S	196 28 T/S	T/S	T/S	S	S	196 13 S	S	S

199 $\boxed{\text{GOS}}$ and 198 26 - means dates of LANDSAT - passage and orbit number.

$\boxed{\text{GOS}}$ - means passage during obligatory day.

At those dates the ships should measure chlorophyll concentration, secchi disc depth, total suspended matter and sea surface temperature.

Chlorophyll a and sea surface temperature measurements should be carried out half-way between the stations, at least those days when there is a satellite passage.

ARG - ARGOS
AV - A VEIMER
AVH - Av.HUMBOLDT
B - BRAARUD
GDA - G DANNEVIG
GOS - GO SARS
GT - G THORSON

HYD - HYDROMET
LT - L TITOV
OCE - OCEANIA
S - SVANIC
SIE - SIEDLECKI
T - TISELIUS

LANDSAT data for SKAGEX (responsible: B. Håkansson, SMHI). One important condition for this is that a sufficient number of ships measure the variables a-d above.

6.8.7 Optical multifrequency spectrometer

According to the Marine Institute in Bergen (E. Svendsen) it may be possible to fly this instrument for a relatively low cost over the SKAGEX area, but the processing of the resulting enormous amounts of data will require funds of the order of 300-400 kNOK.

6.9 METEOROLOGY

6.9.1 Co-ordination group

Located at the Marine Forecasting Services at SMHI in Norrköping the group will have access to all necessary meteorological information. Through cooperation with the Ocean Monitoring and Forecast Programme in Bergen it is also intended to have wave and currents forecasts available.

6.9.2 Information to the participating ships

Special forecasts will be prepared for SKAGEX twice daily covering 3 sub-areas;

a. Kattegatt
b. Inner Skagerrak (east of the line Hirtshals - Arendal)
c. Outer Skagerrak (west of the line " - ")

The forecast length will be 12, 24, 48 and 72 hours and will include the following parameters:

- wind direction and speed
- air temperature
- wave height
- cloud cover

A special form (Annex 6) will be prepared on which these forecasts can be written. The form will also contain 4 maps for current forecasts. An example on how such a form could look like is given in Annex 7)
This form will be transmitted to the ships by dialled fax using the NMT system.

For the transmission of analyses of temperature and salinity a second form will be prepared.
On this form space will also be given for plain language information about other variables of interest such as distribution of nutrients, algal blooms, chemical and biological variables as judged as important information for the programmes of the ships. An example of a possible form is given in Annex 7.

6.9.3 Information from ships to coordination group

Every ship should fill out a meteorological log every 3 hours. A special log following WMO standards will be prepared by SMHI and distributed to all the participating ships. Every ship should ,however,contact their national meteorological service to obtain necessary observing instructions and to have their barometers and other instruments calibrated and checked. The checking is a normal duty of a Port Meteorological Officer.

The meteorological log will give preference to the following parameters:

- wind direction and speed
- surface pressure
- air temperature
- sea surface temperature
- waves
- total cloud cover

The observations should be transmitted to shore within half an hour of the observation times which are: 00, 03, 06, 09, 12, 15, 18 and 21 UTC. This should be done by radio station or by sending it by fax to the coordinating group. Telefax numbers will be announced later on.

7. MEASUREMENTS AT SECTION K

As has been indicated in Fig. 1 there is one section K extending into the Kattegatt. The positions for the different stations are indicated in Annex 3. These positions belong to standard stations of current monitoring programmes. At the meeting in Gdynia the Study Group especially discussed the merits of having one or more longitudinal sections crossing the transects.

The Polish vessel HYDROMET will during the first synoptic period carry out investigations along this more or less longitudinal section. Obligatory parameters will be measured but special attention will be devoted to the oxygen conditions in the southernmost part of the area.

8.SPECIAL PROGRAMMES

8.1 Collection of special data

At the meeting in Gdynia it was decided to collect and collate information on different types of outputs into the Kattegatt and the Skagerrak covering a period of some weeks prior to SKAGEX (river outlets, rainfall etc.)

8.2 Special investigations

During the non-obligatory days the participating vessels will conduct voluntary investigations indicated below:

Special investigation programmes

The programmes of the vessels are mainly given in chronological order.

VESSEL	PERIOD
G.O.Sars	May 19 - June 7

PARAMETERS

a) May 20 - 26 in the northern Kattegatt and eastern Skagerrak. Dense hydrographic mapping using e.g. ADCP. Special studies of entrainment processes.

b) After May 26 outer Skagerrak, e.g. SW of the southern part of the section G. Quantifying measurements of different influxes and of tidal effects. ADCP-measurements.

VESSEL	PERIOD
L.Titov	May 20 -June 7

PARAMETERS

CTD-measurements and full sets of biological measurements near the sections C-E (Hållö-M6-Skagen)

VESSEL	PERIOD
Svanic	May 20 - June 22

PARAMETERS

Reserve vessel to carry out different investigations

VESSEL
Oceania

PERIOD
May 20 - June 8

PARAMETERS
The vessel will primarily work at one station and will study daily total solar energy, spectral light attenuation, S- and T-microstruture and primary production **in situ.**It will also conduct time series of chemistry.
The investigations will be carried out in the central part of the Skagerrak.

VESSEL
A. Veimer

PERIOD
May 23 - June 7

PARAMETERS
Measurements with undulating CTD and particle counting in the eastern Skagerrak.

VESSEL
Hydromet

PERIOD
May 23 - June 8

PARAMETERS
Intensified current measurements. CTD-measurements. Studies of oxygen-depletion. The investigation area will cover the section A (Läsö) and an area in the Kattegatt to the south of this section.

VESSEL
A. von Humboldt

PERIOD
June 2 - 20

PARAMETERS
Current measurements. Studies of mass transports. The investigations will mainly take place in the eastern part of the Skagerrak and in the transitional area between the Kattegatt and the Skagerrak.

VESSEL
G.M. Dannevig

PERIOD
June 5 - 20

PARAMETERS

The vessel will supply and support other vessels with physical, chemical and phytoplankton investigations.

VESSEL
Prof. Siedlecki

PERIOD
June 6 - 21

PARAMETERS
Increased chemical measurements. CTD-measurements. Measurements of primary production **in situ** and of secondary production. The investigations will take place in the transitional area between the Skagerrak and the North Sea.

VESSEL
Argos

PERIOD
June 6 -21

PARAMETERS
Measurements of primary production **in situ** and of secondary production in the central and outer part of the Skagerrak.

VESSEL
G. Thorson

PERIOD
June 6 - 17

PARAMETERS
Special studies of the top of the dome within a dense station net. Entrainment of the deep water. Chemical and biological measurements. Sediment traps at three stations.

VESSEL
Shelf

PERIOD
May 20 - June 30

PARAMETERS
Investigations of mezoscale variability and vertical distribution of fluorescent and light scattering substances important in bio-ecological research by means of submersible instruments and shipborne apparatus for underway observations in surface layer. The cruises are indicated in Fig. 11.

Further comments

* The vessels ATAIR and GAUSS may undertake some investigations during their cruises related to the deployment of the moored equipment.

* In case of a need of special investigations e.g. an intensive study of an algal bloom or of fronts the co-ordination centre may steer the activities of the vessels to the areas concerned.

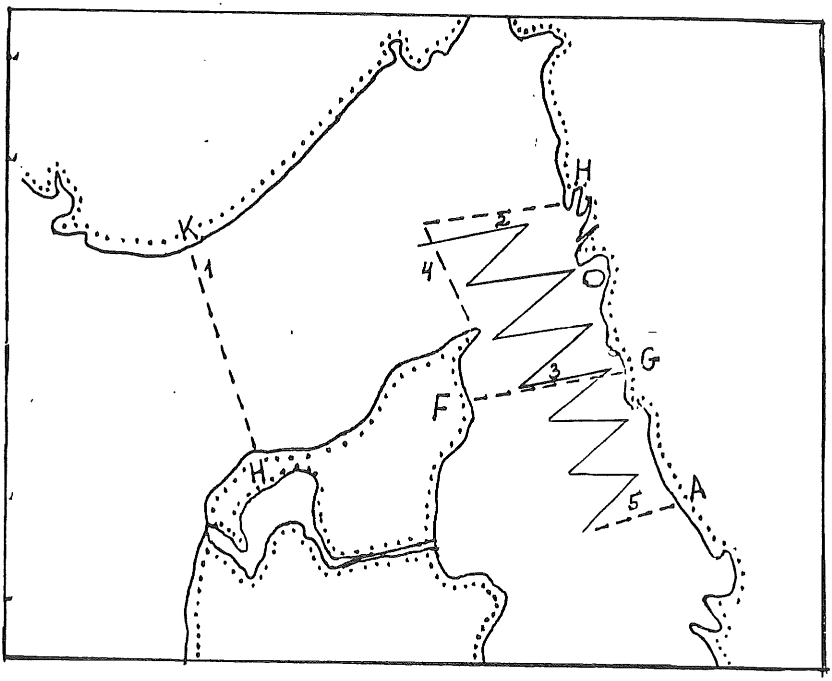


Fig.11 The cruises of the vessel Shelf

9. INFORMATION/COMMUNICATION SYSTEM

9.1 Co-ordination - service centre

At the meeting in Gdynia the Study group agreed upon of establishing a co-ordination centre in Norrköping, Sweden, at the Swedish Meteorological and Hydrological Institute there. One very strong motive for the decision was the fact that it there will be quite easy to link down satellite images and to have good weather forecasts easily available.

It was suggested that Arendal, Norway, the place for the calibration exercise, could be a port of call for different type of service facilities during SKAGEX.

9.2 Communication system

In Gdynia the Study Group decided that the participating vessels should be equipped with NMT (Nordic Mobile Telephone System) and telefax, why it would be possible to submit satellite images and other information to the vessels. The submission can also be achieved by the use of NMT to personal computers.
It will probably also be necessary to use a radio channel as a reserve part of the communication system.
Sweden will undertake to deliver NMT and telefaxes to those vessels that do not have such equipment to-day.

9.3 Information to fishermen, ship traffic etc

The Study Group has emphasized the need of a comprehensive information campaign to fishermen, trade ships etc in the area of investigation during SKAGEX. Mooring stations will be announced in Notices to Mariners and other publications. It might also be advisable to periodically broadcast navigational warnings, especially concerning the positions of the mooring stations. Some kind of patrolling activities may also be relevant.

The main co-ordinating group will discuss this matter at a final co-ordinating meeting in Arendal, Norway, May 9-10 1990.

9.4 General information on the experiment

At the meeting in Gdynia the Study Group accepted a communique' on SKAGEX (Annex 10)

10 DATA COLLECTION AND COLLATION

Like in PEX, where the ICES Secretariat handled most of the data collected, the data should be submitted to ICES in four steps. These steps are the submissions of

- ROSCOP information,
- hydrochemistry data,
- current meter data and
- biological data.

This division is a somewhat natural one taking working up time of the data into account and keeping in mind that reporting formats are different for the individual datasets.
Once each data set is completed it is disseminated again in a way to be agreed. The data should be submitted to ICES through the usual channels (National Data Centres or Designated National Agencies or directly). It is the individual scientists' responsibility to get their data submitted to their national data centre. ICES will keep a copy of the data set for internal purposes only. The SKAGEX data will not enter any ICES database per se. The data will be kept confidential within SKAGEX participants permanently. However SKAGEX data received through e.g. national datacentres after dissemination by ICES will be subject to the normal rules for data exchange.

10.1. ROSCOP forms

These forms giving an overview of the ships activities should be finalized immediately after the active phase of each ship and sent to the ICES Secretariat on paper forms or on diskette. A standard data entry program for MSDOS machines can be provided together with a description.
This information is used for checking the incoming data for completeness.

10.2. The Data

Here we have to take into account the different work up times of the raw data, which change considerably by discipline. Descriptions of the data exchange formats mentioned below can be received through ICES. Data submission is preferably done on half inch magnetic tape or for low volume data on diskettes. If some institutions prefer to submit high volumes of data in the mentioned formats, which are using much space, data compression programs for MSDOS machines can be made available upon request and distributed at the intercalibration port.

10.2.1 Biological data

The reporting format suggested is the one used by HELCOM for biological data reporting. This format covers primary production, chlorophyll, phytoplankton, zooplankton and zoobenthos data. An extension for secondary production data

can be made. Many participants who already do report to HELCOM in this format did not have difficulties during PEX in sending their data in. The secretariat already has the data checking facilities for this format.
The species coding should follow the RUBIN coding system, even if species from the southern North Sea or Atlantic have not yet been given a code. The RUBIN code centre assured that it would be no problem to define new codes for 20 to 30 species within a few weeks time.
PEX showed, that the biological data come in very late compared to physical data. The deadline for this data submission should be set in the light of the very labour intensive process of producing the raw data to early summer 1991.

10.2.2 Hydro-Chemistry data (CTD-bottle)
The reporting format suggested here is 1. ICES punch card format, 2. ICES Blueprint format, or 3. a Comma Separated Values file, which can easily be produced with PC database programs or PC spreadsheets. In the latter case we have to define a sequence of parameters and the set of files to be reported, since it is unhandy to have all data in all records(Annex 9 and 10).

Given the time needed to work up the data, it is expected that data does not arrive in the secretariat before September 1990, at latest by the end of the year 1990.

DEPTH is to be reported as PRESSURE (dbar) measured!!!!!!!!!

The CTD data will be reduced by the originator to intervals to be agreed upon . All bottle values will be reported. Care has to be taken, that chemistry reports contain T and S values of the corrected CTD not those read during sampling, when rosettes are used.
Upon arrival the data will undergo 1. a potentially necessary format conversion, and 2. quality control procedures to assure highest possible quality of the joined data set. It is anticipated that nutrient values will have to be adjusted, and a procedure to do this will have to be developed, such as in PEX (cf MCWG 1990).
After joining the datasets of all ships these data will be distributed.

10.2.3 Moored Current meter data
The MCM data should be reported in the ICES blueprint subset as used during PEX. Details have been given in a letter by W. Lange, DHI,FRG. The data will be reported as hourly mean values and distributed to all interested participants directly.

10.3. Data exchange media
The Secretariat is prepared to support the following data exchange media and formats:

1. Half inch 9 track magnetic tape at densities 800bpi, 1600bpi and 6250bpi written in either ASCII or EBCDIC preferably as nolabel tape, i.e. the data files separated by one EndOfFile mark only, and the files being fixed blocked according to some multiple of the formats record length, the last block not blank or zero filled (VAXes do sometimes so); records not separated by some end of record markers, and not lead in by a record length indicator (again VAX).

2. MSDOS compatible diskettes either 5.25" 360Kbyte or 1.2Mbyte or 3.5" 720 Kbyte or 1.44Mbyte. Preferably only relative low volume data because these data have to be transmitted across a slow line to the main system. Data compression programmes are available upon request to reduce the number of diskettes necessary, e.g. ICES punch card format is shrunk to 25% of its original volume.

3. Submission on paper is very much discouraged, but nevertheless it is possible for SKAGEX participants who do not have access to one of the above media, to submit data on paper so it can be typed up at the Secretariat. For the ICES hydrographic punch card format we can provide even some preprinted forms upon request.

10.4 TECHNICAL GUIDELINES FOR ISOLINES ETC

In Annex 12 the outlines of the obligatory sections A,B,C,E,F,G and H are given. The horizontal scale is: 1 cm = 5 nautical miles, and the vertical scale is split at 100m depth with scales 1 cm = 10 m and 1 cm = 50 m. In this way it is managed to fit all sections in reasonable formats on A4 sheets suitable for telefaxing . It is suggested that other sections shall be plotted in the same scale, or at least in the same horisontal to vertical ratio.

Isolines to be drawn:

It is in this connection urged that everybody uses common sense in plotting any additional isolines to show e.g. any maximum or minimum value etc or to delete any lines if the picture turns out to too crowdy.

TEMPERATURE: Every whole degree C (fully drawn)
Every half degree C (dashed) when appropriate

SALINITY: Every whole ppt. (fully drawn) and in addition
(32.5), 33.5, 34.5, 34.7, 34.8, 34.9 (dashed)
and when appropriate 35.1, 35.2 and 35.3 (fully drawn)

DENSITY: Every whole sigma-t (fully drawn) and in addition
(24.5), 25.5, 26.5, 27.2, 27.4, 27.5, 27.6, 27.7 and 27.8 (dashed)

NO_3 and SiO_4: Every whole umol (fully drawn)

PO_4 and NO_2: Every 0.1 umol (fully drawn)

11. FURTHER WORK BEFORE SKAGEX

A final, main co-ordinating meeting will take place in Arendal, Norway, May 9-10, 1990, where the remaining, more practical questions will be solved, e.g. concerning delivery of material to some of the vessels in Helsingborg, Sweden, the detailed planning of the calibration exercise in Arendal, communication system etc.

12. FOLLOW-UP ACTIVITIES WITHIN SAKGEX

The Study Group has suggested a subsequent exercise in the Skagerrak, 10-15 September 1990, at which the following vessels are foreseen to participate:
G.M. DANNEVIG, ARGOS, SVANIC AND A. VEIMER

At the meeting in Gdynia the participants in SKAGEX were invited by USSR to take part there in the first meeting for a discussion of the obtained results. The meeting will take place in Zvenogorod near Moscow.

13. OTHER MATTERS

During Skagex there will take place an intensive bird counting in the Skagerrak, and the participating vessels have been asked to take bird observers onboard.

The participants' attention has also been drawn to the fact that there is a strong need during SKAGEX to make notes on the occurrences of whales.

14. CLOSING

In closing the meeting in Kiel at 1700 on 2 November 1989, the chairman expressed his appreciation on behalf of the Group of the hospitally offered by the Institut fur Meereskunde, especially by Dr H-P Hansen and his colleagues and staff for providing a pleasant and comfortable meeting place.

In Gdynia the chairman closed the meeting at 1800 on March 8, 1990, after having expressed his thanks and appreciation to the Director of the Sea Fisheries Institute, Dr Z Karnicki, to Dr J. Piechura for organizing the meeting and to the Secretariat for effective work.

Dr Dybern also paid tribut to the Nordic Council of Ministers financially supporting the two meetings.

Annex 1

List of participants in the SKAGEX-meetings in Kiel (K) and Gdynia (G)

Country (etc)	Name	Address
Dk	Ms H. Kaas (G) Mr F. Möhlenberg (G)	National Envir. Research Institute Div. for Marine Ecology and Microbiology Jaegersborg Allé 1B DK-2920 Charlottenlund
	Mr O.V Olsen (K)	Dan. Inst. f.Fisheries a.Mar.Res Charlottenlund Slot Dk -2920 Charlottenlund
FRG	Ms G. Behrends (K) Mr H.P. Hansen (K,G) Mr U. Horstmann (K)	Institut f. Meereskunde Düsternbrook. Weg 20 D -2300 Kiel 1
	Mr W. Lange (K)	Deutsches Hydrogr. Institut (DHI) Bernh.-Nocht-Str. 78 D -2000 Hamburg 4
SF	Mr M. Perttilä (K)	Inst.of Marine Research P.O. Box 33 SF -00931 Helsinki 93
GDR	Mr W. Fennel (K,G) Mr W. Matthäus (K,G) Mr S. Schulz (K,G)	Inst.f. Meereskunde der Akad. d. Wissensch. der DDR Seestr. 15 DDR -2530 Rostock-Warnemünde
N	Mr F. Beyer (K,G)	Biologisk Institutt Avd. Mar. Zool. & Kjemi Po Box 1064 N -0316 Oslo 3
	Mr F-E Dahl (K)	Det norske Veritas P.O. Box 300 N -1322 Hovik
	Mr D. Danielssen (K,G)	Inst.of Mar. Researchh Flodevigen Biological Station N - 4817 His
	Mr L. Föyn (K,G) Mr E. Svendsen (K,G)	Instit. of Mar. Research PO Box 1870 N -5024 Bergen
PL	Mr E. Andrulewicz (K,G) Ms A. Trzosinska (K,G)	Inst. of Meteor. à.Water Mana. Maritime Branch Waszyngtona 42 Pl - 81 342 Gdynia

Country (etc)	Name	Address
PL	Mr J. Dera (K,G) Mr T. Krol (G) Mr S. Sagan (G)	Inst. of Oceanology Pol. Acad. of Sciences Powst. Warszawy 55 Pl - 81-967 Sopot
	Ms M. Pastuszak (K,G) Mr J. Piechura,(K,G) Mr T. Herra (G) Mr Z. Witek (G)	Sea Fisheries Institute Al. Zjednoczenia 1 Pl - 81 345 Gdynia
S	Mr B.I. Dybern (K,G)	Inst. of Marine Research P.O. Box 4 S - 453 00 Lysekil
	Mr I. Olsson (K,G)	National Swedish Board of Fisheries PO Box 2565 S - 403 17 Gothenburg
	Mr L. Edler (G)	Dept. of Marine Ecology Univ. of Lund Box 124 S - 221 00 Lund
	Mr L. Hernroth (G) Mr O. Lindahl (K) Mr P. Tiselius (K)	Kristinebergs Marine Biol. Stn S - 450 34 Fiskebäcksil
	Mr L. Rydberg (K) M. P. Lundberg (K)	Oceanographic Institute Univ. of Göteborg P.O. Box 4038 S - 400 40 Göteborg
	Mr H. Dahlin (K,G) Mr T. Thompson (K,G)	Swedish Met. and Hyd. Institute S - 601 76 Norrköping
	Mr S. Fonselius (K,G) Mr J. Svensson (G)	SMHI, Oceanographic Lab. Box 2212 S - 403 14 Göteborg
USSR	Ms V. Andrjuschenko (K,G) Mr S. Kirjanov (K,G)	The State Oceanographic Inst. 6 Kropotkinski USSR -119838 Moscow
	Mr A. Aitsam (K) Mr L. Talpsepp (K,G) Mr M. Kahru (K)	Inst. f. Thermo+El.-Physics Dept. of the Baltic S Paldiski Str. 1 USSR -200031 Tallinn
	Mr O. Andrejev (K,G)	Leningrad Branch of the State Oceanogr. Institute 23 Linia 2a USSR -199026 Leningrad

Country (etc)	Name	Address
USSR	Mr H. Jankowski (G) Ms M. Püvi (G)	Dept. of Marine Chemistry Institute of Thermophysics and Electrophysics Estonian Acad. Science Paldiski Rd 1 Tallinn 200001 - Estonia
	Mr G.S. Karabashev (K)	Inst. of Oceanol. Acad. Sc.USSR Ul. Krasikova 23 117218 Moscow, USSR
Nordic Council of Ministers	Mr J. Williams (K)	Nordisk Ministerrad St. Strandstraede 18 DK -1255 Copenhagen
ICES	M K. Jancke (K,G)	Intern. Council ICES Palaegade 2-4 DK -1261 Copenhagen K

SECOND PLANNING MEETING FOR SKAGEX

Kiel, Federal Republic of Germany
31 October - 2 November 1989

Agenda

1. Opening. General information.
2. Election of Chairmen and Rapporteurs.
3. Present knowledge of the Skagerrak conditions.
4. Aims of the investigation. Status of the planning so far.
5. Available ships, scientists, equipment etc.
6. Detailed discussions on the practical performance of the investigation (parameters, localization of stations, station depth and frequency, intercalibrations, special requirements etc.).
7. Data collection and collation. Working up of results.
8. Use of data from former and ongoing investigations (e.g. from monitoring programmes). Can we get a better coordination?
9. Next planning meeting(s). Intersessional activities.
10. Other questions (e.g. of financial nature).
11. Closing.

Annex 2

MEETING OF THE ICES STUDY GROUP ON SKAGEX

Gdynia, Poland, 6-9 March 1990

Agenda

1. Opening. General information
2. Adoption of the agenda. Elections of Chairmen and Rapporteurs
3. Available equipment
   a. Ships and their availability and capacity
   b. Equipment for obligatory and voluntary parameters
   c. Personnel
4. First discussion on the practical performance of the investigation (transects, timing, special programmes etc.)
5. Disposal and collection of current meters. Mooring stations
6. Physical parameters
   a. Scheme for obligatory (transect etc.) measurements
   b. Other measurements
   c. Intercalibrations
   d. Sea level measurements
7. Chemical parameters
   a. Scheme for obligatory (transect etc.) measurements
   b. Other measurements
   c. Intercalibrations
8. Biological parameters
   a. Scheme for obligatory (transect etc.) measurements
   b. Other measurements (e.g. sediment trapping, fish larvae)
   c. Special equipment problems
   d. Performance to get highest possible comparability
9. Remote sensing
   a. General outline
   b. Coordination passages/in situ measurements
   c. Practical requirements
10. Meteorology
    a. Measurements on board
    b. Information to be conveyed to ships
11. Information/communication system
    a. Coordination - service center
    b. Communication (mode, equipment etc.)
    c. Information to fishermen, ship traffic etc.
    d. Logo?
12. Questions related to the intercalibration in Arendal
13. Defintive decisions on the performance of SKAGEX
14. Data collection and collation
15. Data obtainable from other investigations
16. Other matters
17. Further work before SKAGEX
18. Closing

Annex 3

POSITIONS OF HYDROGRAPHICAL STATIONS DURING SKAGEX

Section A (Laesö)

Station	Latitude(N)	Longitude(E)	Total depth (m)
1	57.20,7	11.49,5	30
2	57.19,8	11.42,6	60
3	57.18,9	11.34,3	80
4	57.18,0	11.26,2	75
5	57.17,2	11.18,0	40
6	57.15.4	10.45,2	20
7	57.15,6	10.40,0	15

Vessels performing measurements:

1st period: HYDROMET (Poland)
2nd period: A. TISELIUS (Sweden)

Section B (Laesö, Göteborg - Fredrikshavn)

Station	Latitude(N)	Longitude(E)	Total depth (m)
1(GF4)	57.33,0	11.31,5	80
2(GF5)	57.32,3	11.26,0	50
3(GF6)	57.32,0	11.19,5	40
4(GF7)	57.30,3	11.08,5	40
5(GF8)	57.27,9	10.54,0	40
6(GF9)	57.26,0	10.42,5	25

Vessels performing measurements:

1st period: SVANIC and A. TISELIUS (Sweden)
2nd period: SVANIC

Section C (Hållö - Section F)

Station	Latitude(N)	Longitude(E)	Total depth (m)
1	58.20,2	11.09,5	50
2	58.20,2	11.06,1	50
3	58.20,2	11.02,0	80
4	58.19,0	10.56,5	120
5	58.17,7	10.51,0	150
6	58.16,0	10.43,5	200
7	58.13,6	10.33,5	275
8	58.11,3	10.23,5	300
9(E8)	58.09,0	10.14,0	250
10	58.04,5	09.48,0	350
11(F7)	58.00,0	09.21,0	400

Vessels performing measurements:

1st period: LEV TITOV (USSR), stations C1 - C9
2nd period: A.VON HUMBOLDT (GDR), stations C1 - C9

Section D (Oslofjord)

Station	Latitude(N)	Longitude(E)	Total depth (m)
1	58.56,0	09.49,4	250
2	58.52,0	09.55,8	145
3	58.48,0	10.02,2	220
4	58.44,0	10.08,6	265
5	58.40,0	10.15,0	275
6	58.40,0	10.25,0	200
7	58.40,0	10.35,0	135
8	58.40,0	10.45,0	100
9	58.40,0	10.55,0	60
10	58.40,0	11.05,0	60
11	58.44,0	10.20,3	195
12	58.48,0	10.25,7	135
13	58.52,0	10.31,0	170
14	58.56,0	10.36,3	300
15	59.00,0	10.41,7	460
16	59.00,5	10.54,0	245

Vessel performing measurements:

T. BRAARUD (Norway), both periods

Section E (Jomfruland - Skagen)

Station	Latitude(N)	Longitude(E)	Total depth (m)
1	58.49,0	09.36,0	100
2	58.45,0	09.40,0	300
3	58.41,0	09.45,0	500
4	58.36,0	09.49,0	480
5	58.29,0	09.55,0	500
6	58.23,0	10.00,0	500
7	58.16,0	10.08,0	500
8(C9)	58.09,0	10.14,0	250
9	58.03,0	10.19,0	100
10	57.58,0	10.24,0	90
11	57.54,0	10.27,0	100
12	57.49,0	10.32,0	80
13	57.46,0	10.34,0	50

Vessels performing measaurements:

1st period: A. VEIMER (USSR), stations E1 - E7 (night-time)
L. TITOV (USSR), stations E8 - E12
2nd period: G.THORSON (Denmark), stations E1 - E7
A.VON HUMBOLDT (USSR), stations E8 - E12

Section F (Torungen/Arendal - Hirtshals)

Station	Latitude(N)	Longitude(E)	Total depth (m)
1	58.23,0	08.49,0	105
2	58.20,0	08.53,0	260
3	58.16,0	08.59,0	400
4	58.12,0	09.05,0	415
5	58.08,0	09.11,0	645
6	58.04,0	09.16,0	600
7(C11)	58.00,0	09.21,0	425
8	57.56,0	09.27,0	175
9	57.51,0	09.34,0	70
10	57.48,0	09.40,0	35
11	57.42,0	09.47,0	65
12	57.38,0	09.52,0	30

Vessels performing measurements:

1st period: A. VEIMER (USSR)
2nd period: G.M. DANNEVIG (Norway)

Section G (Okso/Kristiansand - Hanstholm

Station	Latitude(N)	Longitude(E)	Total depth (m)
1	58.03,0	08.05,0	100
2	57.59,0	08.06,0	460
3	57.55,0	08.10,0	490
4	57.51,0	08.12,0	500
5	57.44,0	08.17,0	400
6	57.39,0	08.20,0	180
7	57.33,0	08.22,0	135
8	57.29,0	08.25,0	75
9	57.24,0	08.28,0	50
10	57.19,0	08.30,0	30
11	57.14,0	08.33,0	25
12	57.10,0	08.35,0	15

Vessels performing measurements:

1st period: OCEANIA (Poland)
2nd period: ARGOS (Sweden)

Section H (Limfjord - Lindesnes)

Station	Latitude(N)	Longitude(E)	Total depth (m)
1	57.55,5	07.03,0	200
2	57.53.0	07.02,5	400
3	57.48,0	07.02,0	400
4	57.43,0	07.01,0	300
5	57.38,0	07.00,0	250
6	57.30,0	06.59,0	200
7	57.24,0	07.07,0	90
8	57.18,0	07.15,0	60
9	57.12,0	07.23,0	40
10	57.06,0	07.31,0	30
11	57.01.0	07.38,0	20
12	56.55,0	07.45,0	35
13	56.50,0	07.53,0	20
14	56.46,0	07.58,0	20
15	56.42,0	08.04,0	20

Vessels performing measurements:

1st period: G.O.SARS (Norway)
2nd period: PROF: SIEDLECKI (Poland)

Note: The stations H1 - H5 are to be considered as temporary stations.

Section K (Kattegatt-section)

Station	Latitude(N)	Longitude(E)	Total depth (m)
1(GF4)	57.33,0	11.31,5	80
2	57.17,6	10.44,5	45
3	56.51,4	10.47,5	15
4	56.06,0	11.09,0	40
5	57.11,5	11.40,0	75
6	56.57,5	11.45,5	100
7	56.40,0	12.07,0	55
8	56.14,0	12.22,2	25

Vessel performing measurements:

1st period: HYDROMET (Poland), conducting voluntary investigations

Colour of the ocean as an indicator in photosynthetic studies

N. Højerslev, N. G. Jerlov and G. Kullenberg
University of Copenhagen,
Institute of Physical Oceanography,
Haraldsgade 6, 2200 Copenhagen N. Denmark

Spectral analysis of the daylight backscattered from the sea yields information about the optical properties of the upper layer and ultimately about its content of suspended particles and coloured dissolved substances. Generally the spectral character of the colour of the upwelling light can be investigated by employing a two channel system. Thus a colour index is defined as the ratio of nadir radiance in the blue (450 nm) to that in the green (520 nm) (Jerlov, 1974).

$$F = \frac{L(180°)_{450\ \mathrm{nm}}}{L(180°)_{520\ \mathrm{nm}}}$$

This index is determined below the sea surface which avoids several severe complications — appearing in remote spectroscopy – due to reflexion at the sea surface, air light etc. (Clarke and Ewing, 1974; Austin, 1974).

The colour meter which is a simple and cheap instrument, is suitable for routine work: it is lowered manually from shipboard preferably down to one metre. A measurement of the index is accomplished in a few minutes.

The index can readily be fitted into the pattern of optical properties. A clear association is indicated between colour index and depths at which the percentage of surface quanta irradiance (350–700 nm) is 10% (Jerlov, 1974). It seems, however, important to broaden the basis for this comparison by utilizing new experimental material in order to investigate the potentiality of using the colour index in photosynthetic studies.

Experimental material

Table 1 presents a survey of the oceanic stations where combined observations of colour index and quanta were made. A considerable number of data were collected under different weather conditions in August 1975 and March–June 1976 during the Fladen Ground expeditions at a central position of 59°N 0°30′E in the North Sea. The typical upwelling area off West Africa is represented by data obtained during two cruises 1972 and 1975 in February, March.

A few but significant observations originate from the Gibraltar region and the Drake Passage. The bluest water is encountered south of Sardinia.

Results and discussion

A condensation of all observations of colour index (F) and 10% quanta level (z_{10}) is shown in Figure 1. Tentatively a straight line is chosen as the best fit to the points. The depth interval for the 10% level is from 10 to 40 m. Extrapolation to the deepest level – found in the Sargasso Sea – would give a maximum colour index of 4·8.

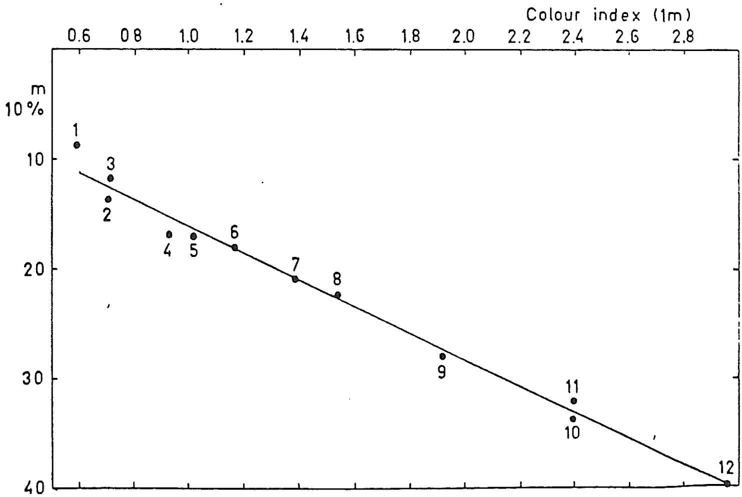


Figure 1. Relationship between colour index (1 m) and depth at which the percentage of surface irradiance of quanta (350–700 nm) is 10%.

Table 1. Oceanic stations where observations of the colour index and quanta measurements were made.

Notation	Region	No. of observations
1........	North Sea	28
2........	North Sea	18
3........	Off West Africa	9
4........	North Sea	18
5........	North Sea	23
6........	Gibraltar Strait	2
7........	North Sea	23
8........	North Sea	8
9........	East Gibraltar	1
10........	East Sardinia	2
11........	Drake Passage	2
12........	South Sardinia	5

Some considerations should be given to errors which generally occur in the measurements. The colour index can show variations within 10% due to cloud effects. On the other hand it is little dependent on solar elevation if above 15° (Jerlov, 1974; Højerslev, 1974a). On the contrary, the 10% level is influenced by the elevation. Experiments indicate a typical variation of ±10% for all atmospheric lighting conditions (Højerslev, 1974a; 1974b).

With overall decreasing quanta irradiance transmittance the shortwave part of the spectrum is reduced more than the longwave part because of selective absorption by particles and dissolved substances (yellow substance); accordingly the colour index also decreases. Chlorophyll has a specific effect on the index as it shows minimum absorption in the green and maximum in the violet.

With regard to possible errors in the mean values the scatter of points 2, 3 and 4 is not important. Only for point 1 does a real deviation from the straight line seem to occur. This deviation may probably be ascribed to the strong plankton bloom during part of the measuring period. With abundant living material daylight was much more scattered than absorbed: the content of yellow substance was relatively low as evident from beam transmittance measurements. On the whole the relation between the 10% level and the colour index becomes rather uncertain for indices below 0·6 and such values have, therefore, been omitted in Figure 1.

The close relation between index and 10% level is not immediately understood since the upwelling field can provide information only about the upper 20–25 m of clear ocean water (Gordon and Mc Cluney, 1975) while the 10% level is deeper. This level is chosen because it is in the middle of the euphotic zone and can be determined with adequate accuracy. In fact a recent investigation based on large material of quanta measurements in different water masses (Jerlov, 1977) shows the somewhat remarkable result that a constant relationship exists between different quanta percent levels. In essence this implies that oceanic waters can be classified in terms of transmittance of quanta irradiance for the whole euphotic zone.

The following conclusion emerges from the discussion: a simple and rapid determination of the colour index at one metre can be used to advantage instead of the more complicated quanta observation.

The index, if above 0·6, yields reasonably accurate information about the level of 10% quanta and ultimately about any other percent level in the euphotic zone (Table 2).

Table 2. Relation between colour index and different quanta percent levels

Colour index	Quanta percent levels (m) 30%	10%	3%	1%
0·6	5·4	11·3	18·5	24·5
0·7	5·9	12·5	20·5	27
0·8	6·5	13·6	22·5	29·5
0·9	7·0	14·8	24·5	32
1·0	7·6	16·0	26·5	35·0
1·1	8·1	17·2	28·5	37·5
1·2	8·6	18·4	30·5	40
1·3	9·1	19·6	32·5	42·5
1·4	9·6	20·8	34·5	45
1·5	10·0	22·0	36·5	47·5
1·6	10·5	23·2	38·5	50
1·7	11·0	24·4	40·5	52·5
1·8	11·5	25·6	42·5	55
1·9	12·0	26·8	44·5	57·5
2·0	12·4	28·1	46·5	60
2·1	12·9	29·3	48·5	62·5
2·2	13·4	30·5	50·5	65
2·3	13·8	31·7	52·5	67·5
2·4	14·2	32·9	54·5	70
2·5	14·6	34·1	56·5	73
2·6	15·0	35·3	58·5	75·5
2·7	15·4	36·5	60·5	78
2·8	15·8	37·8	62·5	80·5
2·9	16·2	39·0	64·5	83
3·0	16·6	40·2	66·5	85·5

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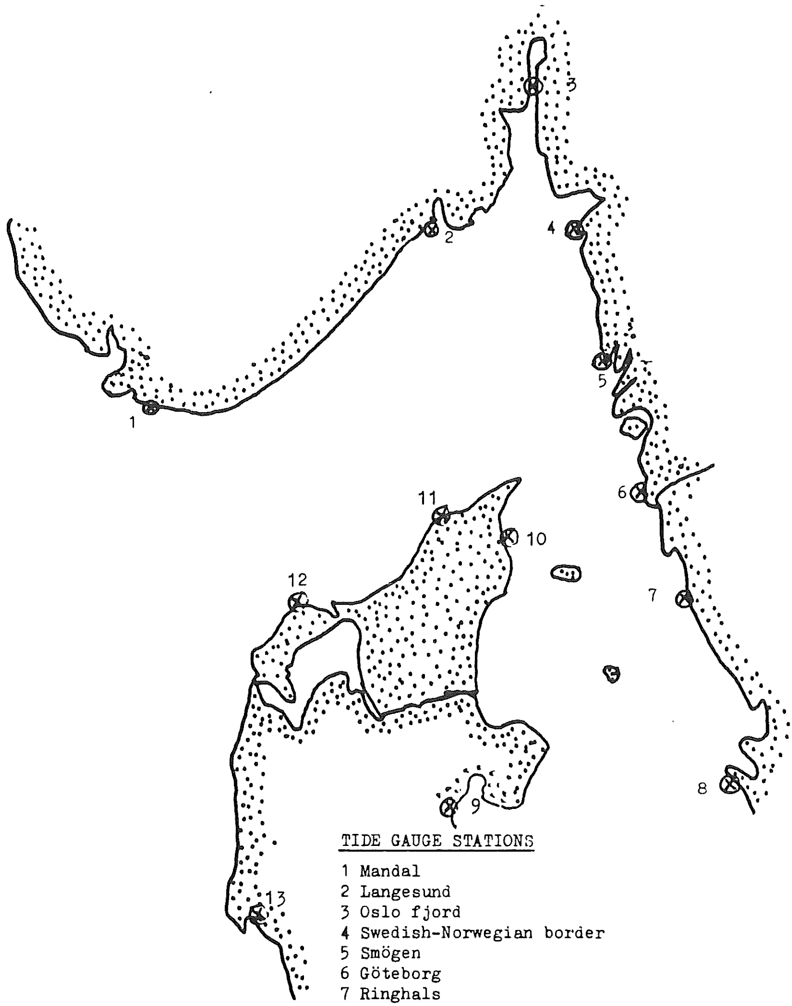
Annex 5



TIDE GAUGE STATIONS

1 Mandal
2 Langesund
3 Oslo fjord
4 Swedish-Norwegian border
5 Smögen
6 Göteborg
7 Ringhals
8 Entrance to the Sound
9 Århus
10 Fredrikshavn
11 Hirtshals
12 Hanstholm
13 Esbjerg

Comment

Some additional gauge stations may be used

Annex 6

SKAGEX 1990.

Marine Forecasting Services

Weather forecast

issued 1990 - - at UTC

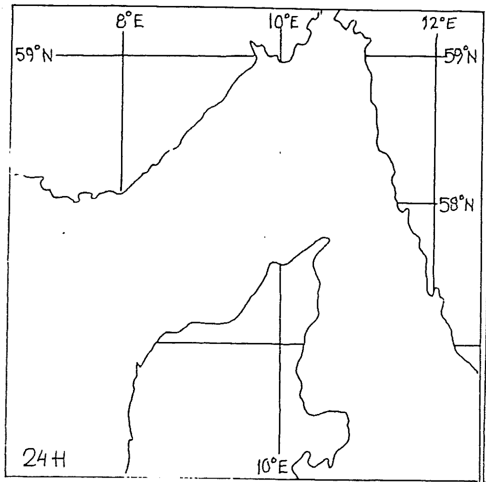
Area	Date	Time (UTC)	Wind dir.	Wind speed (m/s)	Probability in %. Wind above			Sign. wave (m)	Max. wave (m)
					10	15	20		
1.									
2.									
3.									

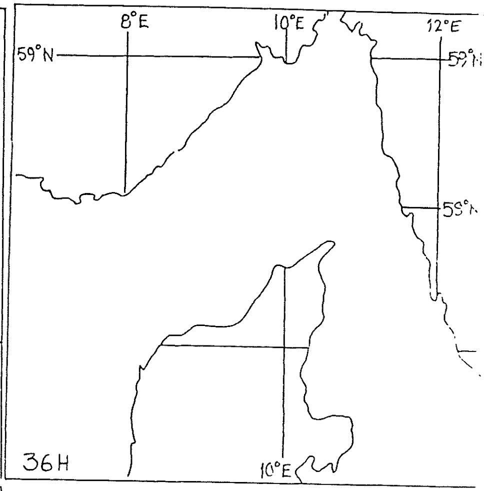
Comments:

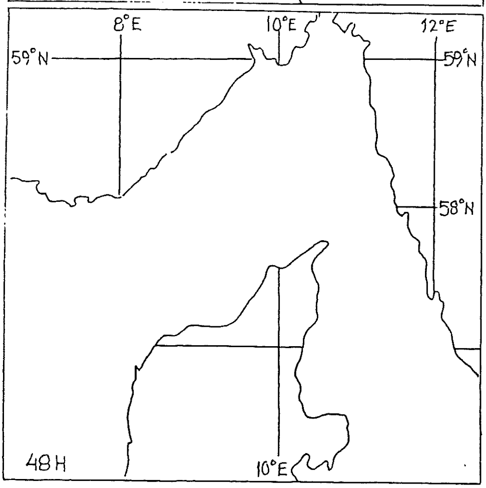
COMMENTS:

Annex 7

CURRENT FORECASTS



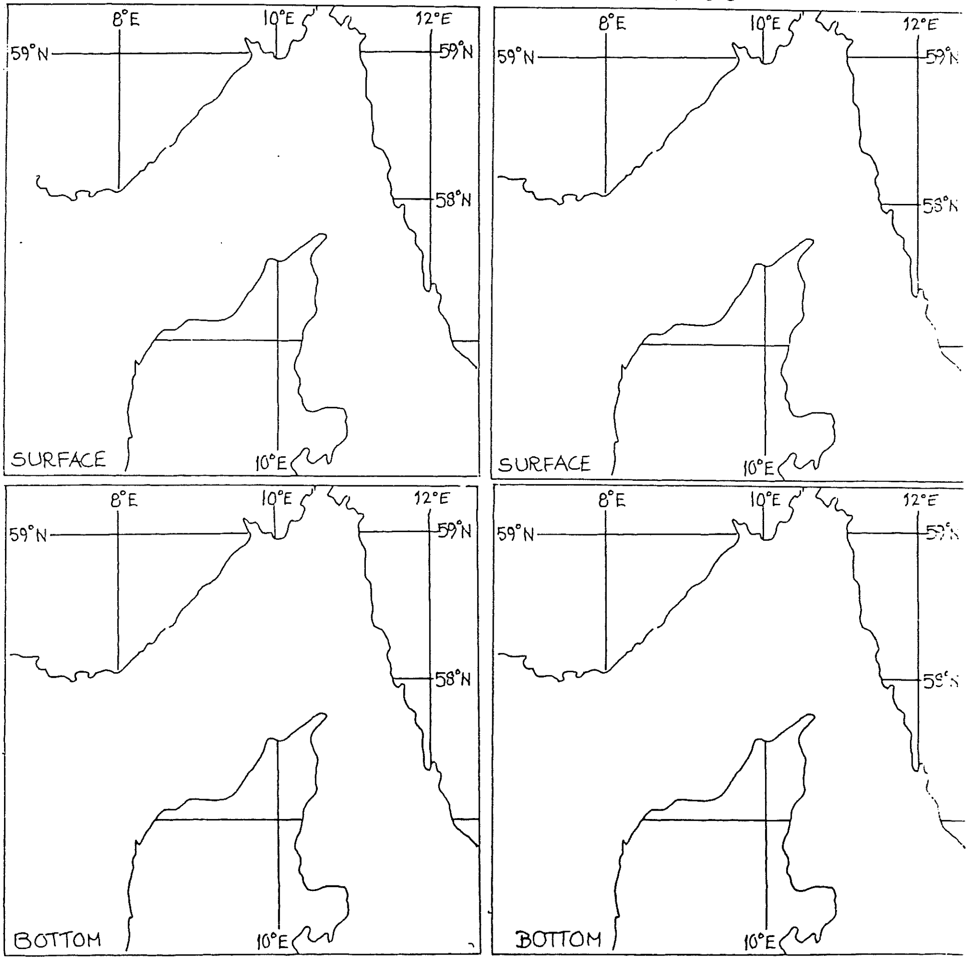




COMMENTS:

TEMP CHARTS

SALINITY CHARTS



ICES HYDROCHEMISTRY FORMAT
(76 format)

Hydromaster record | Position 80 = "J"

Position	Parameter	Description
01-02	Country	coded according to IOC country codes
03-04	Ship	coded as either ICES code (purely numerical code see ICES ships code list) or as NODC ship code (alphanumeric code).
05-08	Station no.	station number within a given year start counting one at the 1.Jan 0000 Hrs UTC
09-12	Latitude	geographical latitude in degrees and minutes (decimals given later)
13-17	Longitude	geographical longitude in degrees and minutes (decimals given later)
18	Quadrant	Indicator of quadrant on globe: 0 = Latitude North Longitude East 1 = Latitude North Longitude West 2 = Latitude South Longitude East 3 = Latitude South Longitude West 0^0 Latitude is defined as being North 0^0 Longitude is defined as being East 180^0 Longitude is defined as being West North, South relative to the equator East, West relative to Greenwich meridian
19-21	Year	number of the year - 1000
22-23	Month	number of the month within a year
24-25	Day	number of the day within a month
26-27	Time	Starting time of hydrographic station in UTC (minutes given later)
28-31	Depth	corrected depth to bottom in meter
32-45	none	reserved
46-64	none	no longer actively used
65-66	Latitude ct'd	decimals of Latitude minutes
67-68	Longitude ct'd	decimals of Longitude minutes
69-70	Time ct'd	minutes of time
71-78	none	reserved
79	Indicator	always "0" (<Null>)
80	Record Type	always "J" (<Juliett>)

Hydrography record

Position 80 = "3"

Position	Parameter	Description
01-27		copy of contents of positions 01-27 in the Hydromaster record
28-31	Depth	Depth in decibar no implied decimals
32-34	Temperature	Temperature given in degree Celsius 2 implied decimal places negative temperatures are indicated by ")" (<Closing Brace>)
35-40	Salinity	Salinity given in PSS 78 scale 3 implied decimals
41-57	none	reserved for derived quantities
58-60	Oxygen	Oxygen contents given in cm^3 O_2 / dm^3 water at STP 2 implied decimals
61-64	none	reserved for derived quantities
65-76	none	reserved
77	Method	Method of salinity determination 1 = Titration by routine method 2 = Titration by special precision method 3 = Conductivity method precision <= 0.01 4 = Conductivity method precision > 0.01
78	none	not used any longer
79	Indicator	Indicator for interpolation with depth 0 = no interpolation, T and S observed 1 = both T and S have been interpolated 8 = T has been interpolated, S observed 9 = T has been observed, S interpolated
80	Record type	always "3" (<Three>)

Hydrochemistry record — Position 80 = "6"

Position	Parameter	Description
01-27		copy of contents of position 01-27 in the Hydromaster record
28-31	Depth	Depth in decibar no implied decimals actual depth in decibar
32-34	Temperature	Temperature given in degrees Celsius 2 implied decimal places negative temperature are indicated by ")" (<Closing Brace>)
35-39	Salinity	Salinity given in PSS 78 scale 2 implied decimals
40-42	Oxygen	Oxygen contents given in cm^3 O_2 / dm^3 water at STP 2 implied decimals
43-45	Phosphate	Phosphate phosphorus given in µgat/dm^3 water at 20^0C 2 implied decimals
46-48	tot. Phosporus	total Phosphorus contents given in µgat/dm^3 water at 20^0C 2 implied decimals
49-51	Silicate	Silicate contents (Silicate Silicon) given in µgat/dm^3 water at 20^0C 1 implied decimal
52-54	Nitrate	Nitrate contents (Nitrate Nitrogen) given in µgat/dm^3 water at 20^0C 1 implied decimal
55-57	Nitrite	Nitrite contents (Nitrite Nitrogen) given in µgat/dm^3 water at 20^0C 2 implied decimals
58-60	Ammonium	Ammonium contents (Ammonium Nitrogen) given in µgat/dm^3 water at 20^0C 1 implied decimal
61-63	tot. Nitrogen	total Nitrogen contents given in µgat/dm^3 water at 20^0C 1 implied decimal
64-66	Hydrog. Sulph.	Hydrogen Sulphide contents (Sulphide Sulphur) given in µgat/dm^3 water at 20^0C 1 implied decimal
67-69	pH	Hydrogen ion concentration in situ 2 implied decimals
70-73	Alkalinity	Alkalinity given in millival/dm^3 water at 20^0C 3 implied decimals
74-76	Chlorophyll <u>a</u>	Chlorophyll <u>a</u> given in µg/dm^3 water at 20^0C 2 implied decimals
77-78	none	reserved
79	Indicator	always "7" (<Seven>)
80	Record type	always "6" (<Six>)

If nitrite is not reported, but nitrate is then the value in the nitrate field is assumed to represent nitrate + nitrite.

ICES Blueprint Format

In an attempt to unify data format structures being transmitted to the ICES Secretariat the ICES Blueprint Format was conceived in order to meet this objective. To date several institutes are using this framework, and in the case of one of them, it is being used as an archive format. The structure described here is for use with hydro-chemistry station data and is very closely compatible with, but not identical to, the ICES "Contaminants in Seawater Format".

The Format has three hierarchies, though in theory many more are possible depending on how parameters are defined. As far as possible compatibility with the Internationally approved exchange format GF3 has been sought. As a result the same parameter coding system is used and there are many similarities between the GF3 hierarchical structure and Blueprint. Because Blueprint compacts data to a much greater extent than does GF3, data written in Blueprint can quite conveniently be transferred using floppy diskettes. Because Blueprint preserves a fixed record structure, magnetic tape transfer is of course as equally convenient. Blueprint has not been designed as an alternative to GF3. It merely provides a easier way to transfer the multi-parameter data sets with which ICES normally deals, and which cannot economically be converted into GF3.

A brief explanation of the 3 levels of Blueprint is as follows (templates for each of these levels are attached).

Level 1: Parameter Definition Record

The Parameter Definition Record template presented overleaf refers specifically to one that would be used for station water bottle type data. Whereas GF3 has subsets developed for the commonest types of data sets, Blueprint has Parameter Definition Records. Normally these record(s) are placed at the start of the data file, though new definitions are possible at any time. The essential point of this record is to enable the user to define a "link" between a parameter, as defined by its GF3 parameter code, and its value as given in a data record (see below). The parameter referred to as a "Link code" in the template is a user-defined alphanumeric code; in practice users tend to prefer a purely numeric code and are encouraged to do so. By defining the link code in this way, it is possible to define a station with several thousand different parameters.

Level 2: Station Information Record

This part of the format is rigidly specified in order to ensure that the user provides essential information concerning the station (GF3 does this also). At present, for want of anything better, the existing ICES master record is used.

Level 3: Data Record

This part of the structure is common for all data set (Parameter definition record) types. Here all data values are identified by associating each with the user-defined "link code" given in the parameter definition record. Thus for a data set of hydrographic stations at which phosphate and oxygen were also collected, it will be necessary to define link codes in the definition record for depth, temperature, salinity, phosphate and oxygen. Values of each of these parameters will then be recorded in the Data Record alongside the corresponding link code. Depth will define the cycle, the other parameters can be recorded in any order, or omitted in the case of no observation of it at the particular depth. Thus the format is particularly economical in use for those data sets that contain a very variable number of measured parameters from station to station and depth to depth.

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The Parameter Definition Record template presented overleaf refers specifically to one that would be used for station water bottle type data. Whereas GF3 has subsets developed for the commonest types of data sets, Blueprint has Parameter Definition Records. Normally these record(s) are placed at the start of the data file, though new definitions are possible at any time. The essential point of this record is to enable the user to define a "link" between a parameter, as defined by its GF3 parameter code, and its value as given in a data record (see below). The parameter referred to as a "Link code" in the template is a user-defined alphanumeric code; in practice users tend to prefer a purely numeric code and are encouraged to do so. By defining the link code in this way, it is possible to define a station with several thousand different parameters.

Level 2: Station Information Record

This part of the format is rigidly specified in order to ensure that the user provides essential information concerning the station (GF3 does this also). At present, for want of anything better, the existing ICES master record is used.

Level 3: Data Record

This part of the structure is common for all data set (Parameter definition record) types. Here all data values are identified by associating each with the user-defined "link code" given in the parameter definition record. Thus for a data set of hydrographic stations at which phosphate and oxygen were also collected, it will be necessary to define link codes in the definition record for depth, temperature, salinity, phosphate and oxygen. Values of each of these parameters will then be recorded in the Data Record alongside the corresponding link code. Depth will define the cycle, the other parameters can be recorded in any order, or omitted in the case of no observation of it at the particular depth. Thus the format is particularly economical in use for those data sets that contain a very variable number of measured parameters from station to station and depth to depth.

Table 1	
0	)
1	J
2	K
3	L
4	M
5	N
6	O
7	P
8	Q
9	R

Table 2	
0	(
1	A
2	B
3	C
4	D
5	E
6	F
7	G
8	H
9	I

The left columns in table 1 and 2 show the digits to be recoded, the right columns the replacement characters.

TABLE 3

char	ASCII value	EBCDIC value	char	ASCII value	EBCDIC value	char	ASCII value	EBCDIC value
blank	32	064						
0	48	240	)	125	208	(	123	192
1	49	241	J	74	209	A	65	193
2	50	242	K	75	210	B	66	194
3	51	243	L	76	211	C	67	195
4	52	244	M	77	212	D	68	196
5	53	245	N	78	213	E	69	197
6	54	246	O	79	214	F	70	198
7	55	247	P	80	215	G	71	199
8	56	248	Q	81	216	H	72	200
9	57	249	R	82	217	I	73	201

Table 3 shows the representation of characters used in ICES format in terms of the positions of the characters in the colla-ting sequences of both the ASCII and EBCDIC character sets.

ICES Blueprint Format - Template for hydro-chemistry/CTD Data

---

(A) PARAMETER DEFINITION RECORD (Hydro/chemistry version)

```
1    2    3  4  5   2    3  4  5   2    3  4  5  - (key)
1-4  5-8  9  10 12  14   18 19 21  23   27 28 30 - (start column no)

     2    3  4  5   2    3  4  5   2    3  4  5
     32   36 37 39  41   45 46 48  50   54 55 57

     2    3  4  5   2    3  4  5  6  7
     59   63 64 66  68   72 73 75 77 79
```

Key:

1 For originator use.
2 'GF3' parameter code
3 units flag (GF3)
4 method identifier
5 Link code
6 For orginator use
7 Record code (02)

(B) STATION INFORMATION RECORD - as for ICES format Master record.

C. DATA RECORD

```
1  2  3  4  5  6    7  4  5  6    7  - (key)
1  5  9  11 13 15   21 22 24 26   32 - (start column no.)

         4  5  6    7  4  5  6    7
         33 35 37   43 44 46 48   54

         4  5  6    7  4  5  6    7  8  9
         55 57 59   65 66 68 70   76 77 79
```

key:

1 For originator use
2 Station/sequence no.
3 year
4 Link code (cf Definition record)
5 qualifier (quality flag + < > indicators)
6 value (6 figures, right justified)
7 number of decimal places in value
8 For originator use.
9 record type (10)

General rules for coding data into fields

All fields for which a value is given should be "0" (<Null>) filled to the left, fields where no value is given must be left blank. If within a field the rightmost positions are left blank, it is assumed that the measurement accuracy did not allow determination of this decimal position; e.g. Temperature measured is 2.3^{0}C the Temperature field given "023 " (<Null>, <Two>, <Three>, <blank>).

Coding of values too big for field width and Qualifiers

In all chemistry fields, including the oxygen field in the hydrographic record, a provision is made to accomodate values which are too big for the field width provided. In case the e.g. oxygen exceeds the value of 9.99 cm^3/dm^3 you have to subtract 10.00 from the value observed, enter this new value and recode the first digit of the field according to table 1. The value of 19.99 is used to indicate a value out of range, coded as "R99" (<Romeo>,<Nine>, <Nine>). Hence the highest value which can be reported is for oxygen 19.98 cm^3/dm^3. For substances which are reported to only 1 decimal place, e.g. nitrate these numbers are 99.9, 100.0, 199.9,and 199.8 respectively.

If the value found seems unrealistic you recode the second digit in the field according to table 1.

If there are traces found below the threshold of the reporting format (< 0.01 or < 0.1 respectively) you code "00)" (<Null>, <Null>, <Closing Brace>).

If for some reason the value can be observed only as being below a certain threshold, this threshold value is given and the last digit is recoded according to table 2.

The recoding according to table 1 of the second digit within a field applies as well to T and S in the hydrographic records, indicating questionable values.

All this is known as "overpunching" from the ICES punch card format.

GF3 codes to be used inconnection with ICES blueprint format for SKAGEX

the '7' in the codes is the units flag and XX or the substitution for __ is the method identifier.

1. Hydrochemistry data

Alkalinity	ALKY7XX
Ammonium	AMON7__
Chlorophyll A	CPHL7__
Nitrate	NTRA7__
Nitrite	NTRI7__
Nitrite + Nitrate	NTRZ7__
Oxygen	DOXY7__
__ PR for in situ oxygen probe	
TI for titration value	
pH	PHPH7XX
Phosphate	PHOS7__
Pressure	PRES7__
__ RT for Reversing Thermometer	
PR for in situ pressure probe	
Salinity	PSAL7__
__ PR for CTD conductivity	
BS for Bench Salinometer	
Secchi Depth	SECC7XX
Silicate	SLCA7__
Temperature	TEMP7__
__ RT for reversing Thermometer	
ST for Ctd Temperature sensor	
Total Nitrogen	NTOT7__
Total Phosphate	TPHS7__

For the other parameters __ is substituted by

__ DX Dissolved component only
PX particulate component only
TX particulate + dissolved component

If none of the specifiers for __ applies __ is given as XX.

2. Current meter data

Depth	DEPH7__
__ PR for pressure measurement WL for wire length	
Pressure	PRES7__
North Component (true) northward positive in m/s	NSCT7__
East Component (true) eastward positive	EWCT7__
__ SM scalar averaged from mechanical measure SA scalar averaged from acoustical measure SE scalar averaged from electromagnetic measure CM vector averaged from mechanical measure CA vector averaged from acoustical measure CE vector averaged from electromagnetic measure	
Year	YEAR7__
Date within year (as MMDD)	DATE7__
Time within day (as HHMMSS)	TIME7__
__ ZS time of observation start in UTC ZE time of observation end in UTC	
Time intervall in hours	NTHR7PR

optional if CM equipped with sensors :

Temperature	TEMP7__
Salinity	PSAL7__
__ as above in hydrochemistry data	

Please note that the following extensions in the Hydromaster record have been made.

The field in position 71-78 is used for both a SKAGEX station name and the Secchi disk depth.

Position	Parameter	Description
71-74	Station name	SKAGEX station name, e.g.1F03 indicating the first coverage of station 3 on section F
75-77	Secchi Depth	Secchi disk depth [m] to one decimal, e.g. 9.8m is coded 098
78	none	

1990-03-22

THE SKAGERRAK EXPERIMENT - SKAGEX

The Skagerrak between the Kattegatt and the North Sea can be regarded as a transitional area. The anticlockwise water circulation in the North Sea takes a turn into the Skagerrak before leaving the North Sea.The Skagerrak also receives large quantities of water, mainly surface water, from the Baltic via the Kattegatt.

The different water masses in the Skagerrak create fronts with a high biological production. The fish production per unit araea is high and almost double compared to that of the North Sea. At present the annual yield in the Skagerrak is about 400 000 tonnes, caught mainly by fishermen from Denmark, Sweden and Norway.

Environmental pollution affects the Skagerrak through transport from land and the atmosphere and by transport of polluted water from the North Sea and the Baltic.

There are, however, large gaps of fundamental knowledge concerning current systems, water exchange, the transports of nutrients and contaminants etc. One major issue is the serious lack of synoptic surveys, which could help at the interpretation of results from current monitoring investigations in this highly dynamic area.

The International Council for the Exploration of the Sea at its meeting in the Hague in 1989 decided to support an international survey of the Skagerrak and the adjacent sea areas. The objectives specified in its resolution are:

to identify and quantify the various water masses that enter and leave the Skagerrak area, and their variations over time
to investigate the mechanisms that drive the circulation in the area, and its links with biological processes
and to investigate the pathways of contaminants through the Skagerrak.

A nutrient budget for the Skagerrak should also be elaborated.

The main part of the survey called SKAGEX will be carried out in May-June 1990 and there will also be some minor investigations on later occasions to cover up seasonal changes. About 30 marine Institutes and Organizations having about 20 research vessels from the Baltic area and the Skagerrak-Kattegat areas have shown interest to participate in the exercise. Probably more than 200 scientists will take part in SKAGEX.

Water currents will mainly be measured along two sections, one between Kristiansand and Hanstholm and the other in the Kattegat to the west and east of the island Läsö with totally about 60 recording moored current meters.Some current measurements will also be carried out directly from the vessels. It is of great importance to establish the occurrence of the Jutland current and also its influence on the Kattegat and the Baltic.

The chemical measurements will be focussed on nutrient parameters as it is of vital importance to know the amounts of nitrogen and phosphorus transported from the North Sea into the Skagerrak and the Kattegat.Silicate will be measured as it is of basic importance to the production of diatoms. During the severe algal bloom of Chrysochromulina in 1988 the wiew was expressed that nutrients originating from the southern North Sea considerably contributed to the outburst of the bloom in the Kattegatt.

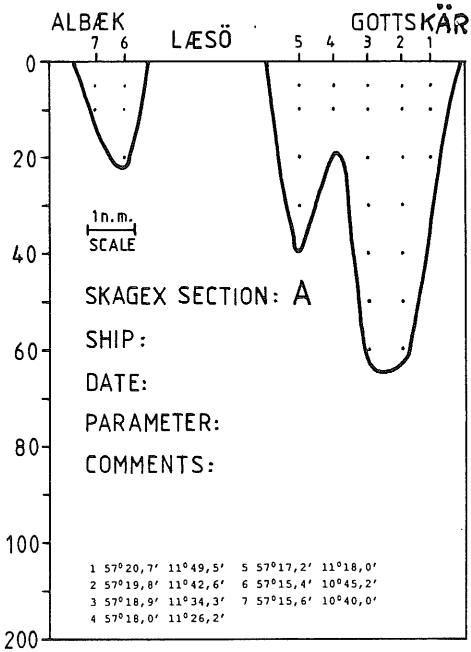
The biological investigations focus on the distribution and production of phytoplankton and zooplankton. These organisms can also be used for the characterization of water masses.
In the central part of the Skagerrak the water is strongly stratified and the discontinuity layer uplifted (" the dome"). This part exhibits a special phytoplankton community with small forms. Along the periphery there is as a rule a different plankton community.

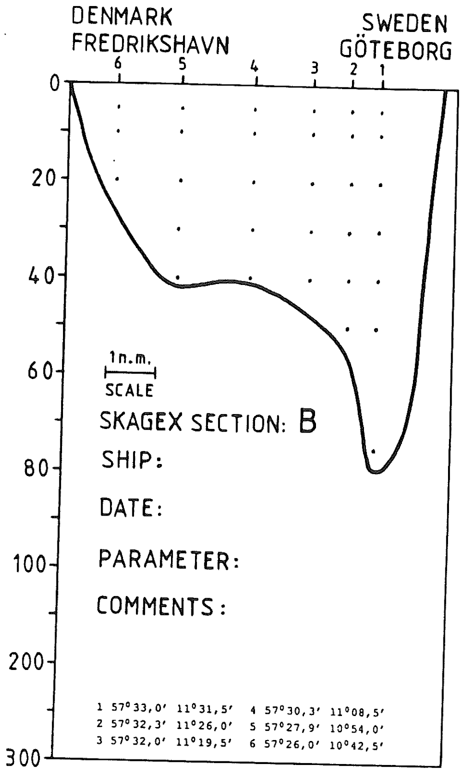
SKAGEX also includes satellite-based observations of currents, temperature and dispersion of particles at the sea surface and these observations will be of great importance in the analysis and evaluation of the field measurements.

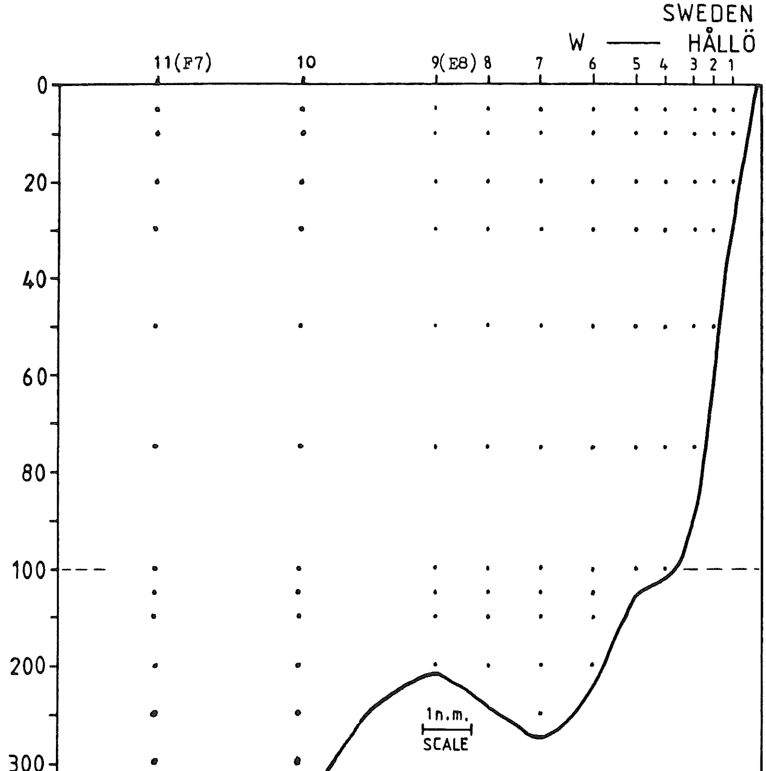
The Skagerrak Experiment implies an excellent opportunity to obtain a nearly synoptic three-dimensional model of the circulation and of the distribution and transport of various substances in the Skagerrak area.

Annex 11

GUIDELINES FOR ISOLINES


ALBÆK
LÆSÖ
GOTTSKÄR
7 6 5 4 3 2 1
0
20
40
60
80
100
200
1n.m.
SCALE
SKAGEX SECTION: A
SHIP:
DATE:
PARAMETER:
COMMENTS:
1 57°20,7′ 11°49,5′
2 57°19,8′ 11°42,6′
3 57°18,9′ 11°34,3′
4 57°18,0′ 11°26,2′
5 57°17,2′ 11°18,0′
6 57°15,4′ 10°45,2′
7 57°15,6′ 10°40,0′


DENMARK
FREDRIKSHAVN
SWEDEN
GÖTEBORG
6
5
4
3
2
1
0
20
40
60
80
100
200
300
1n.m.
SCALE
SKAGEX SECTION: B
SHIP:
DATE:
PARAMETER:
COMMENTS:
1 57°33,0′ 11°31,5′
2 57°32,3′ 11°26,0′
3 57°32,0′ 11°19,5′
4 57°30,3′ 11°08,5′
5 57°27,9′ 10°54,0′
6 57°26,0′ 10°42,5′



SKAGEX SECTION: C

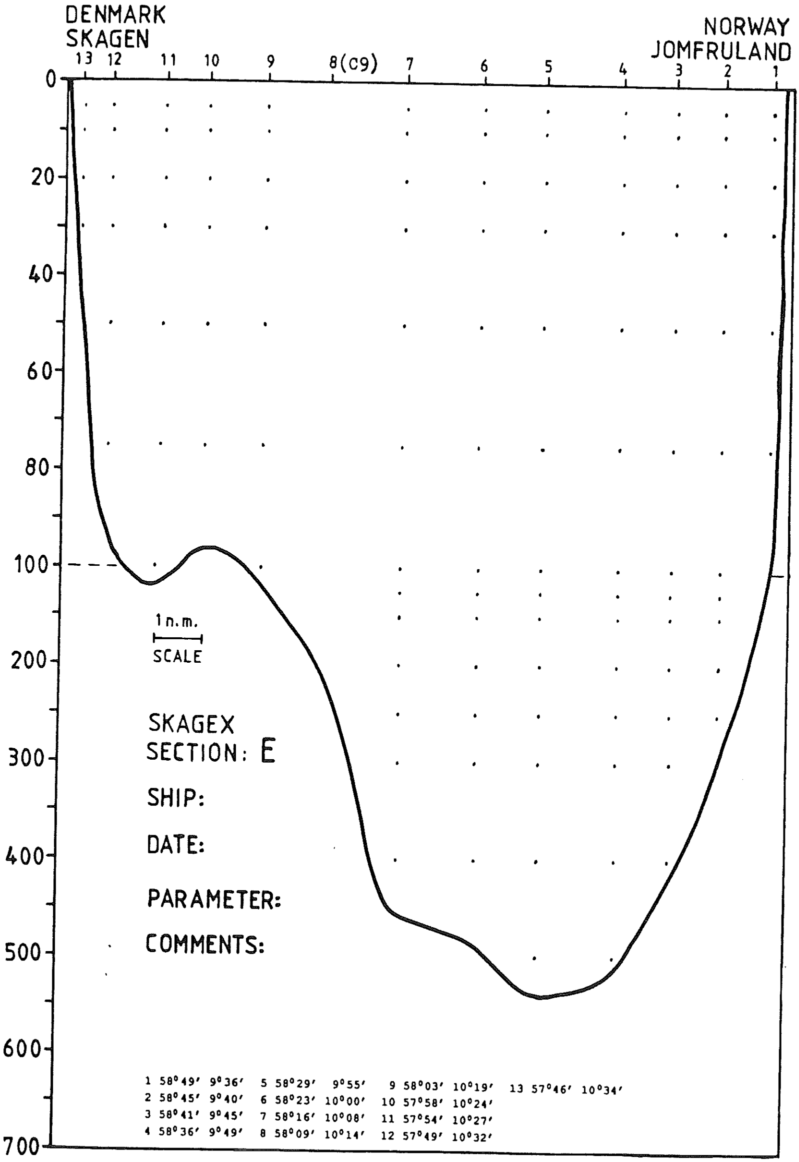
SHIP:

DATE:

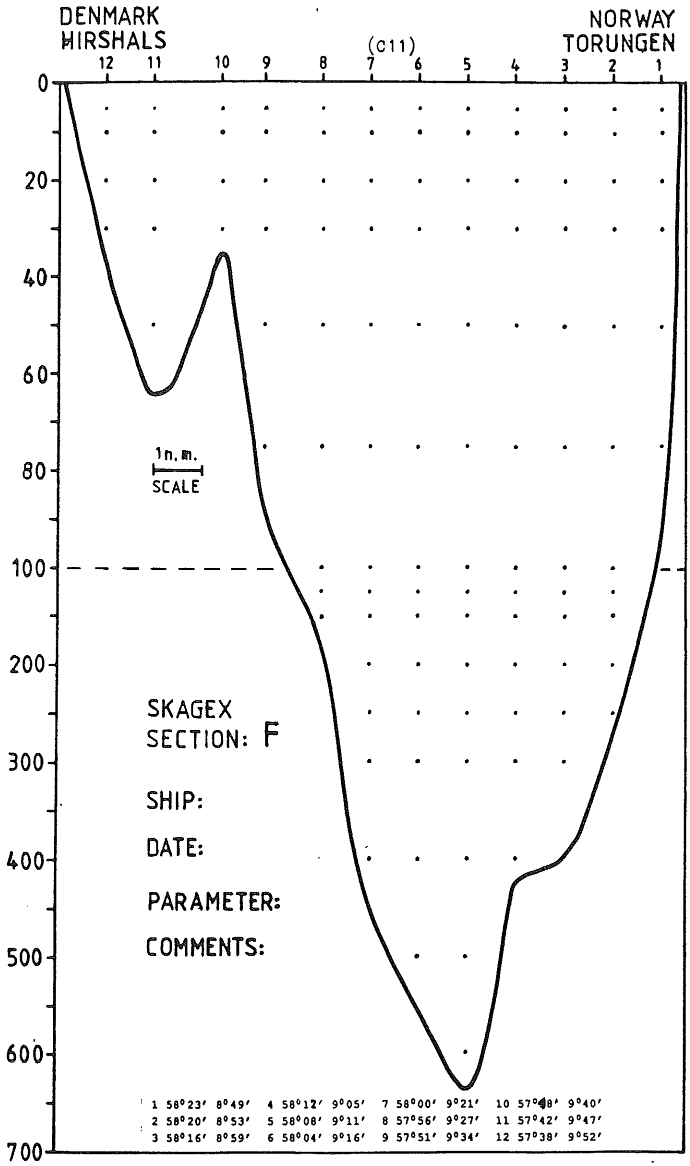
PARAMETER:

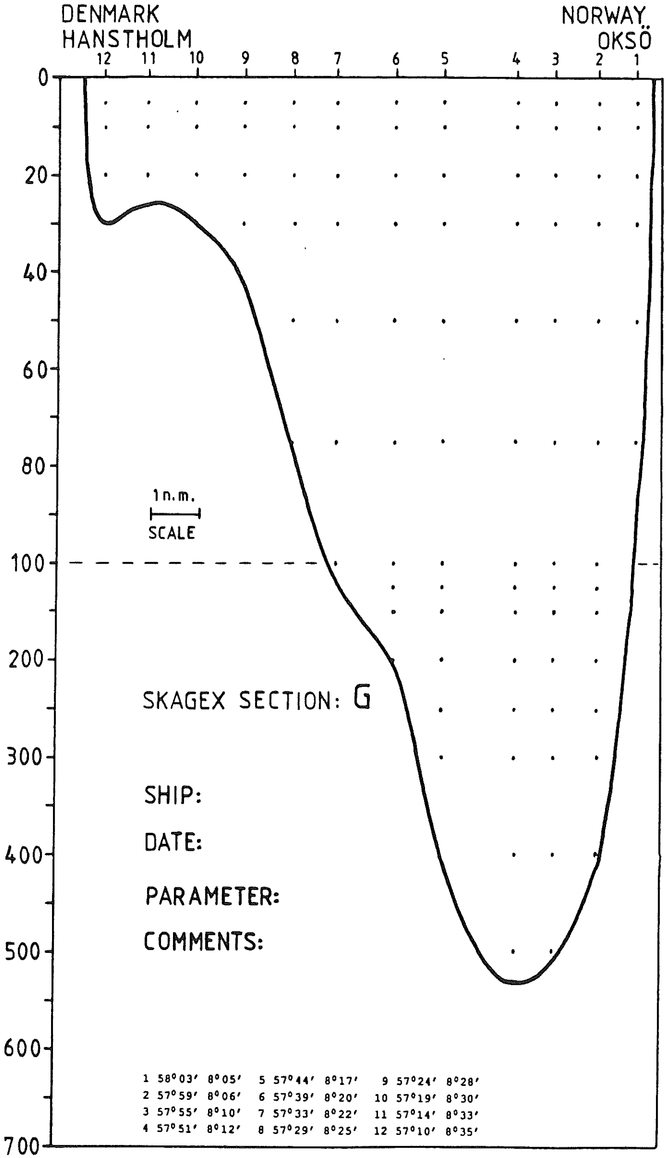
COMMENTS:

Station	Latitude(N)	Longitude(E)
1	58.20,2	11.09,5
2	58.20,2	11.06,1
3	58.20,2	11.02,0
4	58.19,0	10.56,5
5	58.17,7	10.51,0
6	58.16,0	10.43,5
7	58.13,6	10.33,5
8	58.11,3	10.23,5
9(E8)	58.09,0	10.14,0
10	58.04,5	09.48,0
11(F7)	58.00,0	09.21,0

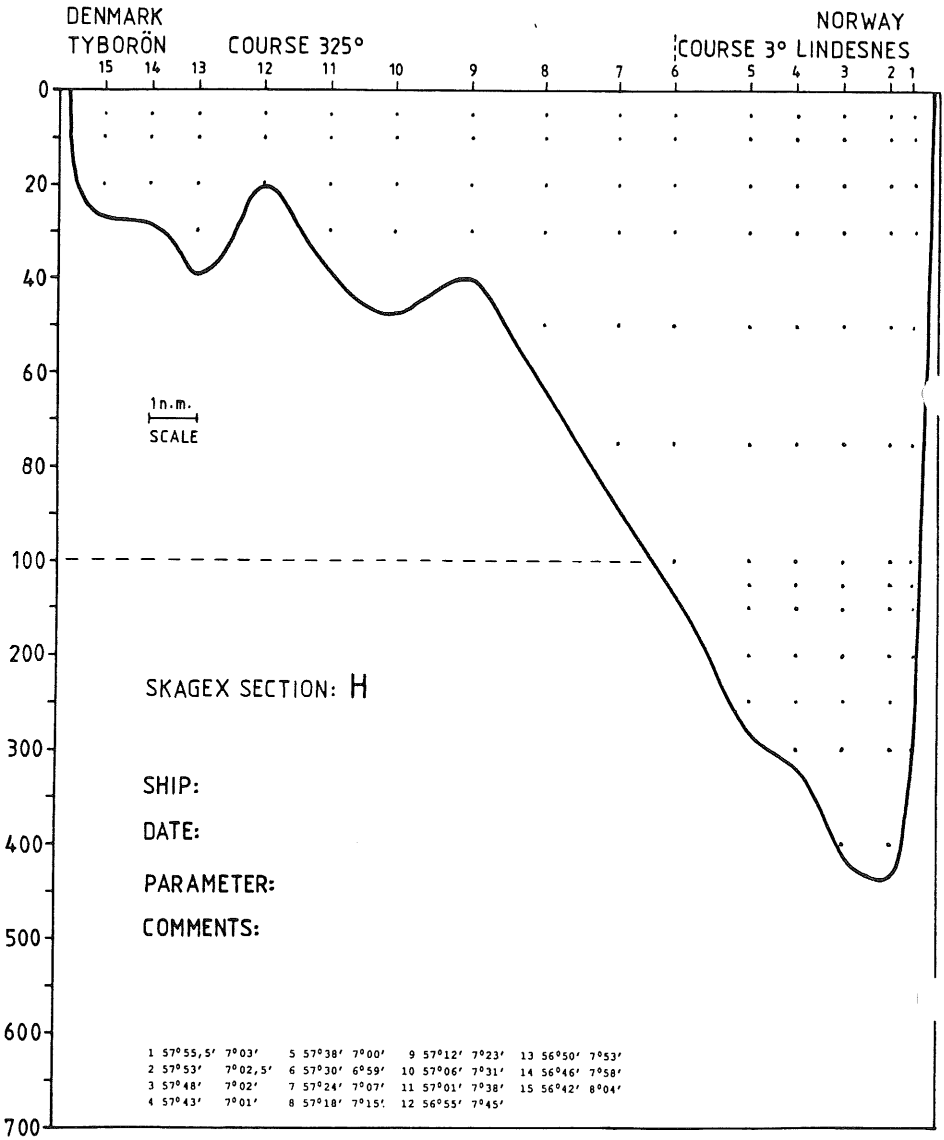


DENMARK
SKAGEN
NORWAY
JOMFRULAND
13 12 11 10 9 8(C9) 7 6 5 4 3 2 1
0
20
40
60
80
100
200
300
400
500
600
700
1 n.m.
SCALE
SKAGEX
SECTION: E
SHIP:
DATE:
PARAMETER:
COMMENTS:
1 58°49′ 9°36′
2 58°45′ 9°40′
3 58°41′ 9°45′
4 58°36′ 9°49′
5 58°29′ 9°55′
6 58°23′ 10°00′
7 58°16′ 10°08′
8 58°09′ 10°14′
9 58°03′ 10°19′
10 57°58′ 10°24′
11 57°54′ 10°27′
12 57°49′ 10°32′
13 57°46′ 10°34′


DENMARK
HIRSHALS
NORWAY
TORUNGEN
(C11)
12 11 10 9 8 7 6 5 4 3 2 1
0
20
40
60
80
100
200
300
400
500
600
700
1n.m.
SCALE
SKAGEX
SECTION: F
SHIP:
DATE:
PARAMETER:
COMMENTS:
1 58°23′ 8°49′ 4 58°12′ 9°05′ 7 58°00′ 9°21′ 10 57°48′ 9°40′
2 58°20′ 8°53′ 5 58°08′ 9°11′ 8 57°56′ 9°27′ 11 57°42′ 9°47′
3 58°16′ 8°59′ 6 58°04′ 9°16′ 9 57°51′ 9°34′ 12 57°38′ 9°52′



DENMARK
HANSTHOLM
NORWAY
OKSÖ
12 11 10 9 8 7 6 5 4 3 2 1
0
20
40
60
80
100
200
300
400
500
600
700
1 n.m.
SCALE
SKAGEX SECTION: G
SHIP:
DATE:
PARAMETER:
COMMENTS:
1 58°03′ 8°05′
2 57°59′ 8°06′
3 57°55′ 8°10′
4 57°51′ 8°12′
5 57°44′ 8°17′
6 57°39′ 8°20′
7 57°33′ 8°22′
8 57°29′ 8°25′
9 57°24′ 8°28′
10 57°19′ 8°30′
11 57°14′ 8°33′
12 57°10′ 8°35′



DENMARK
TYBORÖN
COURSE 325°
NORWAY
COURSE 3° LINDESNES
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
0
20
40
60
80
100
200
300
400
500
600
700
1n.m.
SCALE
SKAGEX SECTION: H
SHIP:
DATE:
PARAMETER:
COMMENTS:
1 57°55,5' 7°03'
2 57°53' 7°02,5'
3 57°48' 7°02'
4 57°43' 7°01'
5 57°38' 7°00'
6 57°30' 6°59'
7 57°24' 7°07'
8 57°18' 7°15'
9 57°12' 7°23'
10 57°06' 7°31'
11 57°01' 7°38'
12 56°55' 7°45'
13 56°50' 7°53'
14 56°46' 7°58'
15 56°42' 8°04'

SKAGEX, list of coordinators, subgroups etc

Chairman

Mr B I Dybern

Main coordinating group

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Norway	Mr L Føyn
Sweden	Mr I Olsson

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	Mr B Håkansson (alternate)
USSR	Mr M Kahru

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Sweden	Mr T Thompson

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