Hydrography Committee

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REPORT OF THE WORKING GROUP ON OCEANIC HYDROGRAPHY

Oban, 26-28 April 1995

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK-1261 Copenhagen K Denmark

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1. Opening

Dr. David Ellett, Dunstaffnage Marine Laboratory welcomed the working group to Oban.

2. Review of membership

The latest list of members from the ICES Secretariat showed that the following had been appointed members of the working group:
A. Edwards (UK), T.Rossby (USA), M.Rhein (Germany), J.P.Vitorino (Portugal) and G. Wegner (Germany):

The following have left the group:
K.Aagaard (USA), R.A.Clarke (Canada), D.J.Ellett (UK), L.G.Golmen (Norway), D.Lafaivre (Canada) and J.Nihoul (Belgium).

3. Remarks from the ICES Oceanography secretary

The ICES Oceanography Secretary, H. Dooley, gave a thorough report on status and ongoing work of the Service Hydrographique. He dealt with the progress of the databank, showing a general delay of data input since 1990. A positive sign though was new data input from SACLANT, Italy, and from Finland. Furthermore, the Oceanography Secretary dealt with archaeology of data with emphasis on surface data. In particular, the enthusiastic efforts of Gilles Reverdin in this aspect was mentioned. The next step was just mentioning ROSCOP, followed by information on EC and MAST efforts which might support Symposia and work of scientists on data, as well as information on cooperation in data management both nationally as on MAST levels, f.ex. GLOBEC data. Regarding further development, H. Dooley dealt with the future function of ICES and its secretariat as regards data bases in connection and integration with other data bases. H.Dooley also informed about WWW, its content including information on institutes and their role, and activities including projects and data. H.Dooley mentioned some points from the discussion on the 1994 Council Meeting in St. Johns - the large scale circulation changes in the North Atlantic on time scales of climatic change as well as Baltic inflow. The importance of standard sections and time series was stressed, as well as a possible changed sampling strategy. Quality assurance was also considered in the report and collaboration with IOC on guidelines and formats.

In the discussion after the presentation of the Oceanography Secretary , data flow was considered both nationally and in project form such as WOCE, with emphasis on securing that project data go into the ICES data base. Surface data flow was also considered, CPR data and other parameters (SST, SSS etc.). The effort in collecting surface data increases heavily with up to 10 different parameters including pCO_2 observations. It was stressed that the different groups working on surface data f.ex. from ships of opportunity should work together. Other information given during the discussion was about a candidate going to support data work at ICES, who should be on a scientific level. It was also stated that GOOS seems to develop to a coastal project due to lack of funds.

In general, the discussion was peaceful showing the support to Service Hydrographique with the importance of data flow and data quality in mind.

4. Results from research and monitoring programmes related to radioactive contamination in the Nordic Seas.

J. Blindheim reported on the research conducted to assess the risks of spreading of radioactive material from the sunken submarine Komsomolets as well as from the dumpsites in the Kara Sea. The Komsomolets sank on April 7, 1989 and lies at 1680 m water depth on the southern slope of the Lofoten Basin, 100 miles SW of Bear Island.

The issue is taken seriously because of possible severe effects on the fish market, stimulated by somewhat over-dramatized press releases.

IMR in Bergen has conducted cruises to the area and put down a current meter rig. Bottom currents were along slope and variable. Residual bottom current of 2.8 cm/sec pointing SW was found over 3 months. Thermohaline stability of the water column is such that the possibility of dissolved radioactive material reaching the surface is very remote indeed. An environmental assessment study concluded that salvaging the wreck would turn a small risk into a big risk. Further information in Roald Saetre (Ed.)(1994): *"The sunken nuclear submarine in the Norwegian Sea - a potential environmental problem?"* Fisken og Havet 7, 46 pp.

Monitoring will continue.

The Kara Sea dumping sites are in two fjords, Abrosimov and Steppovogo, on the eastern side of Novoya Zemlya, water depth 20 to 60 m. A cruise report of the Joint Norwegian/Russian expedition on R/V Buinitsky in August/September 1994 was written by Foyn and Nikitin. Locally increased concentrations of Cs-137 and Co-60 were found by in situ gamma radiometry, mainly in the vicinity of waste containers, less in the vicinity of spent reactors, which apparently are better sealed. Generally, the contributions from Sellafield are larger than those from this waste. Both sediments and biota have been collected; the cruise report states explicitly that final conclusions can be drawn only after other radioisotopes have been measured in these samples.

In the discussion, the effect of long-lived radioisotopes, especially plutonium, was elaborated. The Komsomolets waste contains 2 kg Pu-23q in the reactor fuel and possibly an additional 6-7 kg in the warheads.

Existing evidence on the behaviour of Pu and experience with previous accidents in the deep sea allows the preliminary conclusion that Pu will stay immobilised in the sediments in the vicinity of the site.

Also German and UK cruises will investigate the Komsomolets site.

5. Results from standard stations and sections.

Detailed presentation of data are given i Appendix 5.

S. Narayanan reported on the condition on the coastal water of Newfoundland and Labrador. R.R. Dickson presented some results from the Labrador and Irminger Seas.

Conditions off West Greenland was reported by E. Buch, who also forwarded new ideas concerning the inflow of Atlantic water to the West Greenland area.

S.Aa.Malmberg reported on the condition in Icelandic waters. No Atlantic water was observed north of Iceland in February 1995 after a 4 year period (1991-94) of relatively moderate inflow. Thus North and East Icelandic waters turned unusually cold during the period from November 1994 to February 1995.

B.Hansen presented results from the standard section around the Faroes. Also in this area a reduction in the inflow of water of Atlantic origin is observed during the 1990s reflected in decreases in temperature and salinity.

J. Blindheim presented results from the Norwegian standard sections. The temperature in the Barents Seas was about average but the temperature in the Norwegian and North Seas is decreasing.

S. Østerhus presented results from OWS M. Doubt was raised about the quality of the deep water salinity measurements, both on OWS M as well as in general which has resulted in an uncertainty on the actual salinity of the Norwegian Sea Deep Water. The working group therefore decided to ask J.Blindheim, B.Hansen, W.Turrell. J.van Bennekom and S.Østerhus (chairman) to look carefully into the salinity data from the Norwegian Sea and report back to the working group.

W.Turrell presented results from the Faroe - Shetland standard sections.

D. Ellett presented results from the standard stations in Rockall Channel.

G.Becker presented results from Meteor and Gauss cruises on the 48°N section and WOCE AR-7E in 1994. The temperature in the Labrador Sea compared with 1992 has decreased, the salinity increased.

J. van Bennekom presented results from a cruise to the Norwegian Sea in October 94.

A.Lavin presented results from the standard section off Santander and Vigo.

The ICES database contains long and valuable time series from the Standard Sections and Stations. The working group discussed the possibility to publish these data on a regular basis like it earlier was done in Annales Biologique. Many good proposals were forwarded. To proceed the Working Group agreed on asking H.Dooley, R.R. Dickson (chairman), S.Aa.Malmberg, J.Blindheim and S.Narayanan to design a proper format for publishing results from standard stations and sections. A draft proposal shall be ready for discussion on the next Working Group meeting.

Full depth observations is recommended for the standard stations and sections.

6. Climate variability and long-term changes of the pan-Atlantic cod population.

R.R. Dickson reported the results from the first meeting of Backward-Facing Study Group of the Cod and Climate Working Group.

The objective is to look backwards and try to model the events that have been observed over the years. The idea was to study the stocks before they were overfished, as they are now. The West Atlantic was studied during the first meeting where data from the 1860 - 1990 period was analysed using a North Atlantic model. Two papers are in preparation as an immediate result of the meeting.

The second meeting of the Backward Facing Study Group is planned to take place in Bergen March 1996 and will primarily focus on the East Atlantic. R.R. Dickson presented the task list for the meeting (Appendix 4). R.R.Dickson encouraged the WGOH members to play an active role in this work.

S.Aa. Malmberg presented his work on cod migration with warm waters of the northern North Atlantic. He focused on the cod stock biomass, catch and recruitment. Warm Atlantic water recently gave a 50% possibility for good recruitment, whereas its absence was followed by weak recruitment. During recent years both warm and cold years have resulted in weak recruitment, possibly due to a critically small spawning stock. S.Aa.Malmberg also presented salinity observations from the upper 300m in North Icelandic Waters. Low salinity meant Arctic waters. A relation between this salinity, abundance of the capelin stock and the weight of 5-year old cod was demonstrated.

S.Aa. Malmberg finally presented drift patterns of surface drifters showing a discontinuity south of Iceland. Further releases are planned to given an idea of the circulation around Iceland and the drift of cod larvae.

The importance of establishing correlations between physical parameters (temperature, salinity) and biological parameters was discussed.

S.Aa.Malmberg said that variability of food supply looks as the more important reason for the variability of the growth of the cod than temperature, but temperature and salinity may reflect good or bad conditions for food supply.

S. Narayanan informed that Myers have not found significant correlations between temperature/salinity and the size of the Canadian cod stock. The conclusion of his work therefore is that overfishing is the main cause for the collapse of the cod stock. In Canada a project focusing on a retrospective analysis of the relation between the physical environment and fishing mortality is performed.

R.R. Dickson said that it is necessary not only to focus on correlations, but also to understand the physical and biological processes.

Finally the chairman stressed that the Oceanic Hydrography WG has to work on the subjects in the task list given by R.R. Dickson (appendix 4) and present their results at the Backward Facing Study Group Meeting in Bergen, March 1996.

7. Progress in national and international projects.

WOCE

B.Hansen presented a brief summary of progress within the NORDIC WOCE project to date. Despite initial problems with the RD manufactured ADCPs, a trial deployment began in October 1994. The instruments were recovered in February 1995. (7 instruments were deployed around Faroe; 1 shallow water mooring to the north, and 2 deep water moorings north of Faroe, 1 deep water mooring in the Faroe Bank Channel and 3 in the Faroe Shetland Channel).

In general data return was good. Single ping ensembles showed good coherence between bins and between ensembles. The results are, however, confusing as the directions are not as anticipated. Further checks await to be performed. The full set of 9 moorings will be deployed again in August 1995.

G.Becker described present plans for WOCE participation. J.Meincke will conduct surveys along the AR7 section on Valdivia in 1995. Meteor will work on AR7 E and W in 1997 again. BSH will work along the 48° section in May 1996.

S.Narayanan described Canadian contributions to WOCE. In general this will be focusing on shelf/ocean modeling. Oceanic work is presently under some pressure. A joint industry/university/government modeling proposal has been submitted. It was stressed in the discussions that results from the western Atlantic are of key importance to this group.

J.Blindheim informed on the status of the WOCE Core Project 3. There are some problems with continued funding. Discussions are taking place with NOAA to link WOCE and the US Atlantic Climate Change Program (ACCP). Areas north of the Greenland-Scotland sill are now of interest to WOCE, and they are encouraging the northern IGY sections to be reworked. The main field work for Core project 3 will be during 1996/1997. Work will include gyre modeling experiments.

A.Lavin described previous work along the 24° line.

In the discussions H.Dooley questioned whether Core Project 3 had new funding.

Mare Cognitum

An annual meeting was held in February 1994 (the report is not yet available). Field work has started, although funding was not as great as originally planned. The program essentially focuses on the ecology of the Nordic Seas, with special relation to the recent increase in the Atlanto-Scandinavian herring stocks. The program is a GLOBEC component.

Malmberg described the East Icelandic Ecology study, which is part of Mare Cognitum. 2 cruises were performed in 1994, and several are planned for this year. Phyto- and zooplankton, CO_2 and CTD observations are made.

It was concluded that work has commenced in Iceland, Norway and Russia. The links to ICES are unclear. While the program is essentially a Norwegian project, sub-modules link with other national programs.

GOOS

The agenda item was introduced as a response to a request from the Chairman of the Oceanic Hydrography Committee to solicit views on the role of ICES in GOOS.

An overview of GOOS was presented by Turrell based on the proceedings from a conference organised by the United Nations Organisation for Economic Cooperation and Development held in Tokyo to discuss Oceanography within the Megascience forum.

The main conclusions of the discussion in the working group were:

- ICES can play a major role in the design and implementation of GOOS because of the long - term involvement of ICES members in the data collection along the standard sections and stations, and in the analysis of these datasets to address the climatic variability in the North Atlantic.

- ICES has already established procedure for the quality control, archival and retrieval of multi-national/multi-instrument data sets and can therefore make significant contribution to GOOS in data handling.

- Many of the ICES member countries have signed a memorandum of understanding for a EURO GOOS, which has its headquarters in UK

- The ICES secretariate has already established links to the GOOS office in Paris and the EURO GOOS office in UK

It was recommended that:

ICES Standard Stations and Sections maintained by the Working Group be included a pilot cooperative ICES contribution to GOOS with data being handled by the ICES Oceanography Data Centre.

GLOBEC

H. Dooley introduced GLOBEC. ICES is an official co-sponsor of GLOBEC, along with PICES and SCOR. Presently the main objective is to define a science plan in order to put the project forward to the IGBP. The Cod and Climate program is the ICES contribution to GLOBEC. ICES will be housing a GLOBEC office by the end of 1995. The associated post will be held by a fisheries biologist.

EU MAST III Projects

VEINS:
The objective is to study the Nordic seas exchange regions. There are four regional components: Iceland-Scotland ridge area, Northeastern Boundaries, Fram

Strait and Denmark Strait. Modeling also forms an important component. This project has strong links to the Mare Cognitum and ESOP studies, as well as the Arctic Grand Challenge program. VEINS is co-ordinated by Jens Meincke.

SALINE:
Coordinated by R Pollard (UK). To study the formation of ENAW in the southern Rockall trough, and its transport within the Eastern Boundary Current. Will include modeling and drifter experiments.

ICES involvement in future international projects

This agenda item was introduced to discuss the ways and means to ensure that ICES continues to play a leading role in major international projects in ICES area. There was a concern among some of the WG members that ICES may miss the opportunity to establish strong links with major project groups in future, especially at the early stages of planning and implementation. In the past, ICES had taken a leading role in initiating multinational, multidisciplinary projects. Recently, however, the EU and other organizations are becoming the primary coordinators and funding agencies for such projects. Many of the scientists who are involved in these projects are also active participants in ICES, and in most cases, develop their project plans based on discussions at ICES WG meetings and at the theme sessions at the Annual Science Meetings and symposia on special topics. It was however felt that it is important for ICES to profile itself more strongly in the initiation phase as well as in the coordination and management of North Atlantic research programmes. A strong involvement in GOOS as recommended at this meeting may be a first step in this direction.

8. NANSEN project report.

The North Atlantic Norwegian Sea Exchanges (NANSEN) project had its field phase from 1985 to 1990. Several ICES papers have been based on data from the NANSEN project, a final report has not yet been prepared to present the findings of the project. It has therefore been a repeated topic on the agenda of the WG on Oceanic Hydrography which does not want to leave the topic before more proper reports have been proposed.

During the 1994 meeting of the WG, B. Hansen and S. Østerhus were given the task to initiate the work on a final report. Their plan was to get several papers in a common volume in a refereed journal, covering, for example, the following areas:

1. A general overview of NANSEN
2. The Iceland Basin
3. The Iceland-Faroes region
4. The Faroe Bank Channel
5. The Faroes-Shetland region

In asking relevant institutes for information to this, they got only limited response.

Although they have initiated work on their own data, the WG recognised that this will not lead on to the comprehensive reporting which is wanted. There are, however, some articles in refereed journals already, and the ICES papers mentioned above. It was discussed how this information may be applied in the final reporting, and it was agreed that it should be prescribed in a volume of the ICES Cooperative Research Report Series. This volume should contain a general overview article, written by B.Hansen and S.Østerhus as well as the ICES papers which are based on NANSEN data. The essence of the other publications should be referred to in the general overview or presented as extended abstracts. A resolution was prepared.

The WG was informed that H. van Aken and G. Becker will publish results from the Iceland Basin on the basis of Dutch and German data.

It was also discussed whether the information in the volume of the Cooperative Research Report Series should be wider distributed by prescribing a review paper in a refereed journal as for example the ICES Journal of Marine Science. B.Hansen and S.Østerhus were encouraged to take this work on also.

9. Oceanographic instrumentation.

G. Becker reported problems with the so called intelligent GO-rosette. On a Meteor cruise this type of instrument did not work at all. The instrument has since been somewhat improved. J.Blindheim told that he have had some problem with the first Sea-Bird rosette sampler, but the producer has improved the instrument and it is now functioning very well. S. Narayanan confirmed also good experince with the Sea-Bird rosette sampler which seem to be the best system for the moment.

G.Becker also reported on a comparison between three different CTD-systems. It turned out that the "old" Neil Brown MK III system still had the best performance. The noise of one conductivity cell of a new developed instrument was nearly double of the noise of the two others.

G.Becker finally reported that they have had problems with the recovery of 6 moorings from large depth (3000m) equipped with the new releaser from MORS (OCEANO). The instruments confirm that they have released, but they did not release. Both G.Becker and others reported good experience with older OCEANO releasers, so the problem seems only to be linked to newest model.

B. Turrell reported that new PC's (486) do not read DSU (Data Storing Units) from Aanderaa instruments very well (they are to fast) so he recommended use older PC's (bite 286 and 386). It is impossible to charge batteries in the new DSUs, one have to buy new DSU when the battery has gone flat.

It was suggested to contact Aanderaa about this problem.

10. Review of quality assurance procedures for oceanographic data.

The ICES Oceanography Secretary explained the problems and difficulties the ICES data bank experience in dealing with data deliveries. Data formats and data documentation are causing problems. H. Dooley drew attention to the fact that data deliveries are mostly exports from other national or institutional data banks, which are not designed to export data. H. Dooley raised the problem of untrained personnel, who take the data at sea. The chairman of MDM, L. Richards, described some of the quality checking procedures applied at BODC. L. Richards stressed that quality assurance procedures had to be started before a cruise.

The WG members discussed problems and different solutions of quality assurance procedures. They concluded that a general agreed minimum standard procedure should be applied. J. Blindheim, IMR, reported on a handbook he has written, how to handle CTD systems and data before, during and after a cruise. The WG asked J. Blindheim to distribute this manual before the next meeting, so that members of the WG can discuss this in the institutes. It will be discussed during the next meeting.

H. Dooley pointed to existing manuals (SCOR WG Report No. 51 and the JPOTS manual).

H. Dooley was asked to provide guidelines on the use of units. A manual of quality control standard checks will be supplied by ICES WG on Data management/ICES.

11. Discussion of letter from Hydrography Committee chairman of December 1, 1994.

H.Loeng had in December 1994 sent out a letter to members of the Hydrography Committee, which included details of possible restructuring within ICES, the forthcoming Annual Science Meeting and raised some questions including:

1. GOOS, for input to ACME
2. Work of Hydrographic Committee, should there be more contact with other members of ICES (i.e. biologists, and greater use of standard sections for example)
3. Presentation of papers at the Annual Science Meeting. Should there be more papers presented at the Hydrography Committee or more posters? More time has been allocated to WG reports, which is good.
4. Other ideas from members were requested.

Response from members was fairly small, with only 5 responses.

Some discussion followed on item 2 (GOOS has been discussed as part of an earlier item). S.Aa. Malmberg was in favour of more presentations within the Committee, especially from newer scientists. G. Becker suggested that the bureaucracy should be reduced. The general feeling was that paper presentations should be encouraged and were a better way of passing on the information.

The theme sessions and mini symposia for this year's Annual Science Meeting were briefly mentioned. W.Turrell noted that there may be EU money available for funds for young scientists to travel to the Annual Science Meeting. H.Loeng should investigate this further.

A little more discussion followed on input to stock assessment groups especially with respect to standard section data. Work should also continue with physical oceanographic interpretation of the sections.

H. Loeng also requested members of the WG to suggest topics for future theme sessions or minisymposia.

W.Turrell asked if there was interest for a theme session on changes in the deep water. J.van Bennekom thought that perhaps there was more interest in intermediate waters.

S.Aa. Malmberg thanked the new Chairman of the Hydrography Committee for his active work in contacting members of the Committee and inviting their views.

12. Any other business.

G.Becker encouraged the member to use Deutsche Hydrographische Zeitschrift for publication. This journal offers:

* Four editions per year with world wide distribution..
* Quick publication (1/2 year)
* Takes colour prints
* No publication charges.

13. Place, date and topics of the next meeting.

The Chairman E. Buch invited the working group to meet at the Royal Danish Administration of Navigation and Hydrography, Copenhagen, which was accepted by the working group.
Dates: 24 to 26 April 1996.

As topics for the next meeting the following subjects were proposed:

a) assess quality assurance manuals (equipment, measurements, data processing and training);

b) update and review results from standard sections and stations;

c) evaluate the outcome from the "Design Group on presentation of result from standard sections and stations";

d) evaluate the results from the study group on Norwegian Sea Deep Water salinities;

e) review the conclusions of the second Backward Facing Workshop;

f) evaluate possibilities for ocean climate forecasting;

g) assess the developments in GOOS.

h) review progress in national and international projects in the North Atlantic;

j) finalize the report on ICES NANSEN Project;

k) assess and evaluate the oceanographic instrumentation.

l) comment on a report on ocean pathways of pollutants in Arctic waters (AMAP).

Justifications:

a) A number of Manuals describing procedures for data acquisition at sea have been, and are being, developed at various institutes. These manuals need to be reviewed in order to derive common recommended procedures. This item will be prepared intersessionally by J. Blindheim.

b) This is a standard item to enable the group to closely monitor ocean conditions. This activity may well develop into a basic activity of GOOS, and is being promoted as such.

c) A sub group has been set up to design a format for publishing the ongoing results of standard sections and stations. This group is led by R Dickson and includes H Dooley, S Malmberg and S Narayanan.

d) The monitoring of the salinity of the Norwegian Sea Deep Water requires the ultimate in accuracy of salinity measurement.. Recent changes in the salinity value of this water may be instrumental or real, but it is important for our ongoing studies to clarify the origin of this change. This work will be started inter-sessionally by S Østerhus with the support of J. Blindheim, B. Hansen, J van Bennekom, and W Turrell.

e) The second Backward Facing Workshop will be addressing primarily the long term changes in the Barents Sea ocean climate. Its conclusions may have wide implication on how we monitor the oceans and is therefore an issue that needs to be addressed by the Working Group. R. Dickson will provide a report for the Working Group;

f) Over the past two years Norwegian researchers have been publishing annual forecasts of ocean conditions (physics, chemistry and biology). The working group believes that it is appropriate to evaluate the utility of these forecasts with a view to their potential expansion to other parts of the ICES area. Harald Loeng will prepare a report to provide the basis for discussion.

g) GOOS is, and will be for some time, at the design stage. Most ICES member countries will be formally involved, one way or another, in GOOS activities, including those components of GOOS that will monitor open ocean conditions. In order to acquire an ICES-wide perspective of national contributions and intentions, the working group wishes to keep these activities under close scrutiny. All members will provide GOOS status reports to the chairman.

h) This is an ongoing item providing information to the members and ICES. Since many activities, or planned activities, are now being coordinated via funded proposals (e.g., EU) it is important to evaluate these activities (and those of other relevant Working Groups) in relation to the potential capabilities offered by the international funding framework.

j) This report is now well overdue because of changing commitments by the leading scientists of the NANSEN project. A determined effort will now be made intersessionally by S Østerhus and B Hansen in order to bring this ICES project to a conclusion. It is intended that the final report they will produce for approval by the working group will lead to a CRR publication.

k) Rapid technological developments continue to enhance our capabilities for measuring oceanographic parameters. These lead to many possibilities for increased resolution and efficiences. However there are many drawbacks if misused. This item therefore serves to inform members and ICES on the present status of the operational use of any new equipment

l) The chairman of the Hydrography Committee has asked the group to comment on a report he and others are preparing on ocean pathways of pollutants in Arctic waters, as part of AMAP activities.

Appendix 1.

List of Participants.

Erik Buch, Denmark (chairman).
David Ellett, UK.
Johan Blindheim, Norway.
Peter Lundberg, Sweden
W.Turrell, UK.
Svend Aage Malmberg, Iceland
Bogi Hansen, Faroe Islands
Svein Østerhus, Norway
Harald Loeng Norway
R.R. Dickson, UK
Savi Narayanan, Canada
Alicia Lavin, Spain
Johan van Bennekom, Netherlands
Gerd Becker, Germany
Harry Dooley, ICES
Lesley Rickards, UK

Appendix 2

Agenda

1. Opening
2. Review of membership
3. Remarks from the ICES Oceanography secretary
4. Results from research and monitoring programmes related to radioactive contamination in the Nordic Seas
5. Results from standard stations and sections
   * 1994 results
   * analysis and publication of old data
6. Climate variability and long-term changes of the pan-Atlantic cod population
7. Progress in national and international projects
   * WOCE Hydrographic Programme
   * Mare Cognitum
   * GOOS
   * EU MAST 3 projects
   * Globec
   * ICES involvement in future international projects
8. NANSEN project report
9. Oceanographic instrumentation
10. Review of quality assurance procedures for oceanographic data
11. Discussion of letter from Hydrography Committee chairman of December 1, 1994
12. Any other business
13. Place, date and topics of next meeting

Appendix 3

Recommendations

1) The Working Group on Oceanic Hydrography recommends that the ICES Standard Stations and Sections maintained by the Working Group be included as a pilot cooperative ICES contribution to GOOS with data being handled by the ICES Oceanography Data Centre.

2) The Working Group on Oceanic Hydrography (chairman: Dr. Erik Buch) will meet in Copenhagen, Denmark from 24 to 26 April 1996 to:

* Assess quality assurance manuals (equipment, measurements, data processing and training).
* Update and review results from standard sections and stations.
* Evaluate the outcome from the "Design Group on presentation of result from standard sections and stations".
* Evaluate the results from the study group on Norwegian Sea Deep Water salinities.
* Review the conclusions of the Second Backward Facing Workshop.
* Evaluate possibilities for ocean climate forcasting.
* Assess the developments in GOOS.
* Review progress in national and international projects in the North Atlantic.
* Finalize the report on ICES NANSEN Project.
* Assess and evaluate the oceanographic instrumentation.
* Comment on a report on ocean pathways of pollutants in Arctic waters (AMAP).

Subject/problems for Backward-Facing II.
Meeting: March 1996, 3 days, Institute of Marine Research, Bergen
Chairmen: K Frank; R Dickson
Method: To continue the Backward-Facing philosophy of circulating material for analysis, interpretation and especially modelling in advance of the meeting, followed by review, discussion and conclusions at the meeting.
Primary focus: the Barents Sea, but with Atlantic-wide or other large regional elements.
Tasks: to be selected from the following list:

1. To continue the work of Backward-Facing I to completion and publication.
2. An investigation of 19thC and early 20thC cold periods in the Barents Sea and effects on cod y.c.s. and growth [the extreme cold around 1903 at a time of general cooling will be a primary focus - ie the "cold-on-cold" case].
3. An investigation of the cold episode in the Barents Sea around 1941, at the peak of the 20thC warm wave - [ie the "cold-on-warm" case].
4. A comparative modelling study of local (heat flux, brine drainage etc) versus large-scale forcing in determining the temperature field of the Barents Sea; its time-dependence [long time-series sections] and space-dependence [differences between time-series sections].
5. Atlantic-wide intercomparison of cod:capelin relationships from the specific viewpoint of their physical and climatic controls.
6. Assess whether the closeness of the Brander growth:temperature fit varies regionally according to horizontal and vertical inhomogeneity in temperature.
7. Compare regional cross-shelf exchange mechanisms vis-a-vis C. finmarchicus.
8. Elaborate the pan-Atlantic response to the North Atlantic Oscillation signal.
9. Describe the time-dependence in Norwegian Sea Intermediate Water production and spreading postwar and its role as a control on C. finmarchicus spread to the southern Norwegian Sea.
10. What hydrographic or circulation controls determine the contrasting larval drift and settlement patterns of cod (inshore-offshore) and saithe (offshore-onshore) off NW Norway as 0-4 month olds.
11. Investigation of cold periods on the Baltic Sea cod stock.

Appendix 5

Results for Standard Sections and Stations

Canada (Savi Narayanan):

A review of meteorological and sea ice conditions off eastern Canada during 1994 is presented. Annual air temperatures were slightly colder-than-normal but warmed in comparison to recent years. Seasonally, the winter temperature anomalies were below normal but conditions moderated as the year progressed. By the summer and through into the late autumn air temperatures were warmer-than-normal. The cold air temperatures in winter were related to stronger northwest winds which carried Arctic air masses further south. The stronger winds resulted from an intensification of the Icelandic Low which was reflected in high positive values of the NAO index. These colder-than-normal winter air temperatures and accompanying stronger-than-normal northwest winds caused ice to form early, be of greater areal extent than normal and last longer off Newfoundland and southern Labrador. In addition, there were large numbers of icebergs reaching the Grand Banks in 1994. Heavy ice conditions were also observed in the Gulf of St. Lawrence and on the Scotian Shelf. In February and March the ice edge extended as far south as Halifax on the Scotian Shelf. The warming in eastern Canada in the summer and autumn was due to increased westerly and southwesterly winds over much of the region. These brought warm air from southern regions and central Canada.

Oceanographic data from the Grand Bank, northeast Newfoundland Shelf, St. Pierre Bank and the southern Labrador shelf during 1994 are compared to historical data from the area. The cold air temperatures experienced in Atlantic Canada during the winter of 1994 had moderated to near normal conditions by the spring of 1994 and to above normal values by the summer. As a result the anomalously cold water temperatures experienced in recent years along the east coast of Newfoundland had moderated in the upper water column (0-30 m depth) and by July surface layer temperatures were up to 2.0°C above normal at Station 27. Temperatures remained below normal however in deeper water (100-176 m) until the fall, when they returned to near normal values. The Bonavista cold-intermediate-layer (CIL) was slightly above normal in area (7 %) but much less than the past four years (up to 68 % in 1991). Comparisons of historical temperature data from NAFO Subdivisions 3Pn and 3Ps to data collected during April of 1994 indicates that the anomalous cold period that began in the mid 1980s has moderated somewhat but is continuing into 1994 near the bottom over St. Pierre Bank. In addition, large areas with below normal temperatures exist, particularly on the eastern portions of St. Pierre Bank, Placentia Bay and on the continental slope areas.

A review of physical oceanographic conditions on the continental shelves and adjacent offshore areas off the Scotian Shelf and Gulf of Maine during 1994 is presented. Waters in the Gulf of Maine were consistently warmer-than-normal as revealed by monthly XBT transects, hydrographic data at Prince 5, and sea surface temperatures at Boothbay Harbor and St. Andrews. This warming, including that in the near shore regions, is believed to be mainly due to the intrusion of warm slope water. This is supported by the presence of high salinity waters at Prince 5. Atmospheric heating may also have played a role in the warming of the upper layer waters in the latter half of the year when air temperatures were well above normal. Temperatures in the deep waters in Emerald Basin on the Scotian Shelf and at Cabot Strait were warmer-than-normal. These waters are derived from the offshore slope waters whose temperatures were also above normal. On the Scotian Shelf temperatures in the 50-100 m layer were typically colder-than-normal except over Emerald Basin. At depths greater than 100 m on the northeastern end of the shelf temperatures remained below normal. The shelf/slope front and the Gulf Stream were typically shoreward of their long-term mean positions and more Gulf Stream warm-core eddies formed in 1994 than in any single year in the last 13.

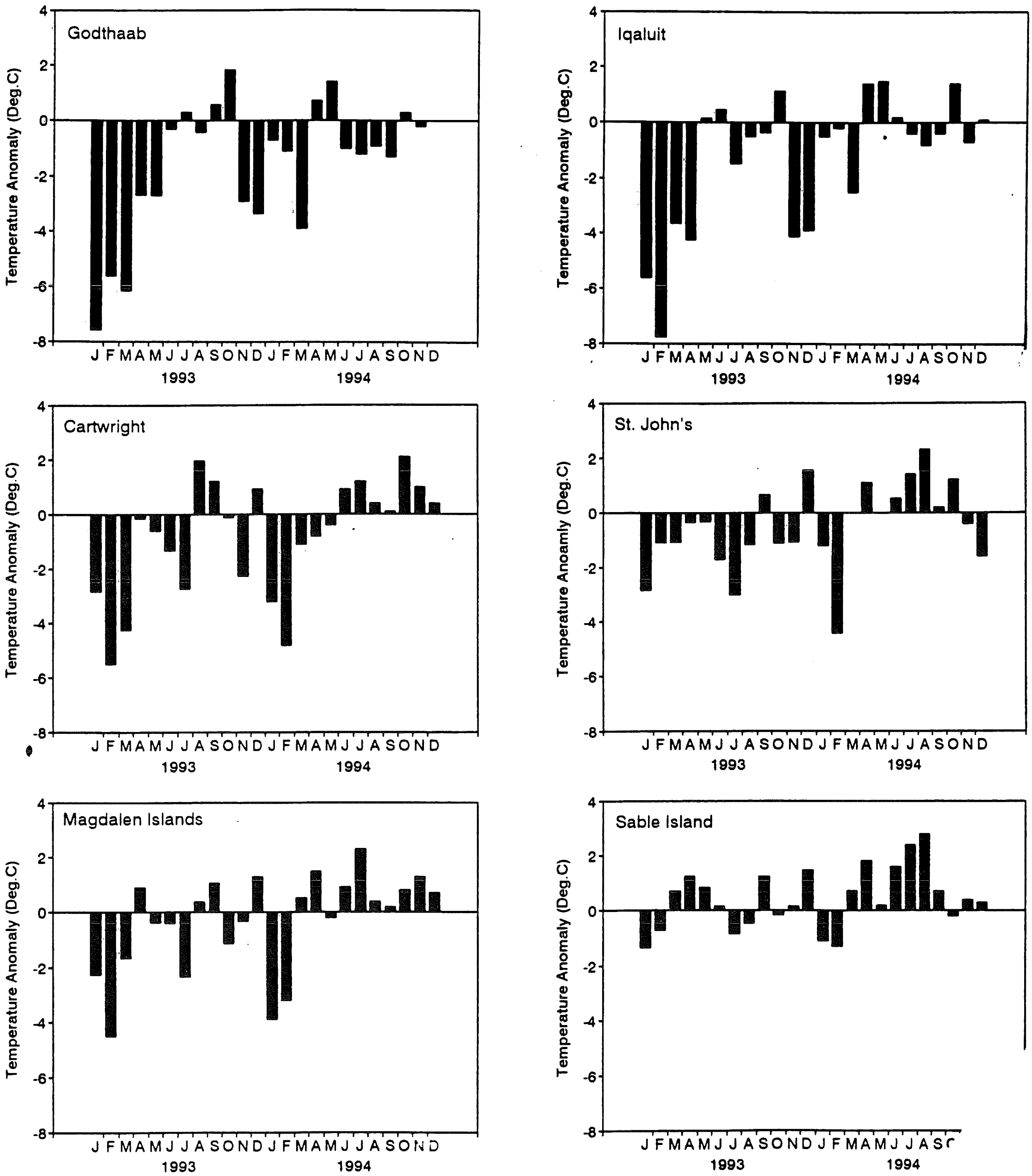


Fig.1 Monthly air temperatures anomalies in 1993 and 1994 at selected coastal sites.

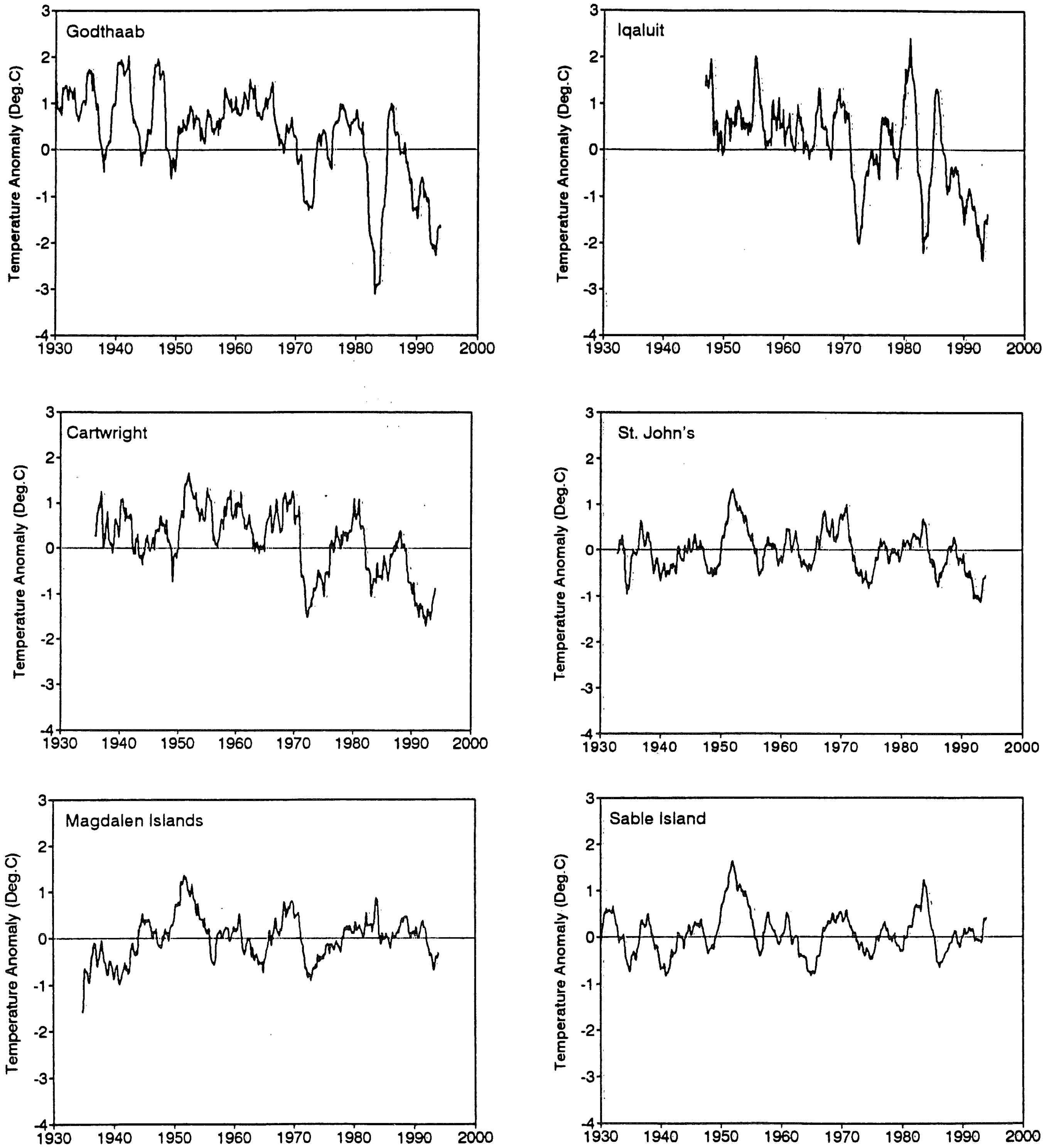


Fig.2 Twenty-five month running means of monthly air temperature anomalies at selected sites

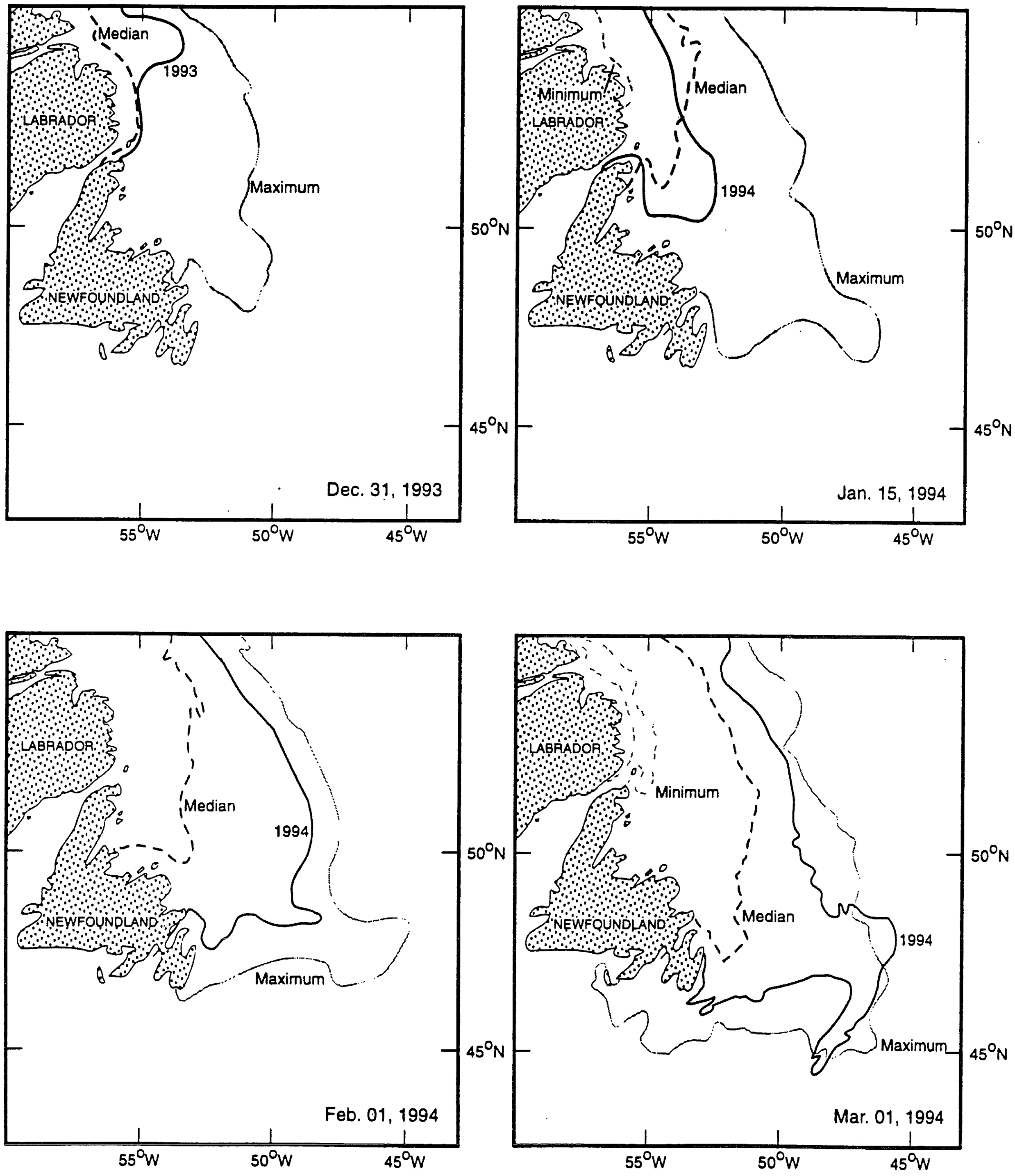


Fig. 3a The location of the ice edge together with the historical (1962-87 median and maximum positions off Newfoundland and Labrador between December 1993 and March 1994

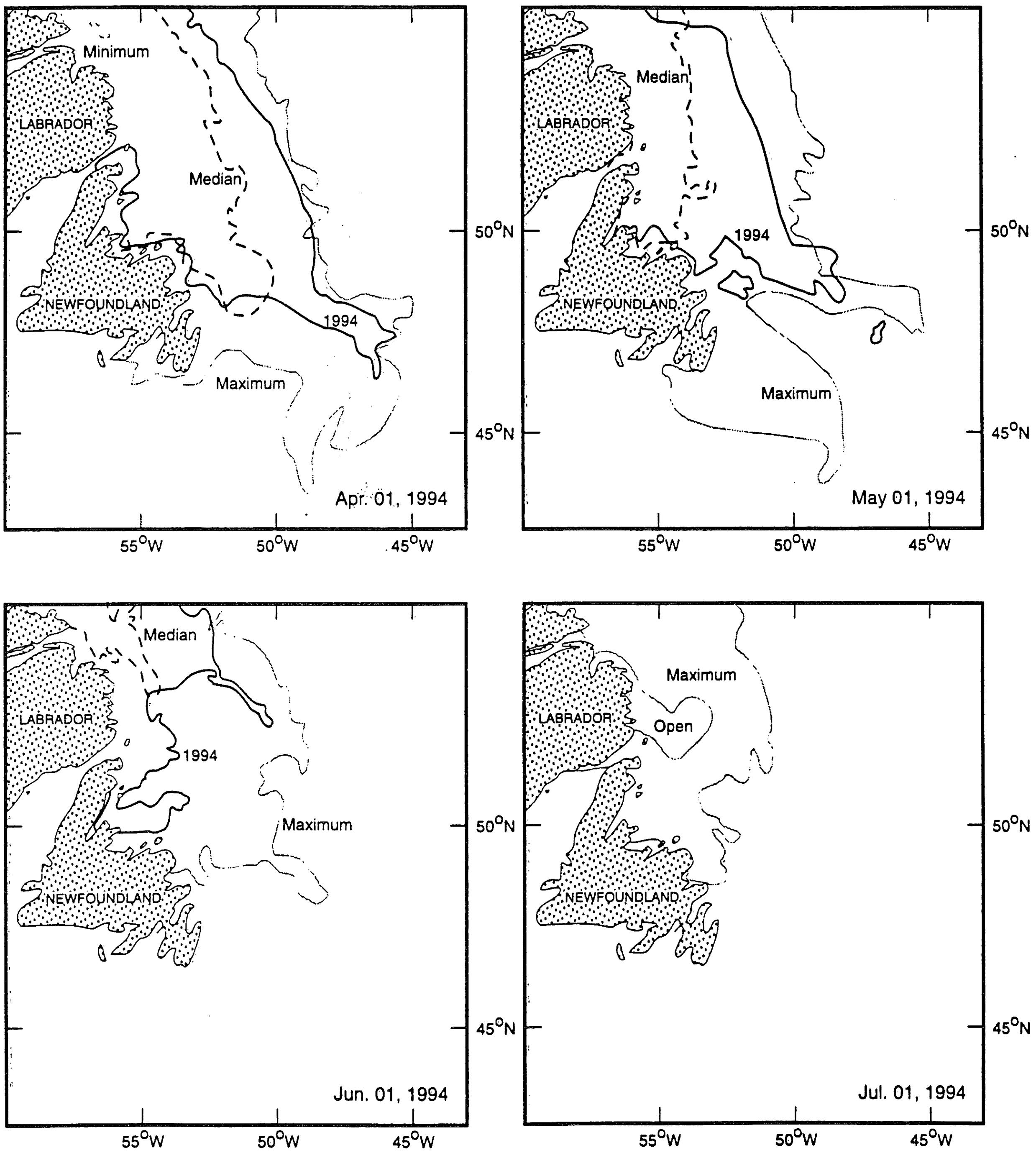


Fig.3b The location of the ice edge together with the historical (1962-87 median and maximum positions off Newfoundland and Labrador between April and July 1994

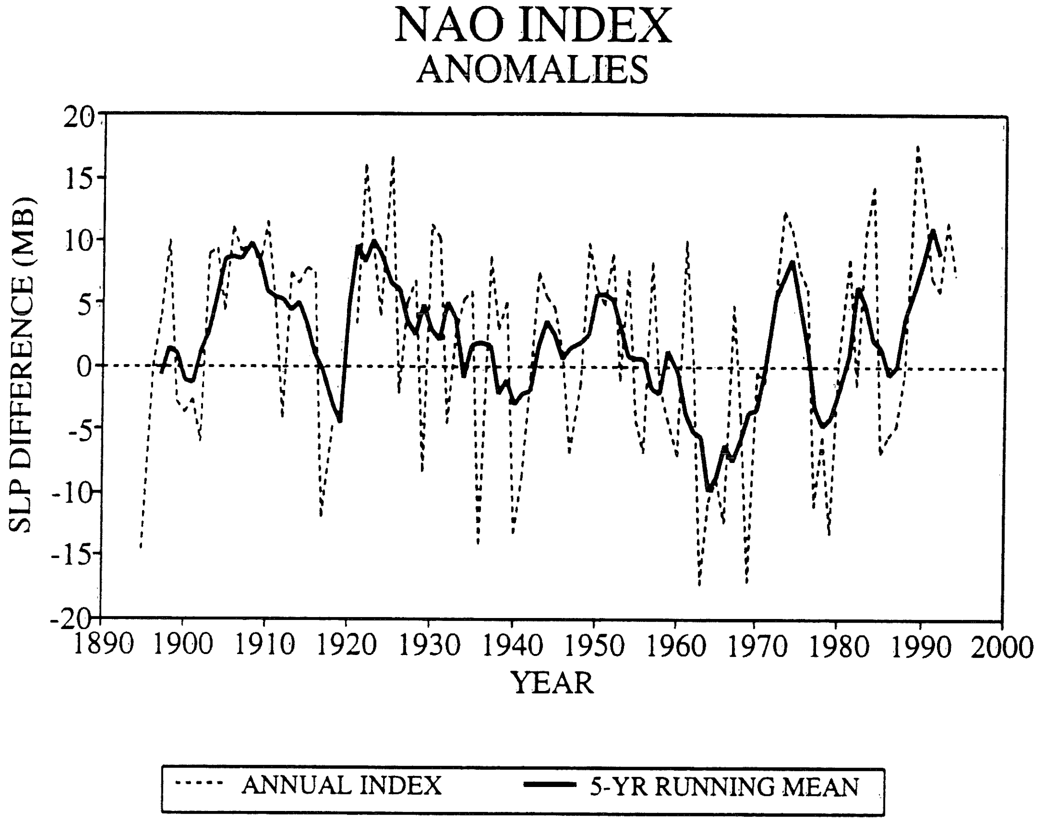


Fig. 4 The North Atlantic Oscillation Index defined as the winter (December,January, February) sea level pressure at Ponta Delgade in the Azores minus Akuary in Iceland.

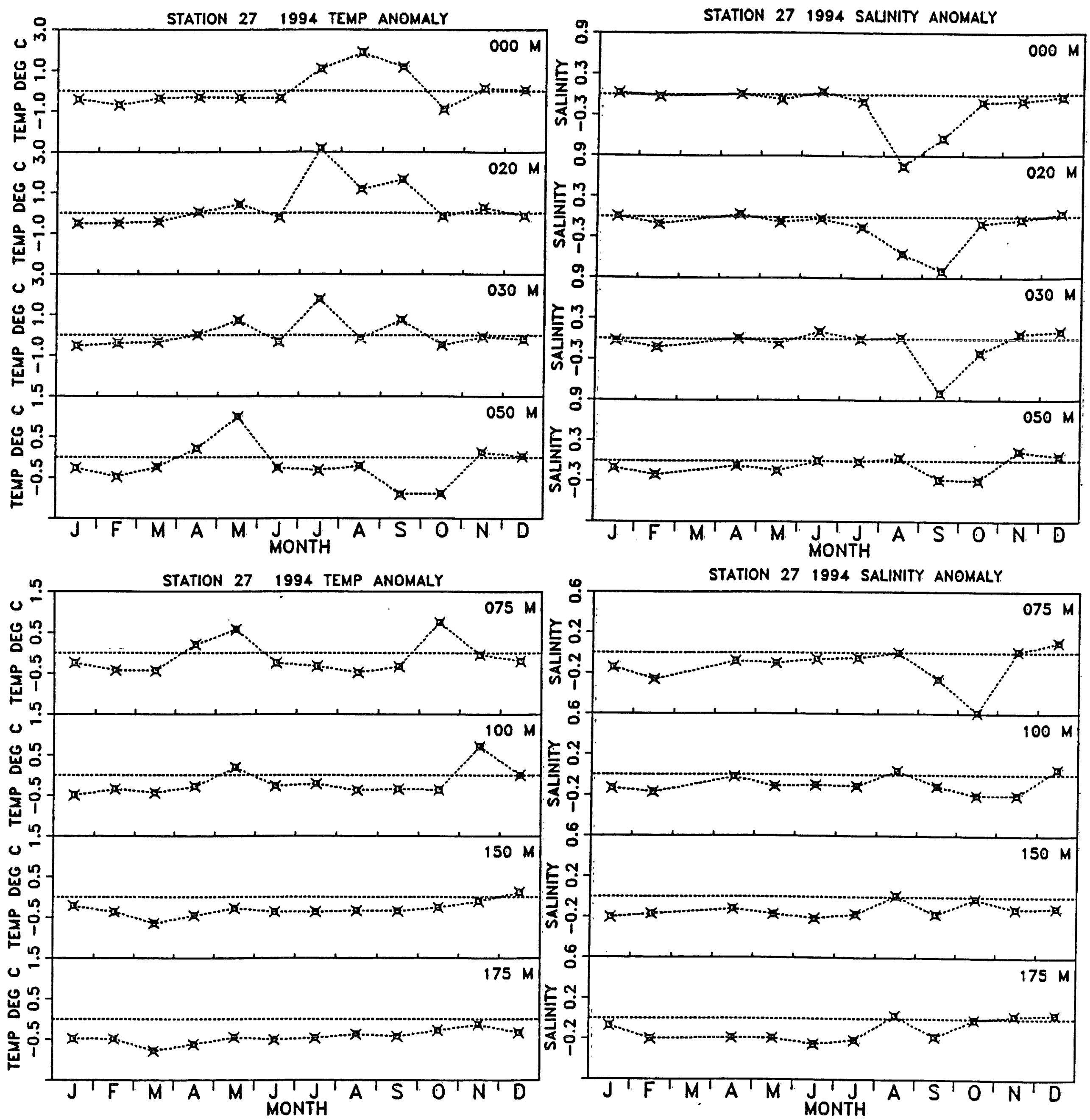


Fig.5 Time series of monthly temperature and salinity anomalies at Station 27 at standard depths during 1994.

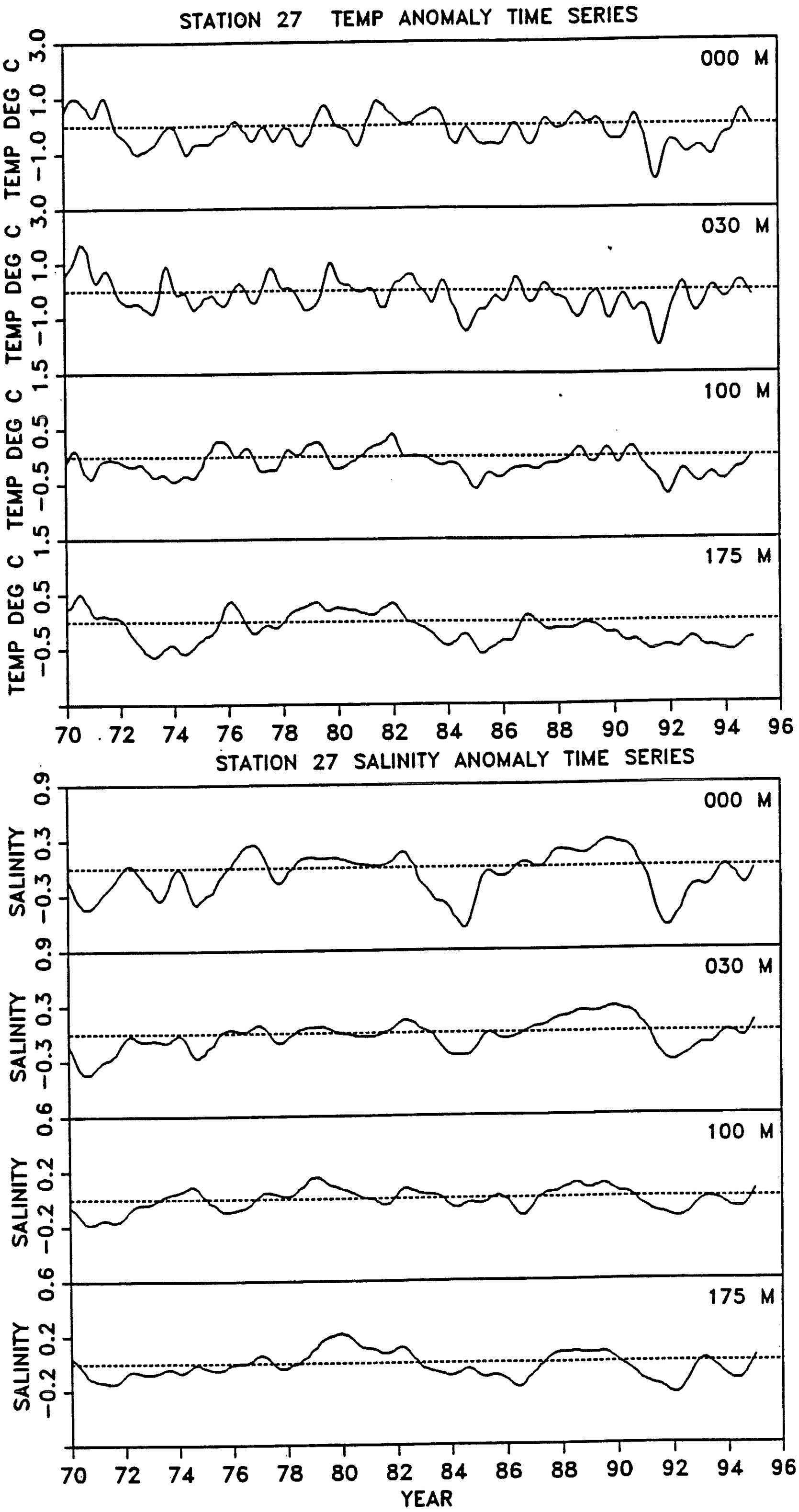


Fig.6 Low passed filtered time series of temperature and salinity anomalies at Station 27 at standard depths from 1970 to 1984.

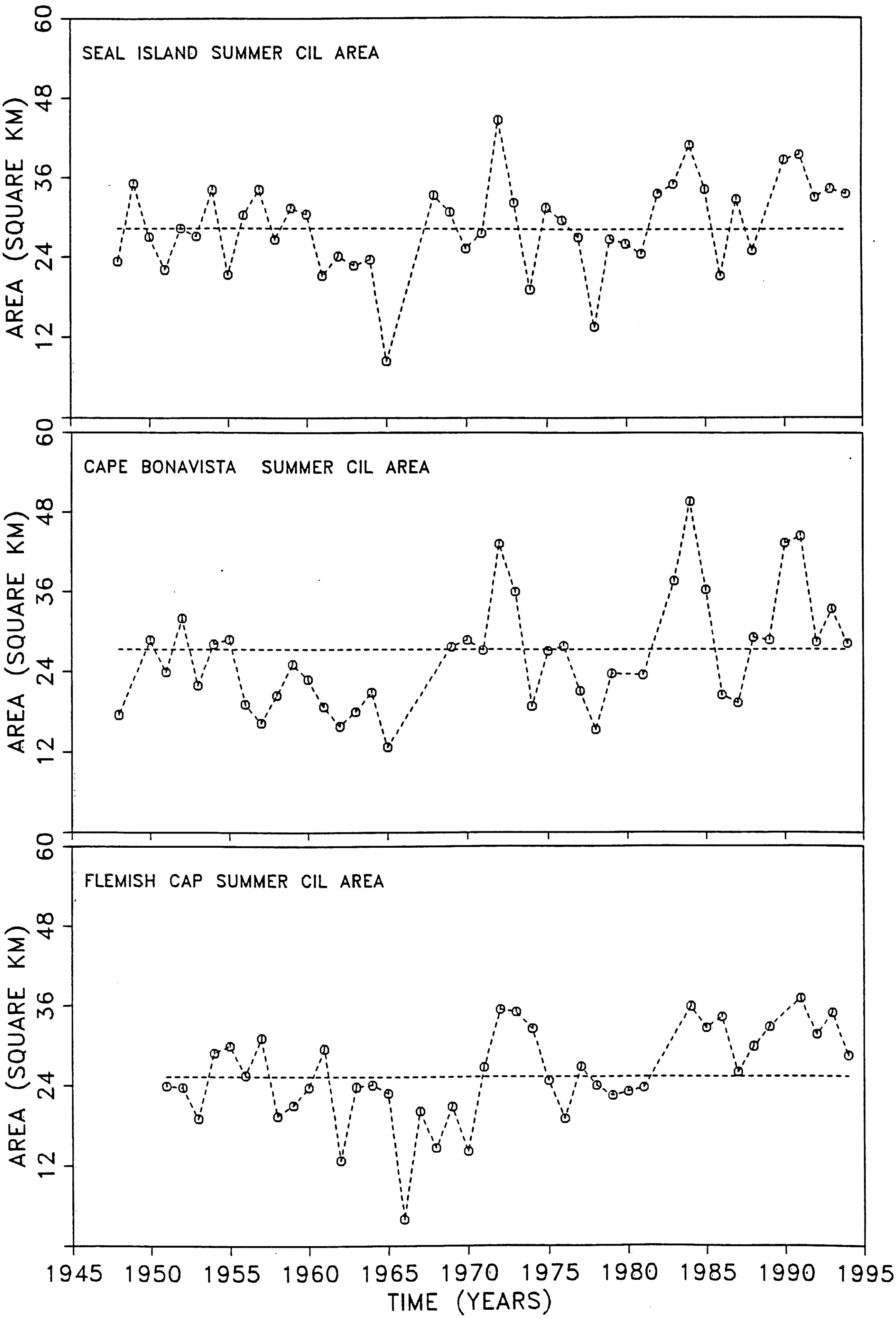


Fig.7 Time series of CIL area along the Seal Island, Bonavista and Flemish Cap transects. The dashed line represents the 1961-90 average.

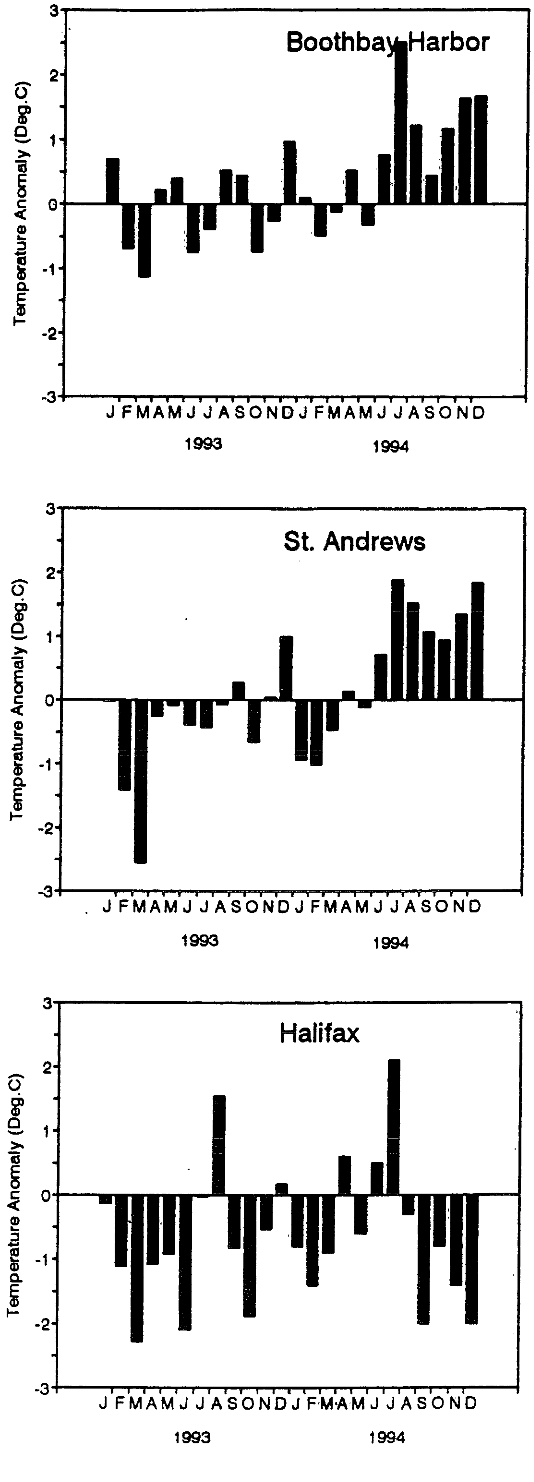


Fig.8 The monthly sea surface temperature anomalies (relative to 1961-90) during 1993 and 1994 for Boothbay Harbor, St. Andrews and Halifax.

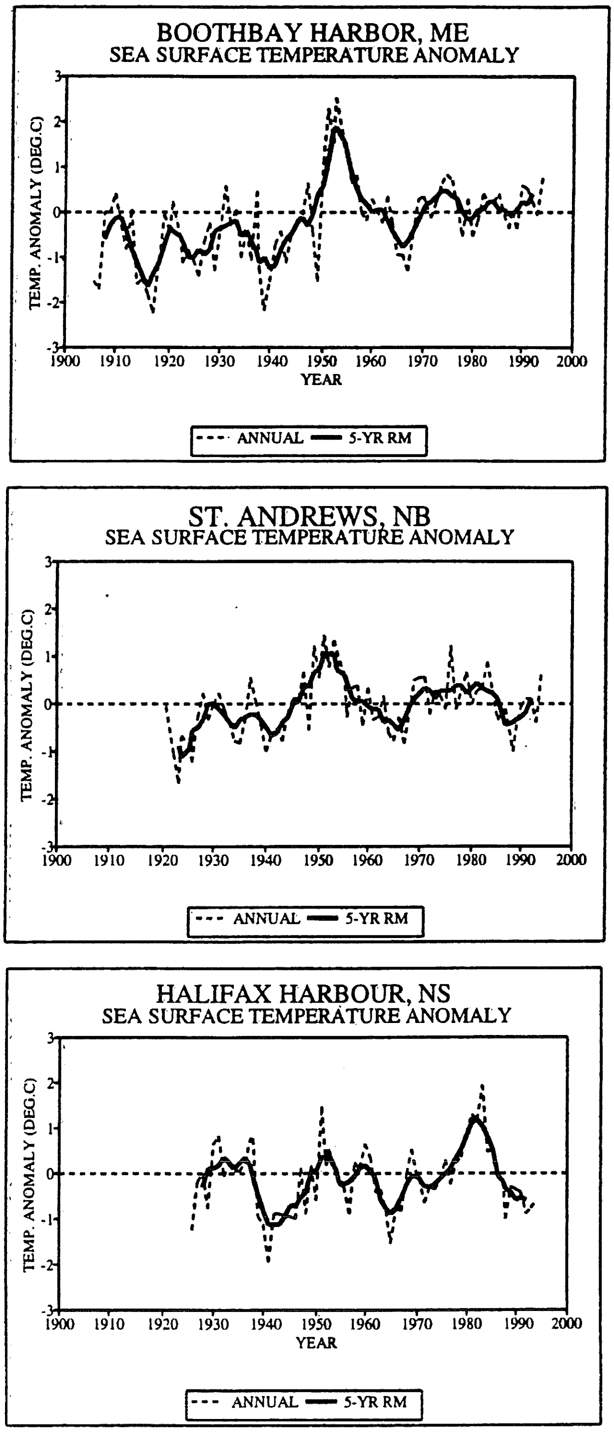
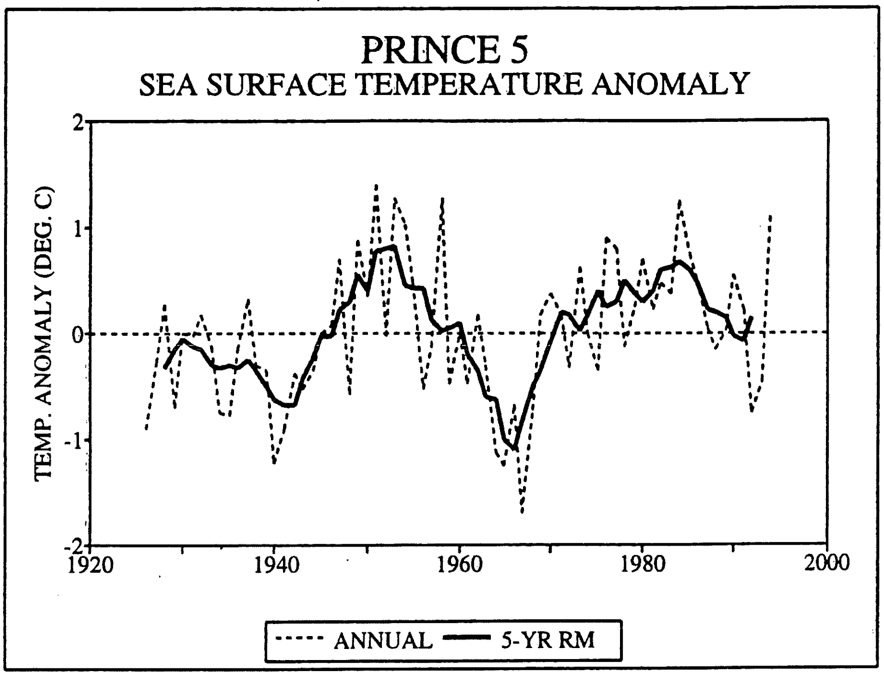


Fig.9 The annual anomalies of sea surface temperature and their 5-yr running means at Boothbay Harbor, St. Andrews and Halifax.



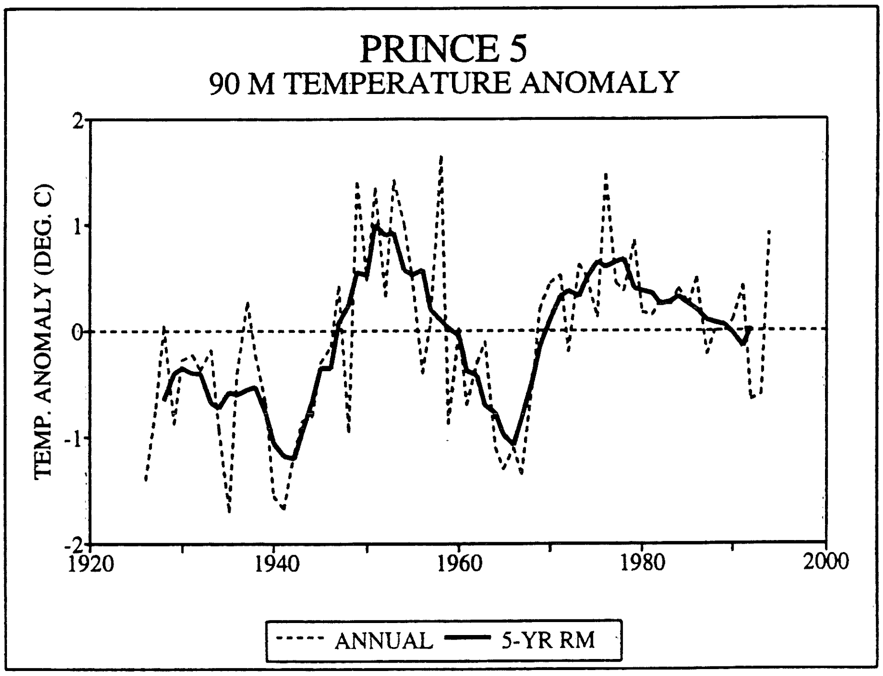
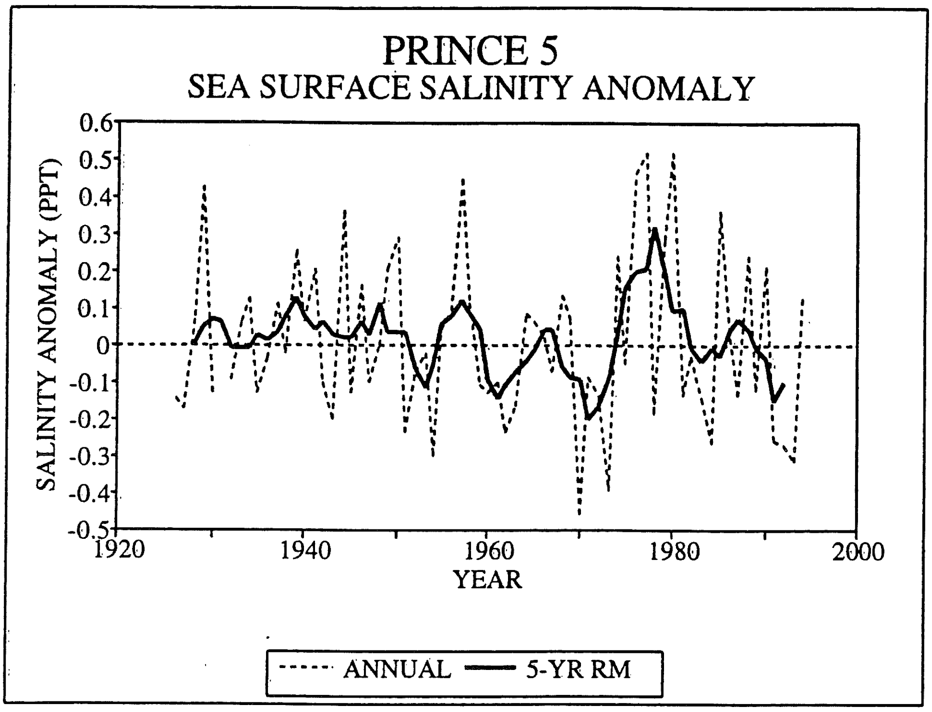


Fig.10 The annual temperature anomalies and their 5-yr running means at Prince 5, o and 90 m.



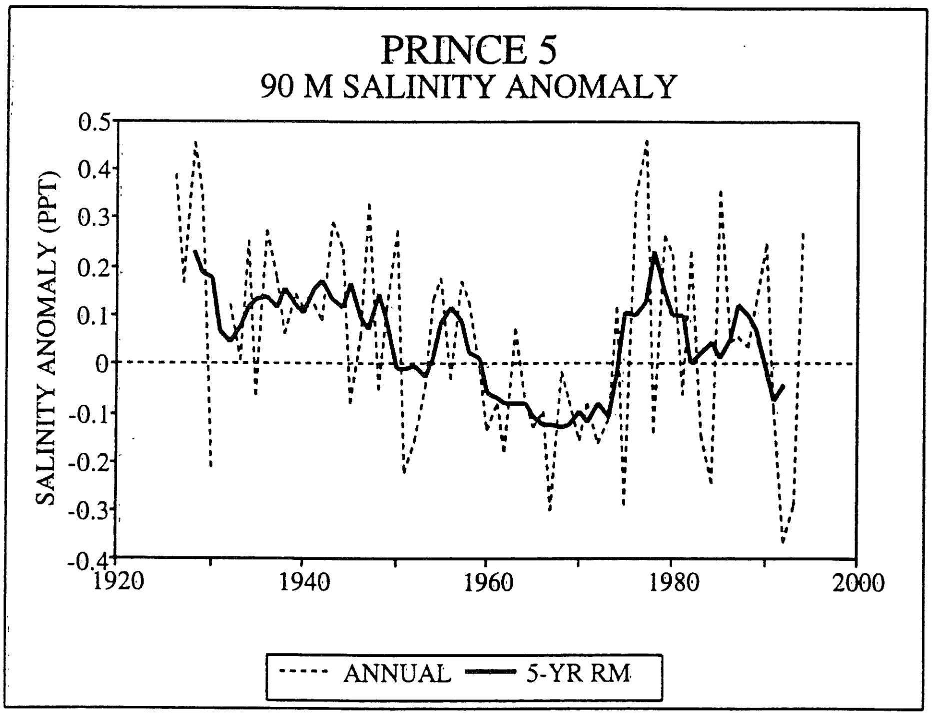


Fig.11 The annual salinity anomalies and their 5-yr running means at Prince 5, o and 90 m.

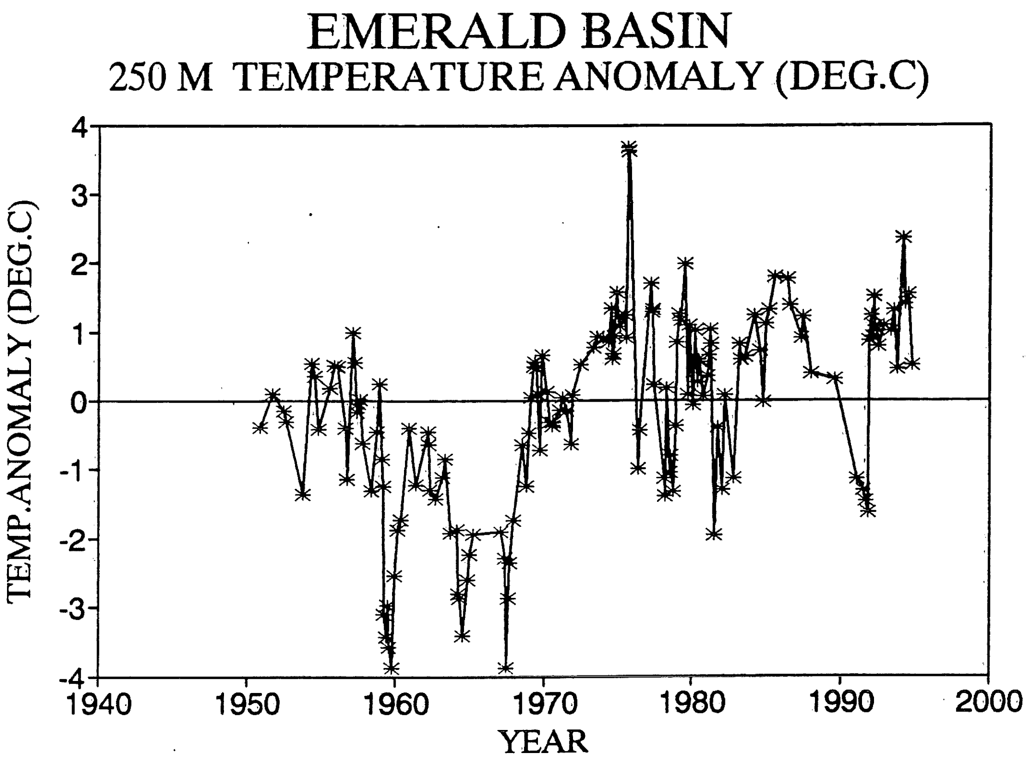


Fig.12 Temperature anomalies at 250 m in Emerald Basin

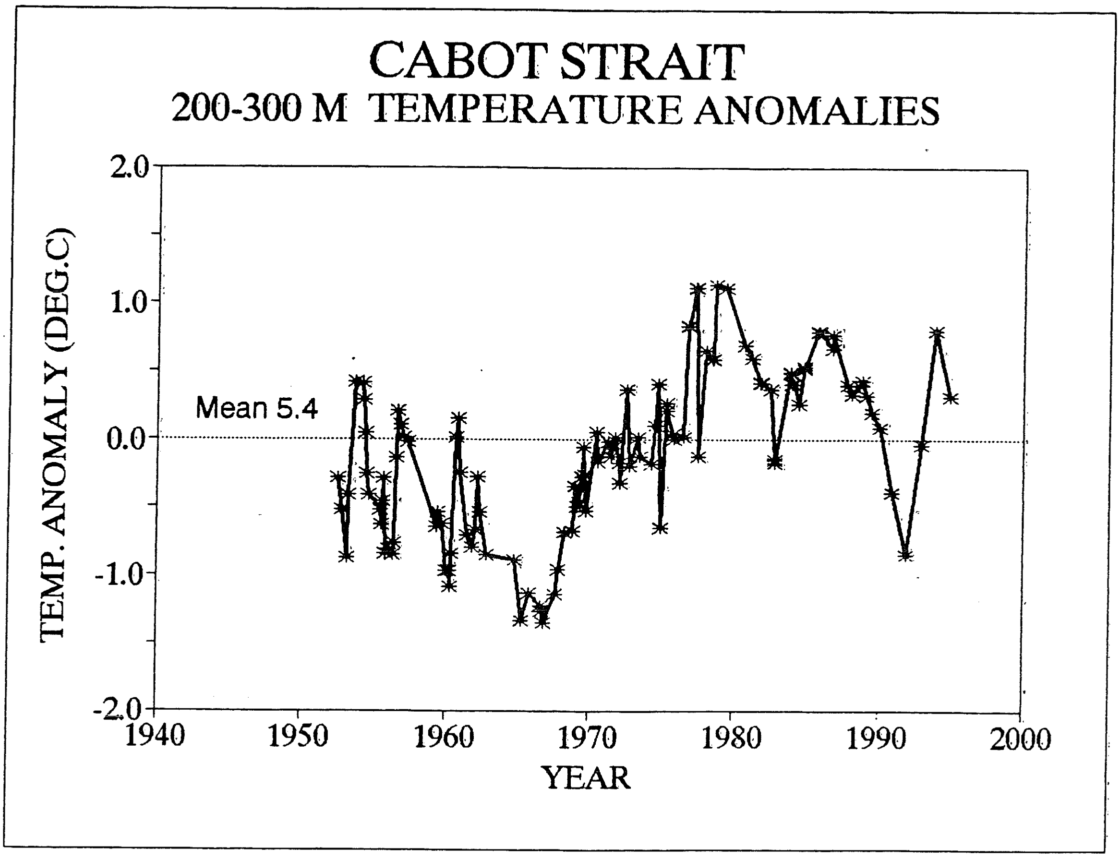


Fig.13 Anomalies of the average temperature in the 200-300 m depth in Cabot Strait.

West Greenland (Erik Buch):

Since 1989 Greenland has experienced cold climatic conditions as can be seen from the monthly mean air temperatures anomalies at Nuuk, Fig.1 as well as on the mean medio June temperature on top of Fylla Bank, Fig. 2. The temperature conditions in 1994 were still below normal although not as extreme as in the previous years. The cold conditions is generated by the inflow to the Davis Strait region of a cold airmass from Arctic Canada.

In 1994 a cruise to the West Greenland standard stations were performed from June 17 to July 9. The cruise was favoured by a lower than normal inflow of arctic ice in Southwest Greenland.

The surface layer was from Cape Farewell to Frederikhaab dominated by a strong front between the cold and low saline Polar water and the warmer, saline water of Atlantic origin. The front is weakened towards the north and north of Frederikshaab the surface layer only consists of Polarwater. The core of the inflowing Polarwater is situated at 100-150 m depth. Summer heating has increased the temperatures in the upper 50m.

At greater depth pure Irminger water (T>4.5°C, S>34.93) only is found at the Cape Farewell section, while modified Irminger water (T>4.5°C, 34.88<S<34.93) and Sub-Atlantic water (3.5<T<4.5; 34.5<S<34.88) was observed as far north as the Sukkertoppen Section. It was, however, remarkable that none of these water masses reached the Holsteinsborg section, which probably was due to an extraordinary outflow of Polar water from the Baffin Bay.

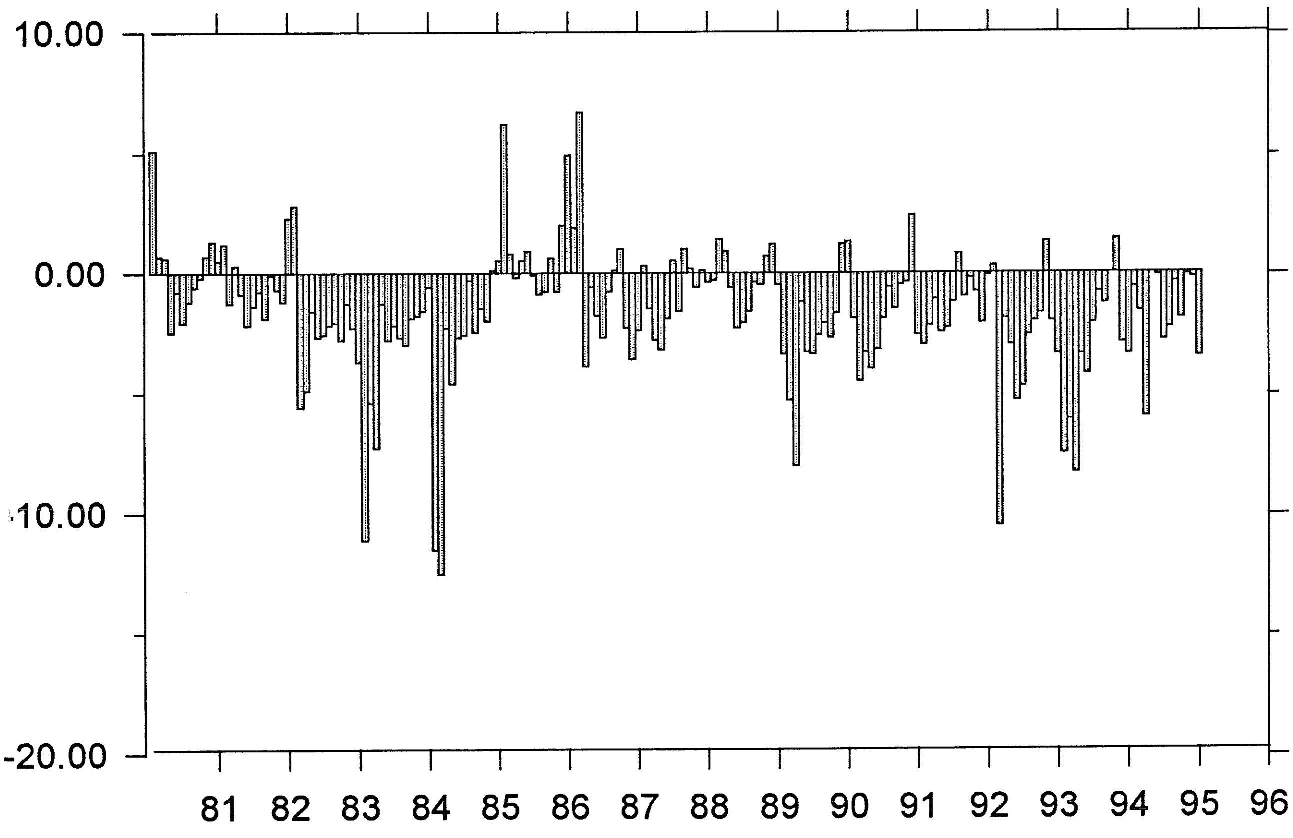


Fig.1 Monthly mean air temperature anomalies from Nuuk for the period 1980 to 1994.

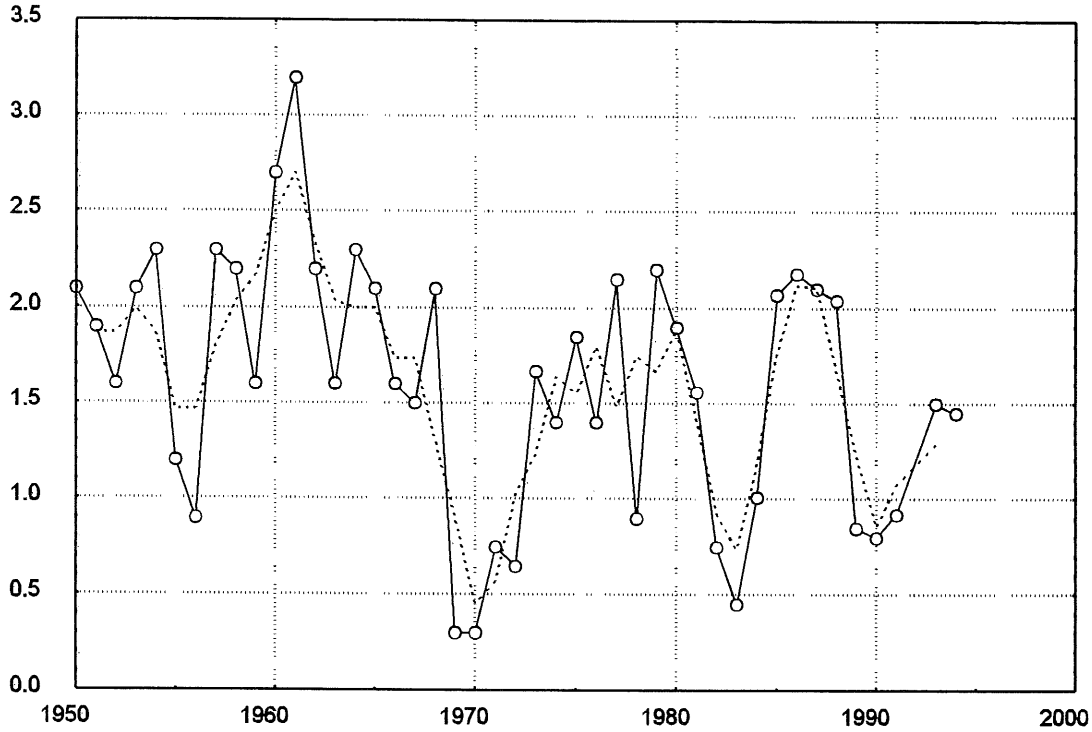


Fig.2 Mean temperatures on top of Fylla Bank, medio June 1950-94

——— Observed values

——— 3 years running mean

Iceland (Svend-Aage Malmberg):

Since 1991 the main results from seasonal cruises in Icelandic waters in 1994 indicate favourable hydrobiological conditions with continuous inflow of Atlantic Water into the North Icelandic shelf area. During the spring cruise in 1994 the zooplankton densities north of Iceland were the highest recorded for the last 30 years.

Nutrient densities and phytoplankton growth was also favourable. The Atlanto-Scandian herring was also for the first time during the past 30 years observed in spring 1994 east of Iceland. Also, no low saline polar influence nor drift-ice was observed in the East Icelandic Current in year 1994, but in the Irminger Current south of Iceland again relatively low salinities were observed in 1994 as since 1992, with values below 34.15.

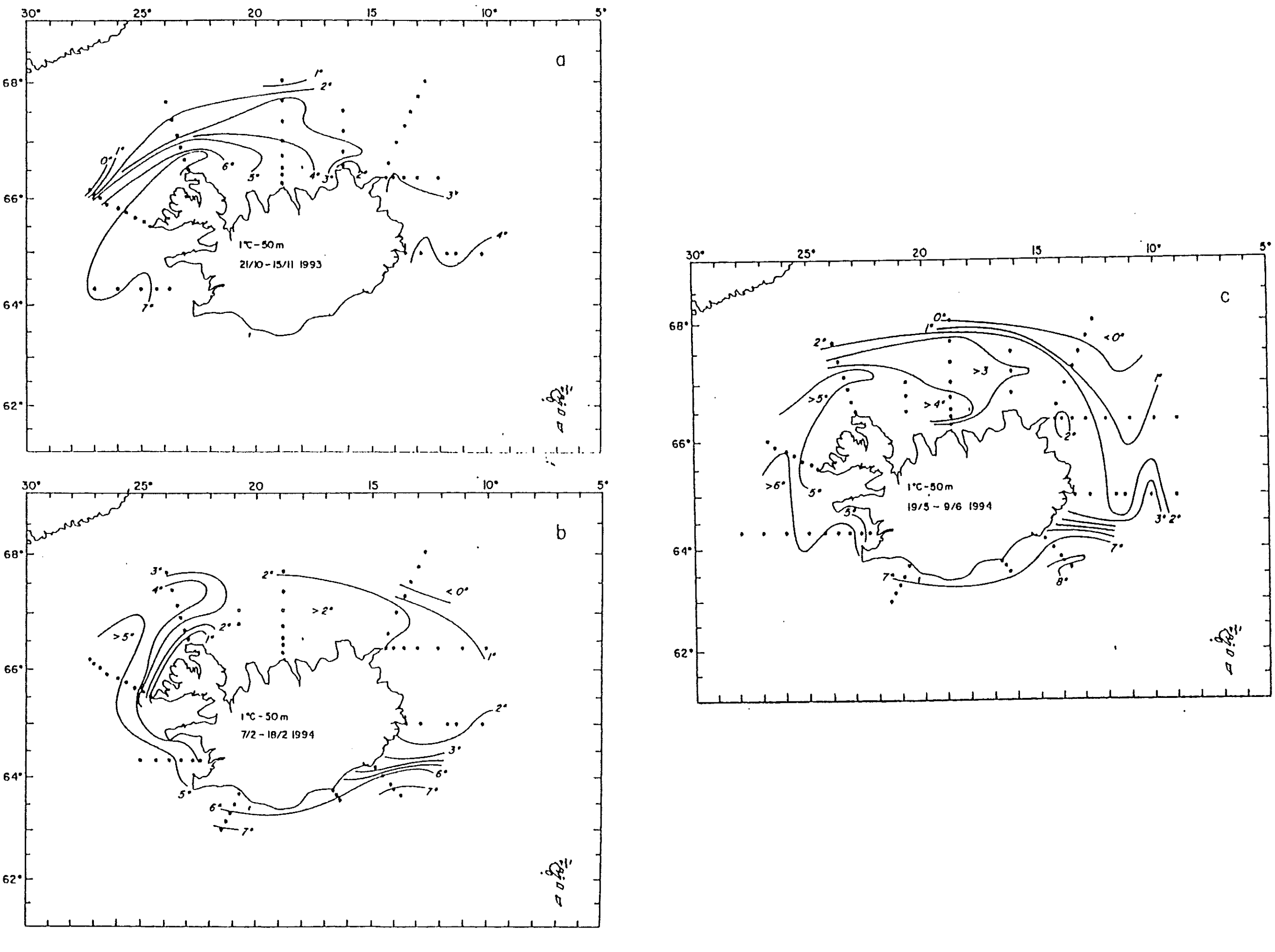


Fig. 1 Temperature distribution at 50 m in Icelandic waters in Oct./Nov. 1993 and Febr. and May/June 1994.

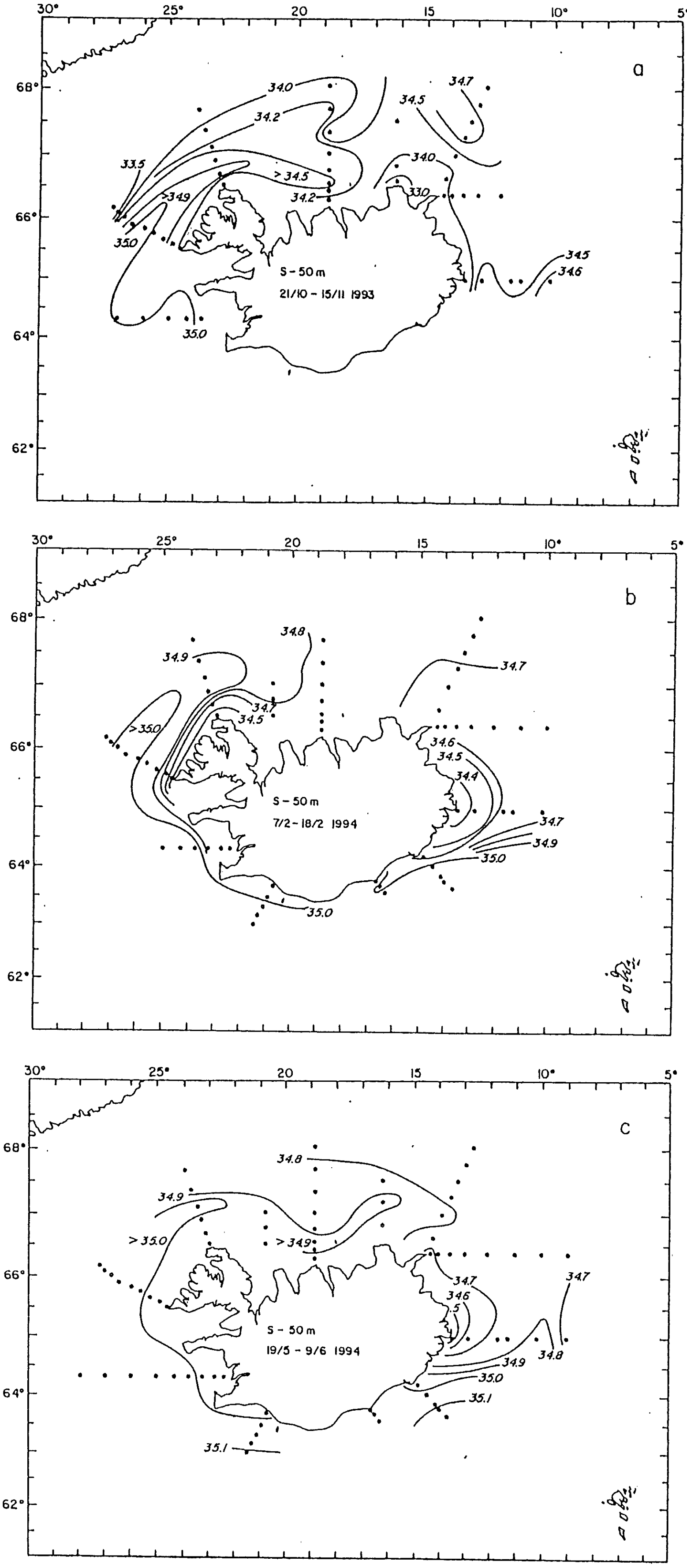


Fig. 2   Salinity distribution 50 m in Icelandic waters in Oct./Nov. 1993 and Febr. and May/June 1994.

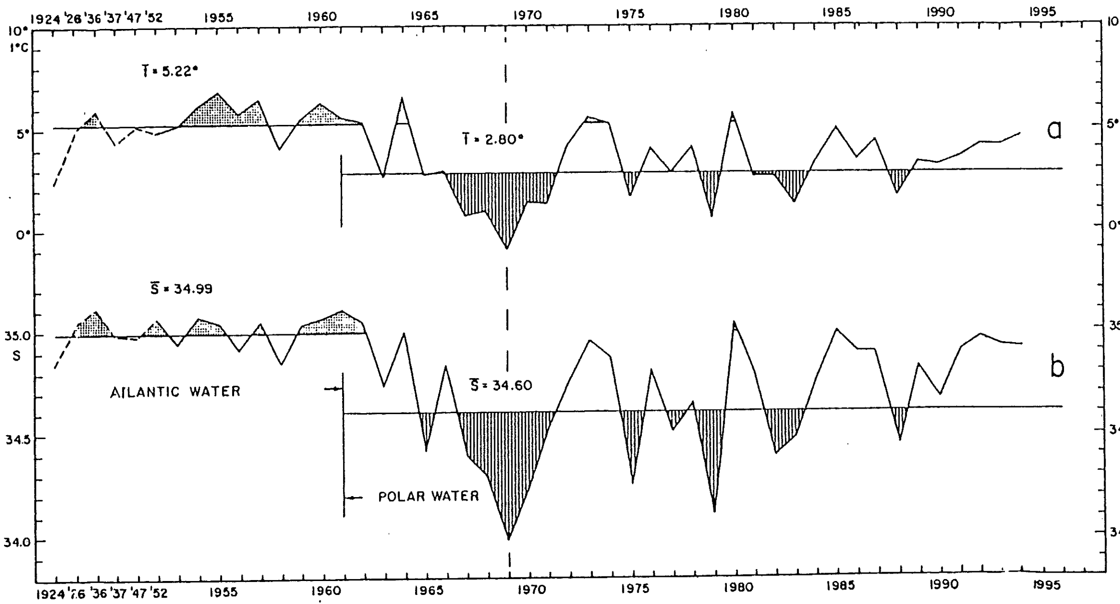


Fig. 3 *Temperature and salinity at 50 m depth at a hydrographic station in North Icelandic waters in May/June 1924, 1926, 1936, 1937, 1947 and 1952-1994*

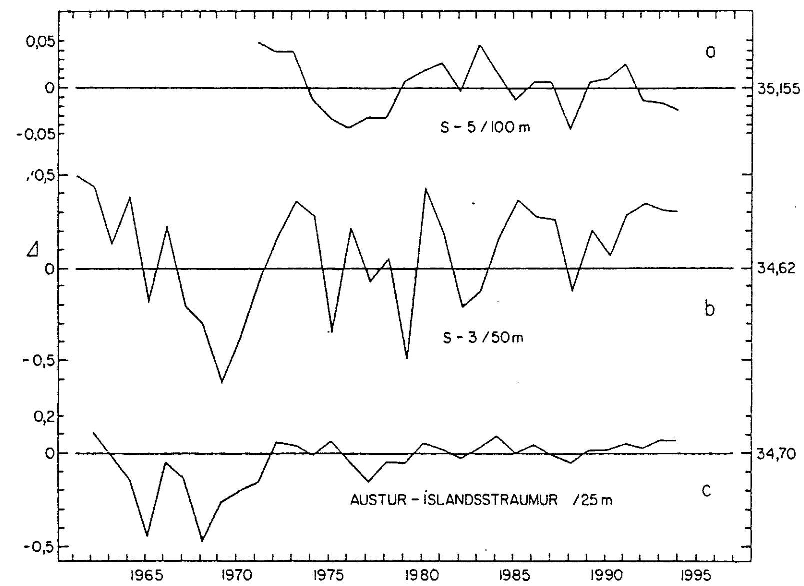


Fig. 4 *Salinity deviations in spring at 100 m in the Irminger Current south of Iceland 1971- 1994; at 50 m in North Icelandic waters 1991-1994; and at 25 m in the East Icelandic Current 1962-1994.*

Faroe Islands (Bogi Hansen):

Since the late 1980s, the Faroese Fisheries Laboratory has carried out CTD observations along three standard sections (E, N and W on Figure 1) around the Faroes that have been occupied three to four times a year. In 1994 each of the sections was occupied four times and a fourth standard section (S on Figure 1) was initiated with two occupations in late 1994. Due to instrumental problems with the CTD, the salinity observations from the last two cruises in 1994 were unreliable, but all four sections were occupied successfully in February 1995 and the results from that cruise are included in the following discussion.

The water mass, dominating the upper waters surrounding the Faroes, is the Modified North Atlantic Water (MNAW), entering the Faroe region from the open North Atlantic and flowing around the Faroe Plateau (Fig. 1). The characteristics of this water are well represented by the homogeneous 100-300 m depth layer in the middle of the Faroe Bank channel (FBC on Figure 1), and Figure 2 shows the salinity variation of this water. In the figure, older CTD and Nansen cast observations have been added to the standard section observations to give a longer time series (Hansen and Kristiansen, Stat. Meeting 1994). After the mid-seventies ("Great") low-salinity anomaly, the salinity of MNAW increased until the early eighties, when it stabilized, but since the beginning of the nineties, the MNAW salinity has been decreasing.

The decreasing salinity trend has also been observed north of the Faroes and in the Faroe-Shetland Channel (FSC on Figure 1) as shown on Figure 3. In 1994-95 the salinity on the western (Faroese) side of the FSC approached levels, which in the observational record have not been so low except during the mid-seventies anomaly.

The temperature variations of the MNAW follow the salinity variations fairly well and temperature also has been decreasing during the last five years (Hansen & Kristiansen, Stat. Meeting 1994). The same trend is seen in coastal temperature observations that reflect the temperature of the well-mixed water on the shallower parts of the Faroe Shelf (Fig. 4).

Associated with the changes in water mass characteristics, observations indicate changes in water mass extent, i.e. dynamical changes. These are most pronounced north of the Faroes, where the wedge of MNAW between the Faroe Plateau and the Iceland-Faroes Front (IFF on Figure 1) has decreased appreciably in width. Figure 5 compares the salinity distribution on a section crossing the flow in February 1995 to the distribution in June 1986 when the width of the MNAW was large. The observed long-term changes MNAW extent north of the Faroes are aliased by seasonal variation, but there is a clear indication of decreasing extent in the nineties (Hansen and Kristiansen, Stat.meeting 1994). The February 1995 salinity distribution (Fig. 5) indicates that the MNAW only extended slightly off the shelf at that time which is highly abnormal.

This implies that the waters of the East Icelandic Current in recent years have approached closer to the Faroe Plateau than had previously been normal. In addition these waters also have decreased in salinity. Figure 6 shows sample TS-traces north of the Faroes for the period since the mid-seventies anomaly up to February 1995. The salinity minimum at 2-4 °C seems to have been lowest in salinity during the mid-seventies anomaly in 1976, but the 1994 and especially the February 1995 observations indicate almost comparable values.

The low-salinity core of water from the East Icelandic Current (here termed East Icelandic Current Water, EICW) may be traced far into the FSC and was clearly evident on the Munken-Fair Isle standard section in February 1995 (Fig. 7). This, no doubt, has contributed to the salinity decrease in the uppermost 200 meters of the FSC (Fig. 3).

Summarizing, the waters surrounding the Faroe Plateau have in the last five years decreased in salinity and temperature. Apparently, the change may be partly attributed to low salinities of the contributing water masses (MNAW and EICW) and partly to a reduced influence of MNAW as compared to EICW. Whether the trend is continuing or has culminated, can only be conjecture at present (April 1995).

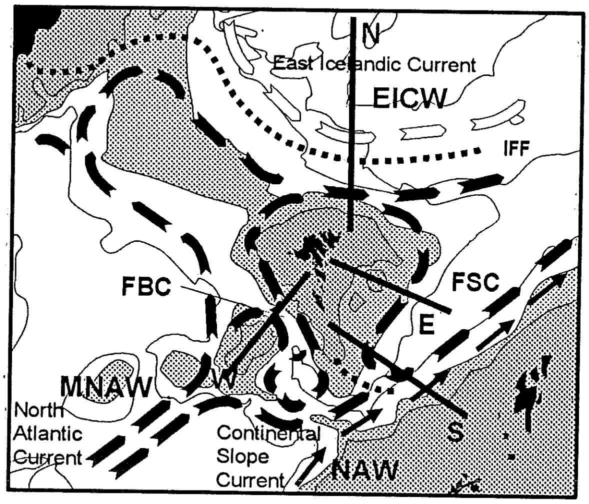


Fig. 1. The bottom topography around the Faroes is shown with isobaths and hatched for areas shallower than 500m. The arrows indicate main flow patterns in the upper layers driven by three major current whose water masses (NAW, MNAW and EICW) are indicated. IFF indicates the Iceland-Faroes Front. The four standard sections are denoted N,W,S and E.

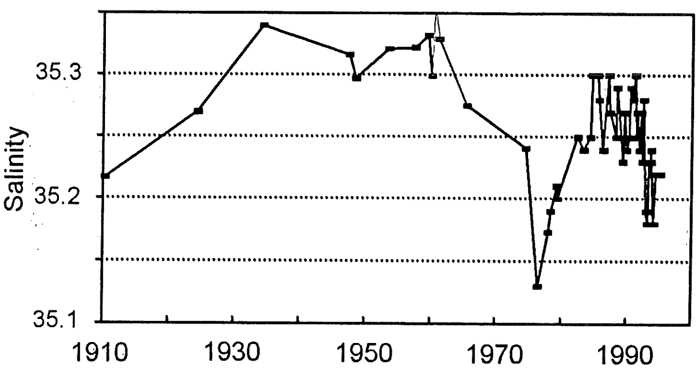


Fig. 2. The salinity of the 100-300m layer in the middle of the Faroe Bank Channel (Fig. 1) as determined from Nansen Casts up to 1976 and CTD observations since then.

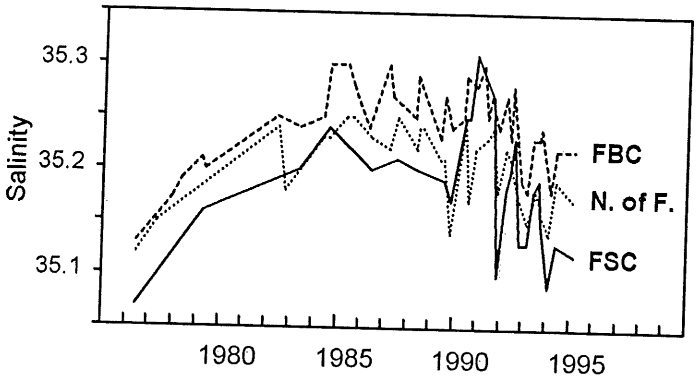


Fig 3. Salinity variations in three region around the Faroes since the mid-seventies. FBC indicates the salinity of the 100-300m layer in the middle of the Faroe Bank Channel. N. of F. indicates the salinity of the core of the Atlantic water north of the Faroes. FSC indicates the salinity of the 25-200m layer in the Faroese (western) half of the Faroe-Shetland Channel (standard section E on Figure 1).

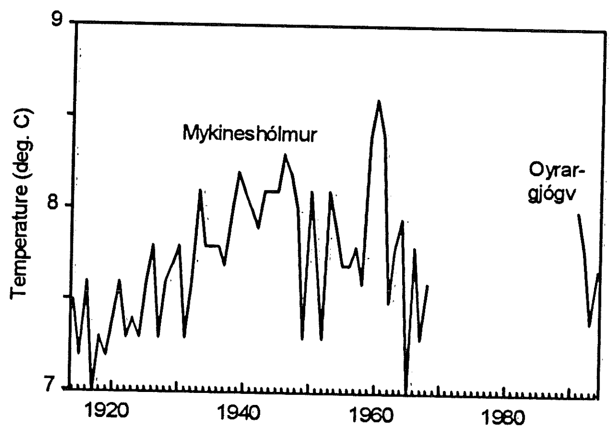


Fig. 4. Shore-based observations of annual mean sea surface temperature from two sites in the Faroes.

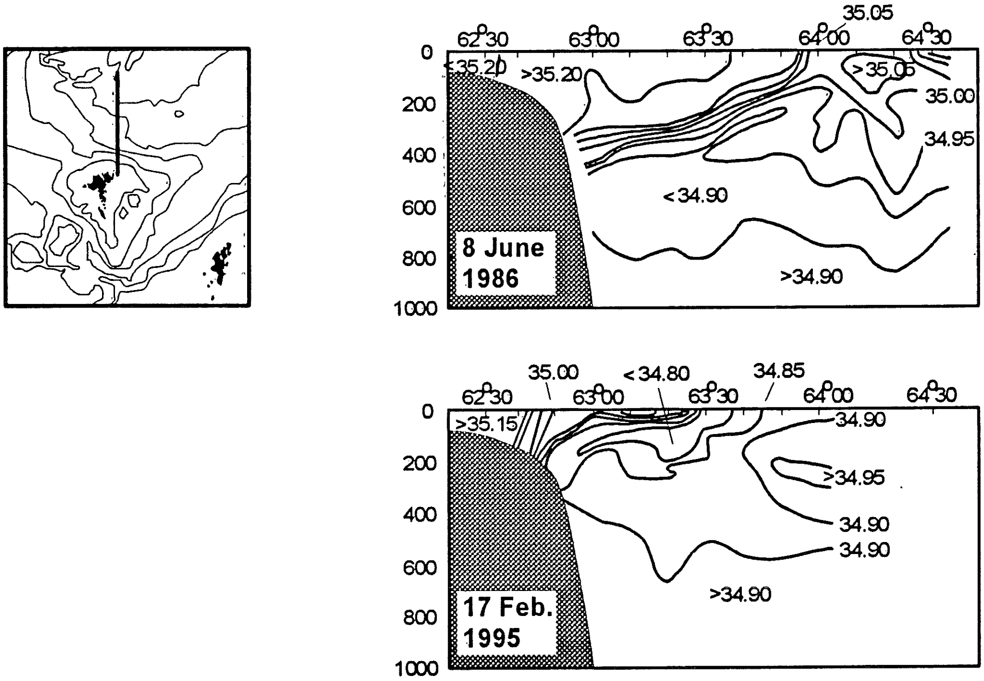


Fig. 5. The salinity distribution on standard section N (shown on map) at two different times, one (June 1986) with large Atlantic water dominance and one (Febr. 1995) with Atlantic water only on the Faroe shelf.

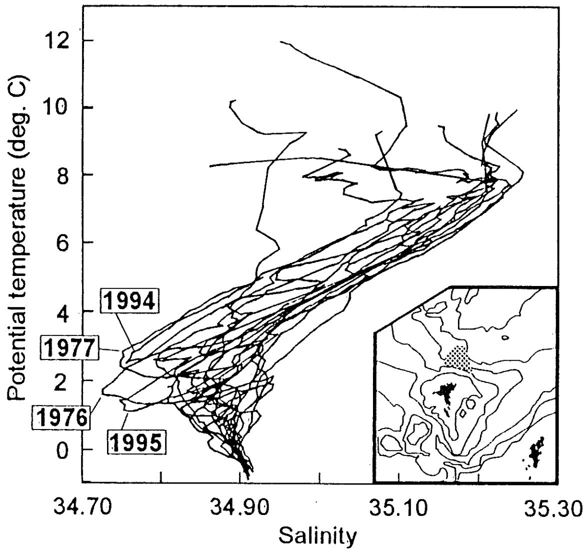


Fig. 6. Sample Theta-S diagrams from a region north of the Faroes (hatched on the map) with one trace for each year in the periods 1976-1977 and 1981-1995. (No observations were available for 1978-1980).

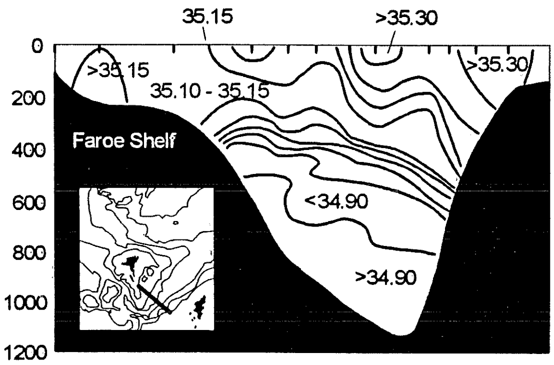


Fig.7 The salinity distribution along section S (shown on inset map) in February 1995.

Norway (Johan Blindheim):

The North Atlantic Current and its continuation, the Norwegian Atlantic Current, are the main carriers of heat into the northern areas. The transport of Atlantic water in this current system flows mainly into the Norwegian Sea through the Faroe-Shetland Channel, but also west and north of the Faroe Islands. It is now well known that variability in this inflow is an important ecological factor which is of great importance for the biological conditions in the area. Hence, commercially important fish populations in the Nordic and Barents Seas have largest growth and best reproduction success during warm periods.

The Barents Sea

Figure 2 shows time series of temperature and salinity in standard sections in the Barents Sea 1) between the Bear Island and the Norwegian coast 2) Vardo-N and 3) Sem Islands - N. The position of these sections are indicated in Figure 1. Temperatures and salinities are presented as mean values, averaged vertically between 50 and 200 m depth and horizontally over the stations which cover the core of inflow in the three sections.

Temperatures in the Barents Sea were decreasing during the autumn in 1993 and it was expected that this cooling would continue during 1994. This also happened and by early summer the temperature had fallen to near the seasonal mean in the whole Barents Sea. However, a transitory warming occurred in the western Barents Sea during August and September, resulting in higher temperatures than in the same season in 1993 (fig. 2). Observations later in 1994 showed that the western Barents Sea again was cooler than the year before. In the eastern parts of the area there was a gradual and uninterrupted cooling to temperatures below the mean for the observational period. This is a typical feature when the Barents Sea is being cooled. The temperature decrease is greatest in the eastern part where conditions are more marginal than further west. East of 35°E the volume of water masses of sub-zero temperatures usually increases considerably during such events.

The salinity has decreased gradually throughout the year (Fig. 2). This may indicate a decrease in inflow to the Barents Sea from the Norwegian Atlantic Current. This signal was clearest in the western Barents Sea. As a rule, the cold and warm periods in the Barents Sea have a duration of 3 - 5 years.

The Nordic Seas

In the Norwegian Sea, temperature and salinity have been regularly observed in standard sections for a number of years and at Ocean Weather Station MIKE a similar series of observations has been collected since 1948 (University of Bergen).

Figure 3 shows the variability of temperature and salinity in the core of the Atlantic water in two sections across the Norwegian Atlantic Current and one across the West Spitsbergen Current; the Svinoy - NW , Gimsoy - NW and Sorkapp - W sections, as observed in July/August since 1978. Mean values which are averaged vertically between 50 and 200 m depth and horizontally along a given part of the sections, are shown in the figure. Figure 4 shows the temperature anomalies at 100 m depth at Stn MIKE. The observations show considerable variability and the sections indicate relatively cold periods at the end of the 1970s and during the period 1985 - 1987 while there were warm periods around 1983 and 1990. The period 1992 - 1994 has been characterized by falling temperatures, to near or a little below the mean in the two southern sections while in the Sorkapp Section temperature in August was still above its observational period average. The associated salinities have decreased to values below the average in all three sections, the decrease being greatest in the southern section. Both of the warm periods around 1983 and 1990 coincided with strong year classes in important fish stocks such as herring, cod and haddock. As indicated by the time series from Stn MIKE (Fig. 4), the temperatures in the Norwegian Sea were generally higher before about 1975 than in the later years. The warmest period of the whole observational period since 1948 was observed around 1960.

The North Sea and Skagerrak

In the shallow shelf area of the North Sea, the water column is homogenized by mixing during winter to have the same temperature from surface to bottom while a 20 - 40 m deep surface layer is warmed during summer. The salinity of the various sectors of the North Sea depends on fluctuating supply of Atlantic water, river discharge of freshwater, low-salinity water from the Baltic and the current conditions, which largely are affected by the prevailing wind regime.

Large-scale climatic conditions in the North Sea depend, however, mainly on variations in volume and properties of the inflowing Atlantic water.

The main Atlantic inflow to the North Sea follow the western slope of the Norwegian Trench at depths between 50 m and 200 m. Smaller amounts flow in both to the north and south of the Shetland Islands to flow southward in the western part of the North Sea.

Figure 5 shows summer observations of temperature and salinity near the bottom in two positions on the Utsira - W Section, position a in the northwestern part of the North Sea and B in the western slope of the Norwegian Trench (Fig. 1). The time series from Position A represent the winter conditions in the western branch of the inflowing Atlantic water which during the preceding winter has been mixed with the waters from the upper layers. Similarly, part B shows observations from the core of the Atlantic water in the western slope of the Norwegian Trench. In general temperature and salinity are respectively 1 - 2°C and 0.1 salinity units lower on the North Sea plateau than in the Atlantic inflow in the Norwegian Trench. After very warm and saline conditions around 1990, there has been a decrease in both temperature and salinity since 1992.

Figure 6 shows temperature and salinity variability at 600 me depth in the Skagerrak Deep (Position C in Fig. 1). The observations show that large scale renewal of water masses in the Skagerrak Deep occurred in 1991 after several years with stagnant water masses in the deeper strata of the basin. The temperatures in 1990, shortly before the renewal, were the highest since these observations were initiated in 1947. During spring in 1994 we had a new exchange of the bottom water to cooler and fresher water masses, probably originating from the central and northern parts of the North Sea plateau.

Coastal waters

Temperature and salinity are observed regularly on 8 fixed oceanographic stations in the coastal waters (Fig. 1) and time series from two are presented here. Figure 7 presents results from the station at Skrova in Vestfjorden in the Lofoten area (Fig. 1), while Figure 8 shows the trends at Ytre Utsira off the Norwegian North Sea coast (Fig. 1). Both figures show mean temperature and salinity values at 150 m depth, averaged over the months July, August and September.

The water at 150 m depth on these stations is a mixture of Atlantic and coastal water types, with Atlantic water as the major component. At this depth also these coastal stations reflect the fluctuations in the Atlantic inflow which is carried by the Norwegian Atlantic Current. Hence, the maximum around 1990 and the following temperature/salinity decrease is seen also in these time series.

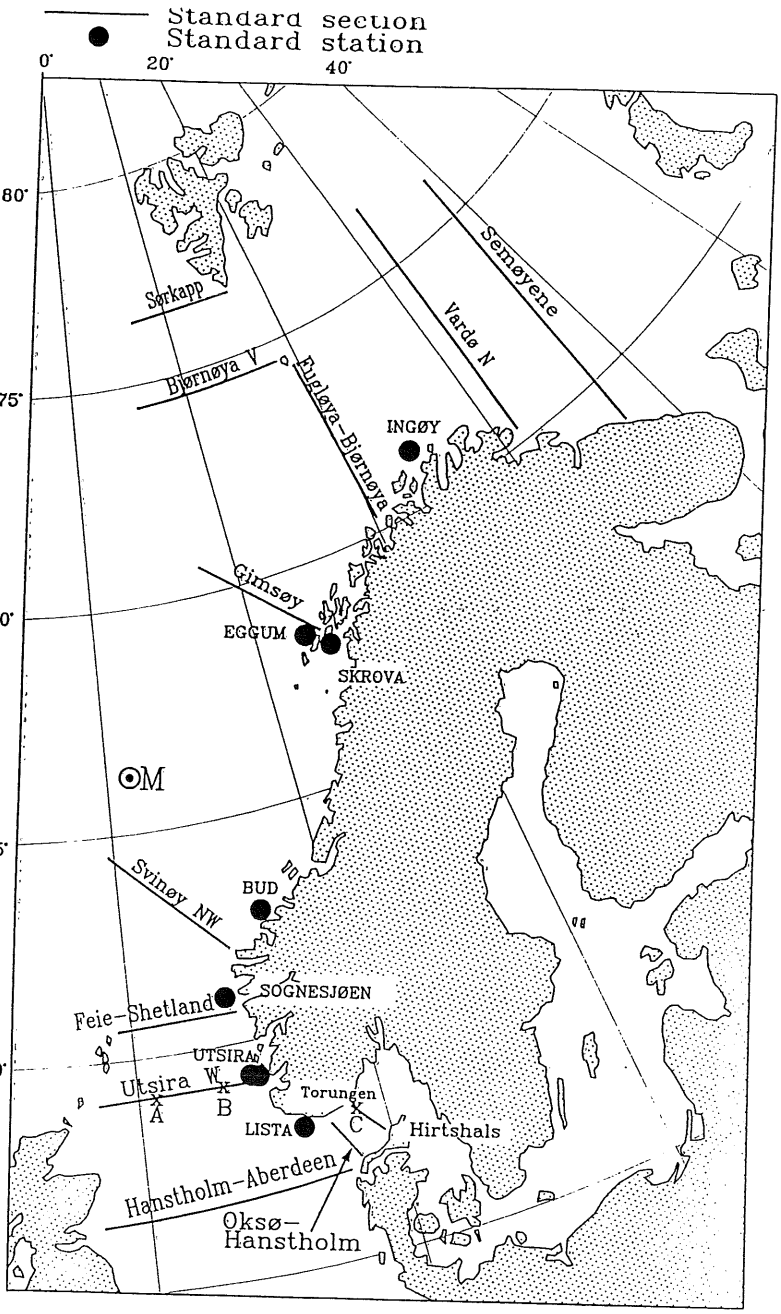


Fig. 1. Hydrographic standard sections and fixed oceanographic stations.

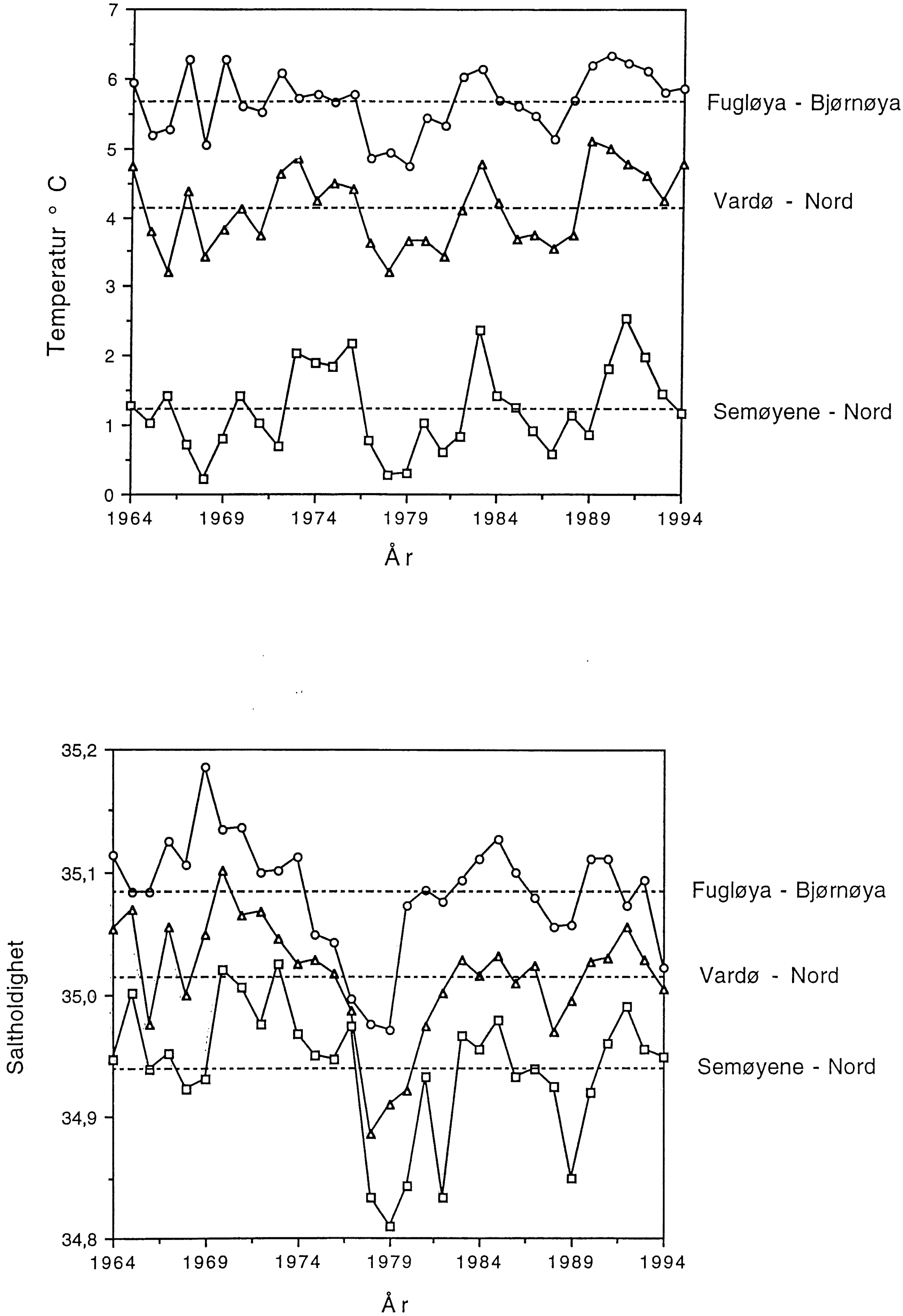


Fig. 2. Mean temperature and salinity between 50 and 200 m depth in August /September in the sections Fugloya - Bjornoya, Vardo - N and Sem Islands - N, 1963 - 1994.

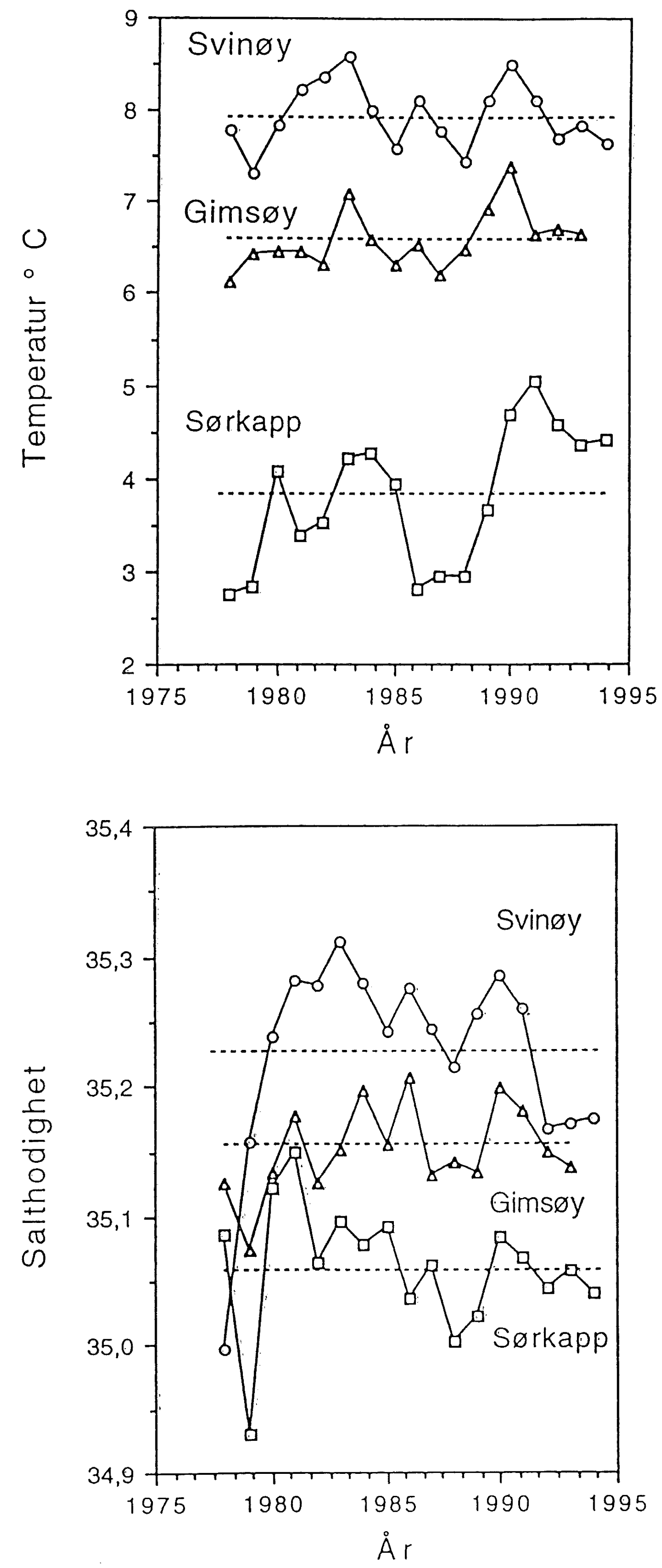


Fig. 3. Temperature and salinity in the core of Atlantic water in July/August, in the sections Svinoy - NW, Gimsoy - NW and Sorkapp - W, averaged between 50 and 200 m depth.

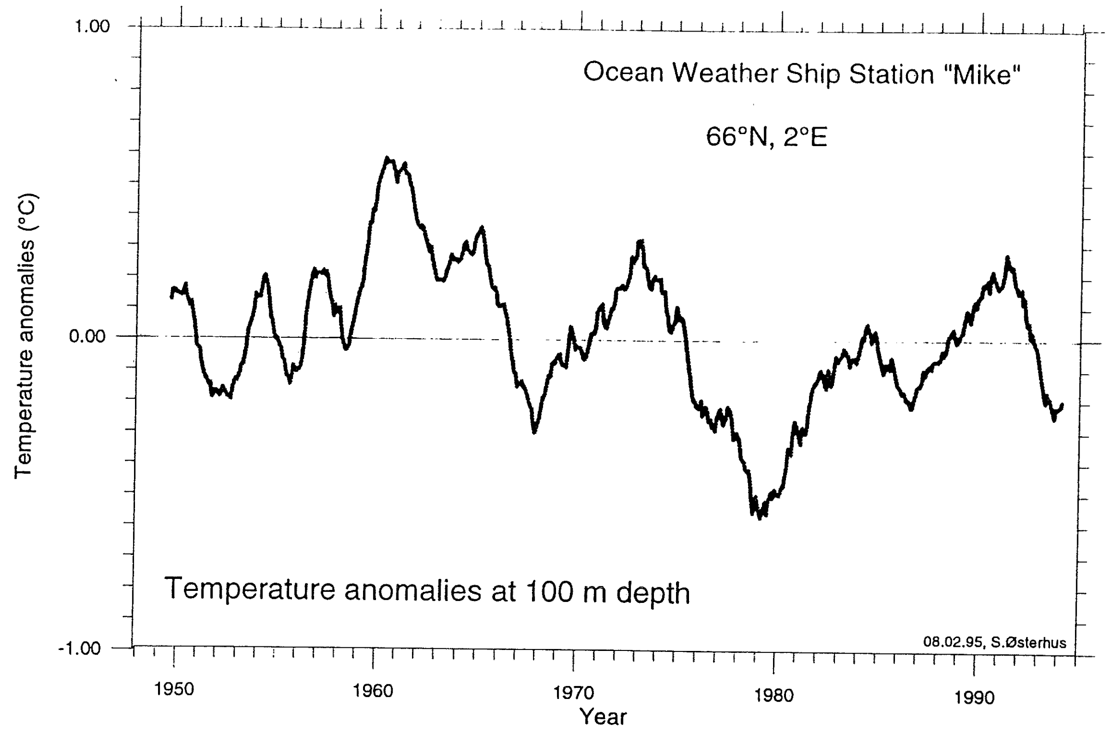


Fig. 4. Temperature anomalies at 100 m depth at Ocean Weather Station MIKE, 21 months running means.

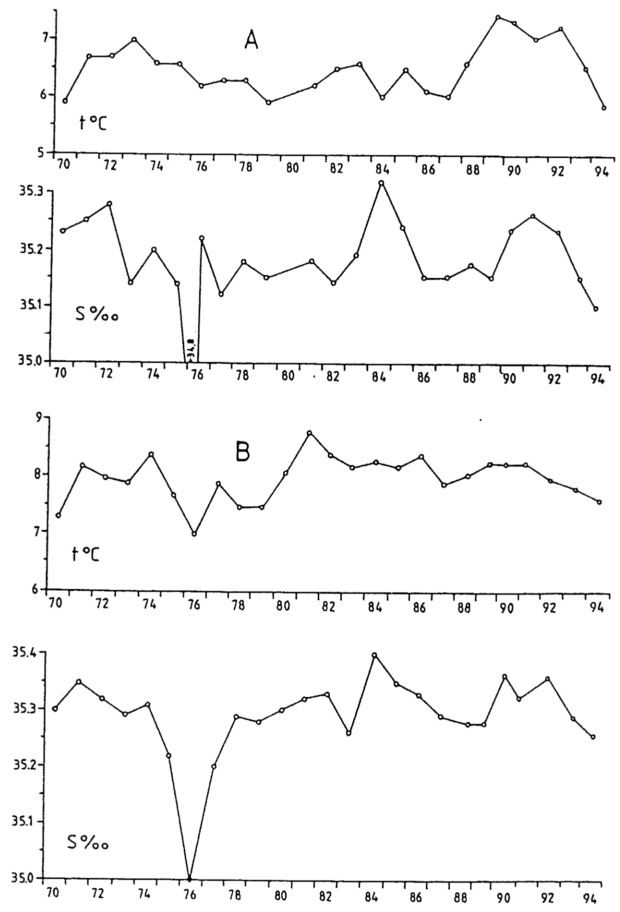


Fig 5. Temperature and salinity near bottom in the northwestern part of the North Sea (A), and in the Core of Atlantic water (B) in the western slope of the Norwegian Trench during summer, 1970 - 1994.

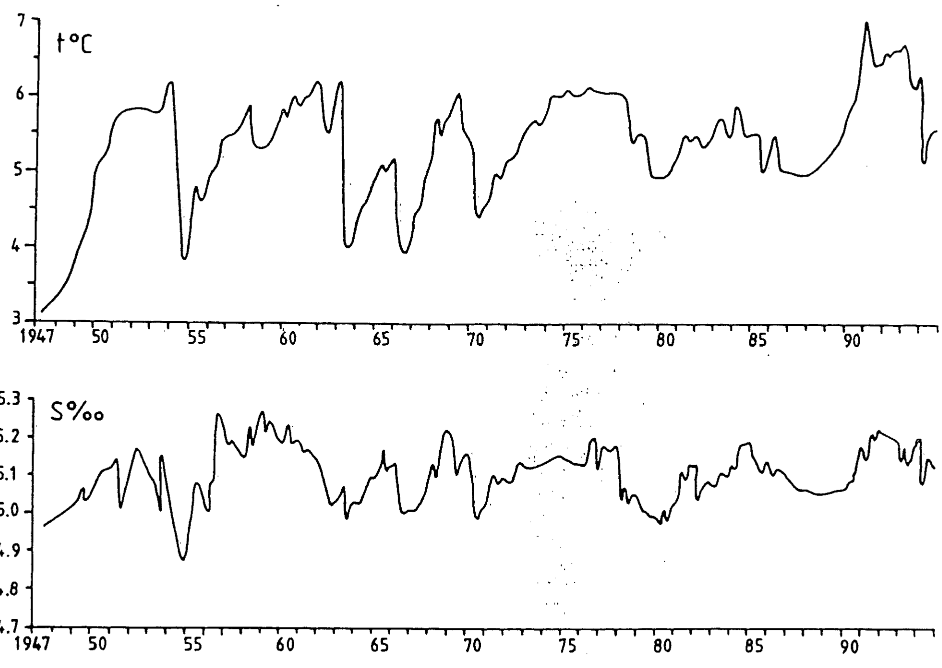


Fig 6. Variations in the temperature and salinity of the bottom water (600 m depth) in Skagerrak for the years 1947 - 1994.

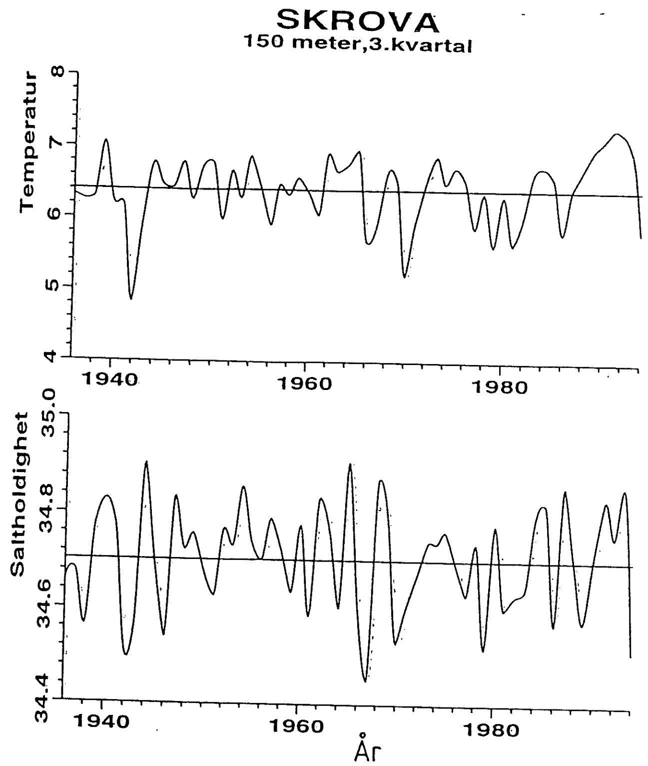


Fig. 7. Mean values and year - to - year variations of temperature and salinity at 150 m depth (3rd quarter) at Skrova (See Fig.1 for position).

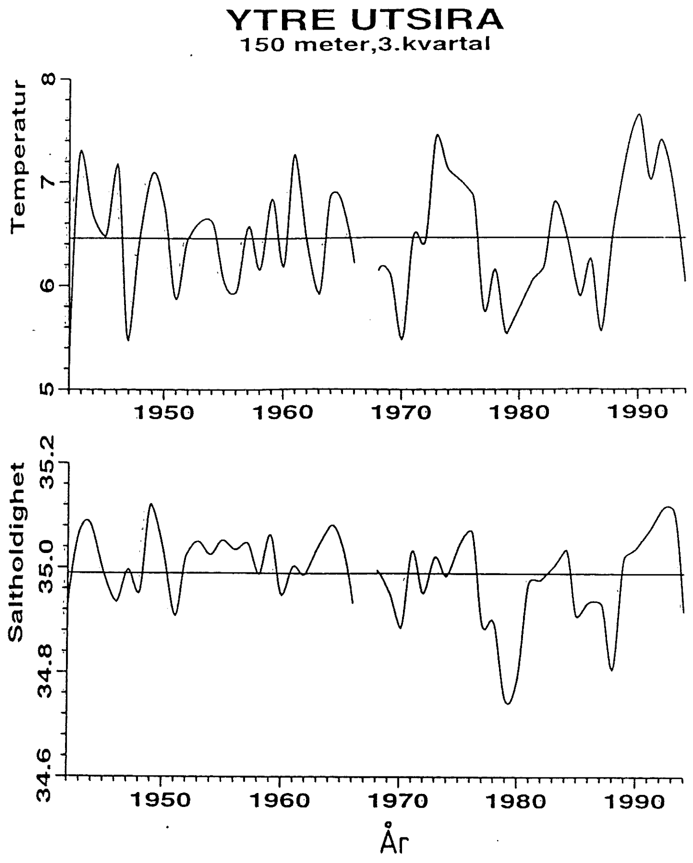


Fig. 8. Mean values and year - to - year variations of temperature and salinity at 150 m depth (3rd quarter) at Utsira (See Fig. 1 for position)

Scotland:

Results from Faroe-Shetland Channel standard sections (W R Turrell):

The two standard Faroe-Shetland Channel sections (Nolso (Faroe) -Flugga (Scotland) and Fair Isle (Scotland) - Munken (Faroe)) have been occupied by the Marine Laboratory Aberdeen on four occasions since April 1994. However, unfortunately only partial surveys (on the Scottish side of the Channel) were completed in December 1994 and January 1995). The preliminary results are presented here as contoured sections in Figures 1 to 3. They may be compared with the mean sections derived from calibrated data collected along both sections between 1903 and 1992 (Figure 4). The time-series of North Atlantic salinity as defined by the maximum salinity recorded inshore from the 200m contour on the Scottish continental shelf has been extended to 1995 in Figure 5. Temperature-salinity diagrams derived from the preliminary data are presented as Figures 6 and 7, and the derived t and S characteristics of the different water masses are presented in Table 1.

In summary conditions in 1994 continue to demonstrate low salinities at intermediate depths in the Faroe-Shetland Channel. Large areas of low salinity intermediate water were evident, possibly of Arctic Intermediate (AI) and Norwegian Sea Intermediate (NSI) origin. The low salinities in April 1994 of North Atlantic (NA) appear to have recovered to normal values.

Figure 1 - September 1994

NA water salinities > 35.35 persisted on the Scottish side of the Channel. The tS characteristics of this water were significantly different from the MNA water on the Faroese side of the Channel, as indicated by a break in the slope in the tS diagram. This implies water on the Scottish side had been mixed with a high salinity source water, possibly associated with the slope current. The anomalous bolus of low salinity water (<34.9) observed in April 1994 appears absent, although the normal salinity structure is again not observed in the Nolso-Flugga section, with lower salinity intermediate central water reaching the surface, and occupying the entire lower volume of this section. An anomalous inflection in the tS curve was observed between AI water and NSI water, with an intermediate salinity maximum. The salinity of NSD water is exceptionally high, especially in respect to recent trends. This, coupled with the anomalous inflection above, calls some doubt into the quality of this data. It is presently being re-examined.

Figure 2 - November 1994

The high salinity core on the Scottish side of the channel had moved offshore and reduced in area. The central bolus of low salinity water at intermediate depths was again evident in the Nolso-Flugga section, and also evident against the Faroese shelf in the Munken-Fair Isle section. The break between NA and MNA water was no longer evident in the tS diagram. Nor was the inflection between AI and NSI water.

Figure 3a - December 1994

The high salinity NA water evident on the Scottish shelf inshore from the 200m contour. There was some evidence that the central low salinity bolus was still in evidence at the Fair Isle-Munken section.

Figure 3b - January 1995

The area occupied by high salinity water on the Scottish shelf had increased. Anomalously low salinity water lay offshore.

Time Series - NA water

Figure 5 shows the temporal change in North Atlantic water salinity since 1900. The very low salinity observed in April 1994 was anomalously low for the year. Salinities at the Scottish shelf recovered, and the annual mean was normal. Low salinity water still appears to be affecting waters in the central channel.

Table 1. Characteristic t and S of different waster masses during the four surveys.

	MNA		NA		AI		NSI		NSD	
	t	S	t	S	t	S	t	S	t	S
1	8.4	35.24	9.9	35.38	2.8	34.91	0.6	34.91	-0.6	34.93
2	8.1	35.23	9.9	35.38	3.2	34.93	0.4	34:89	-0.7	34.92
3	8.8	35.20	10.3	35.35	3.6	34.95	0.2	34.89	-0.6	34.91
4	7.5	35.18	9.3	35.36	2.9	34.93	0.4	34.88	-0.6	34.90

September 1994

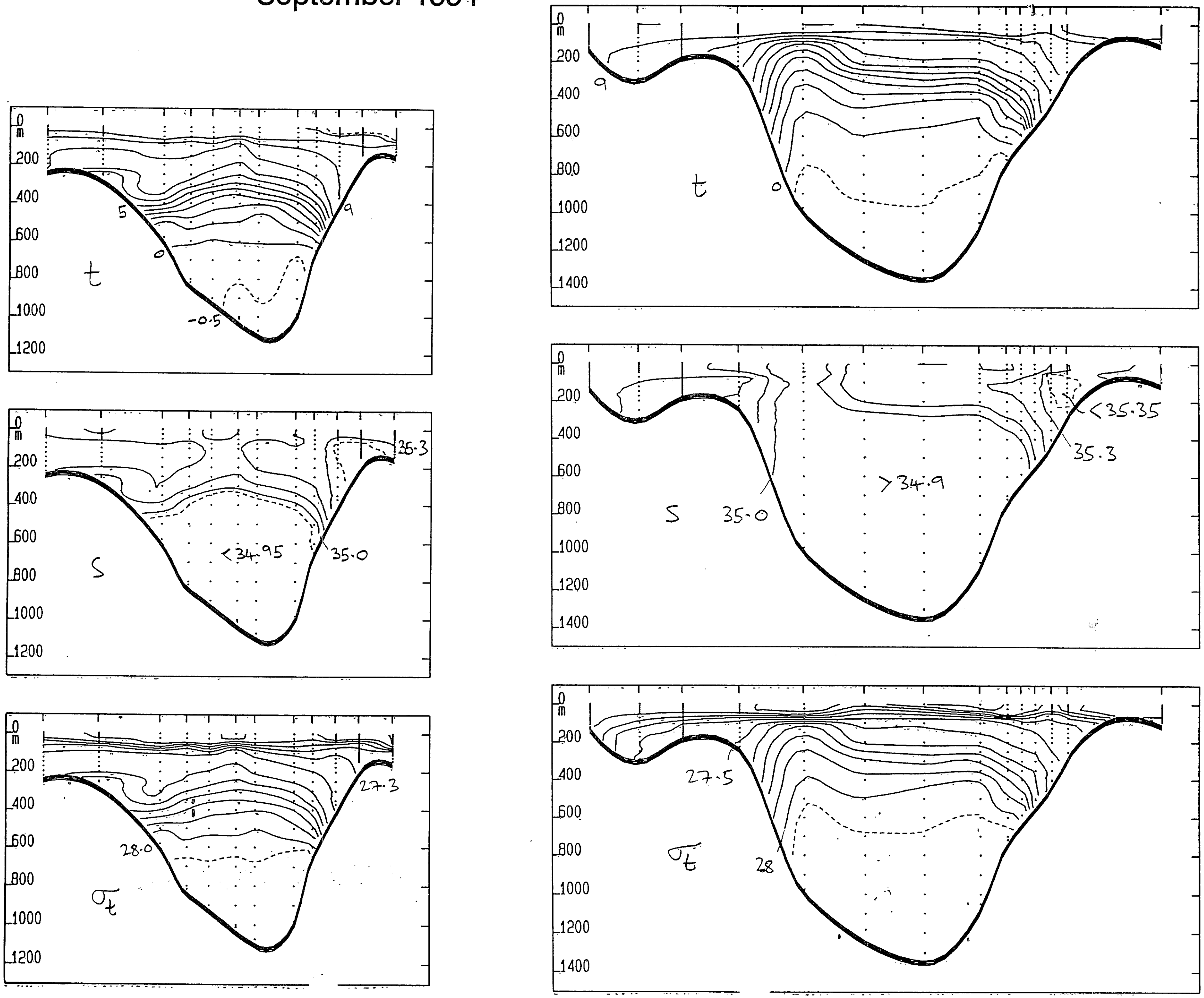


Figure 1

November 1994

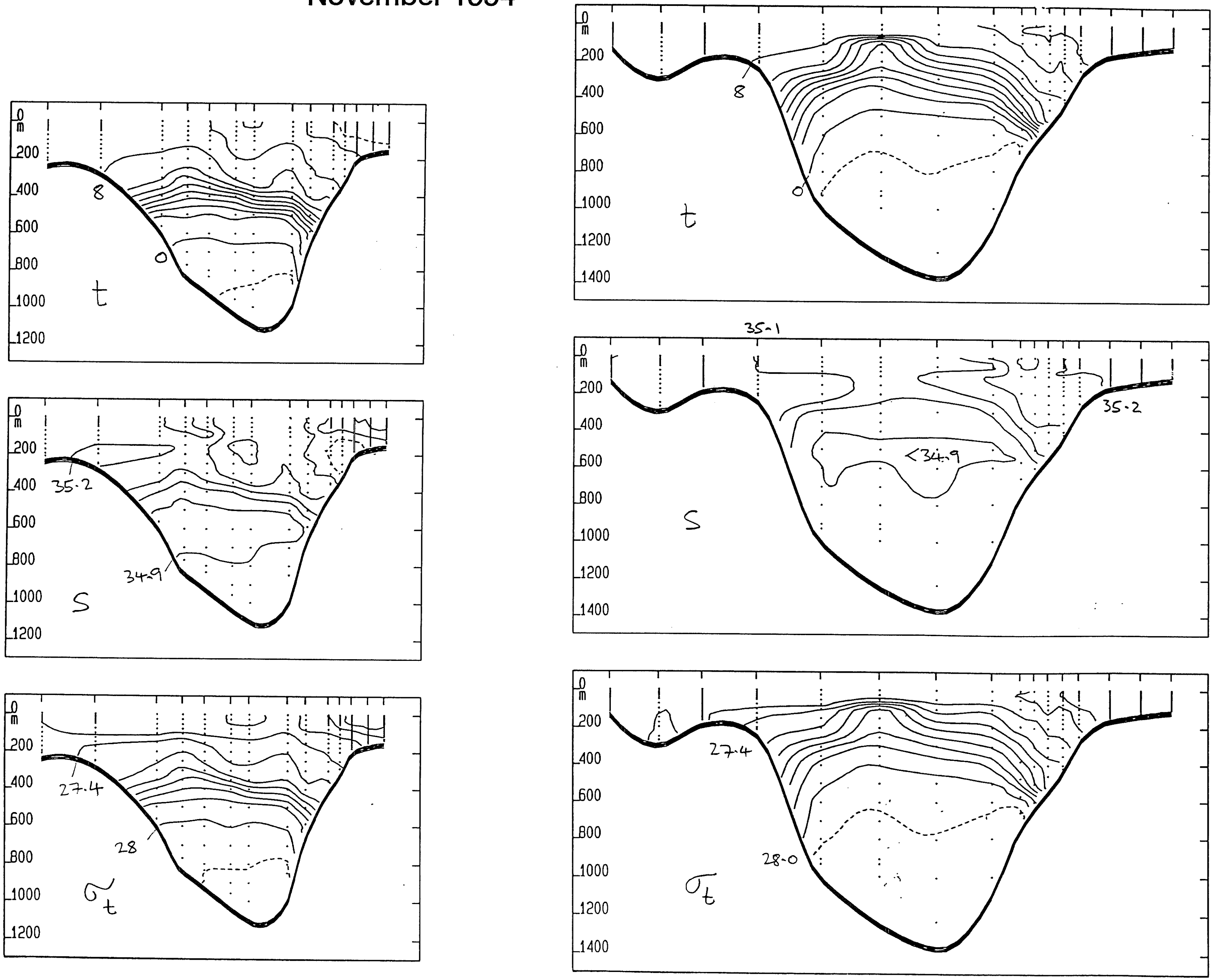


Figure 2

Figure 3b

January 1995 (Nolso-Flugga)

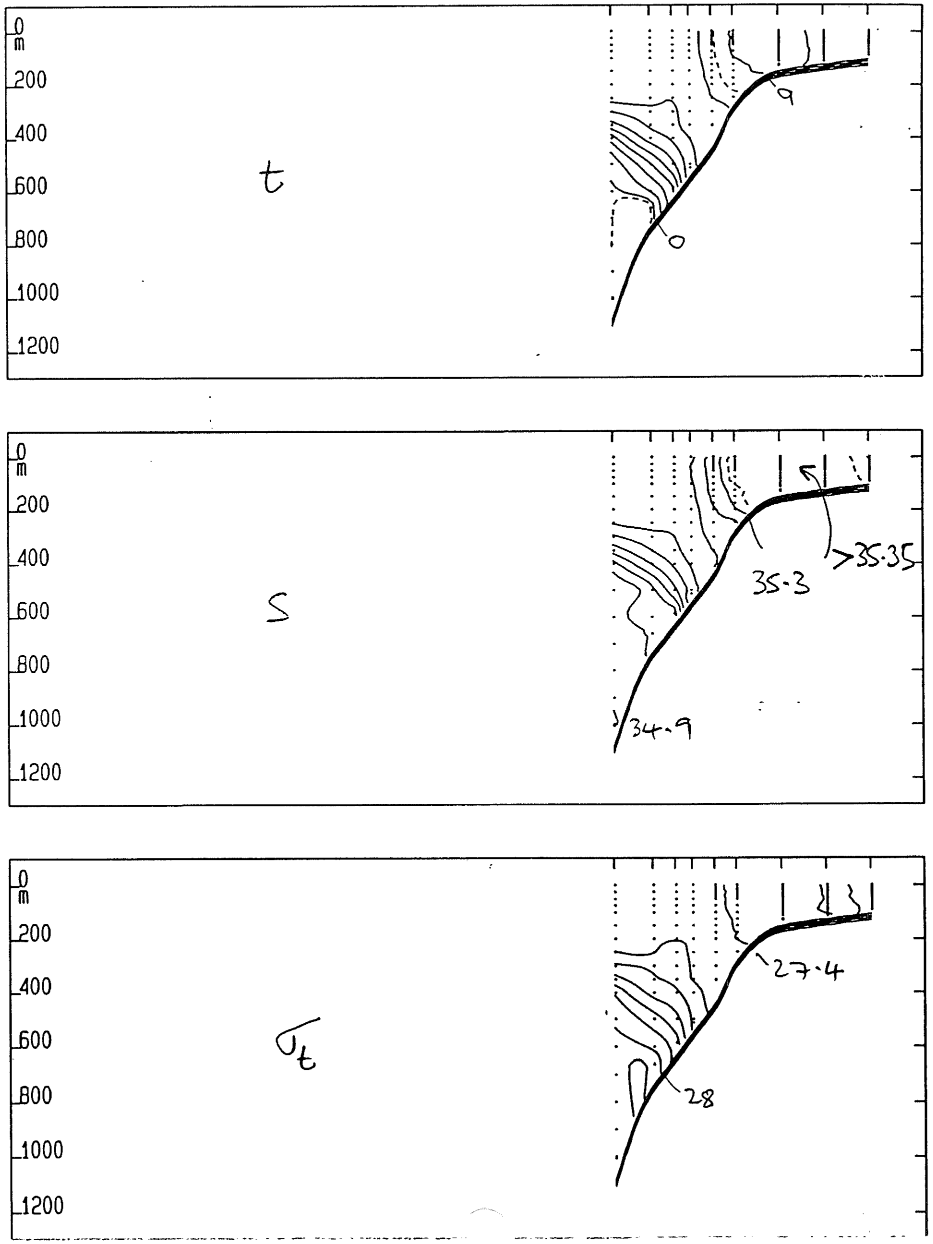


Figure 3a

December 1994 (Fair Isle-Munken)

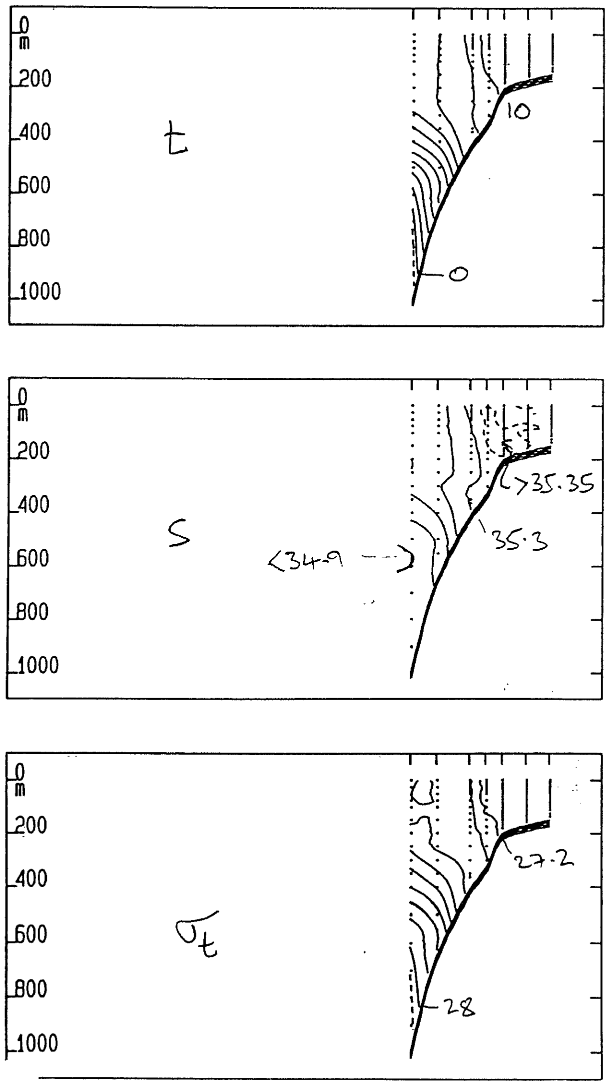
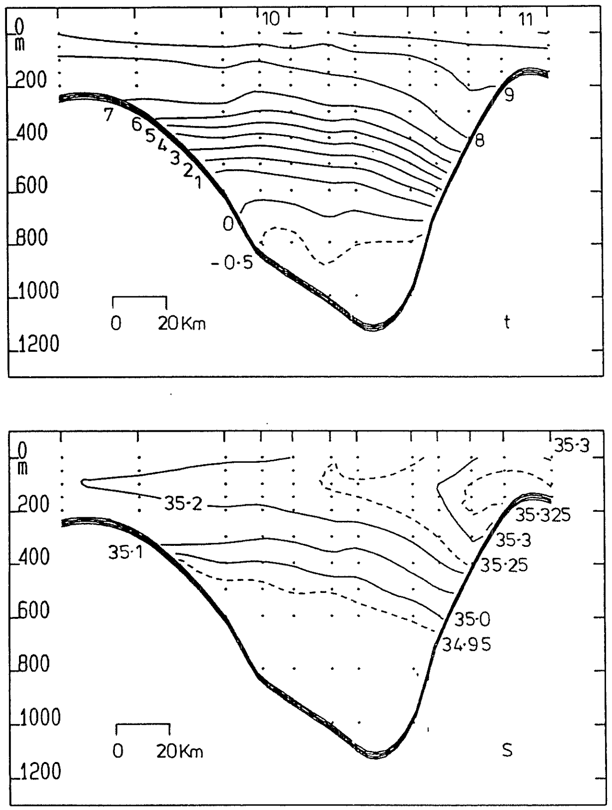


Figure 3

Fair Isle - Munken
Mean Values 1903-1993



Nolso - Flugga
Mean Values 1903-1993

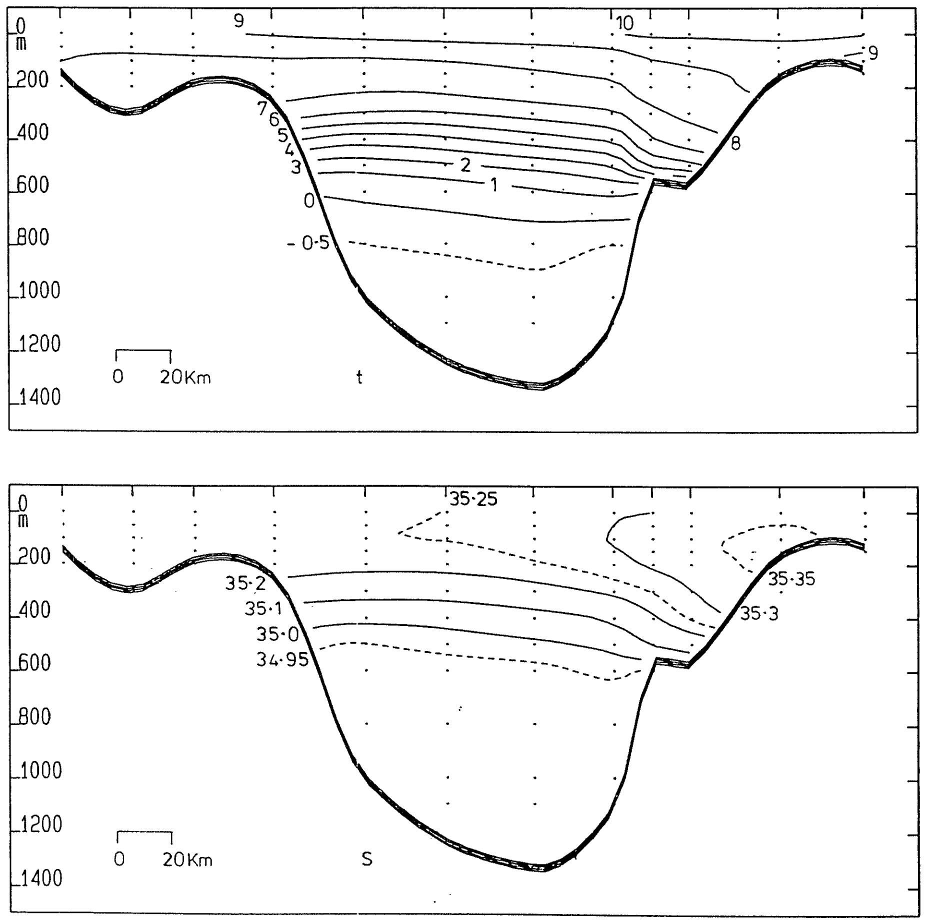


Figure 4

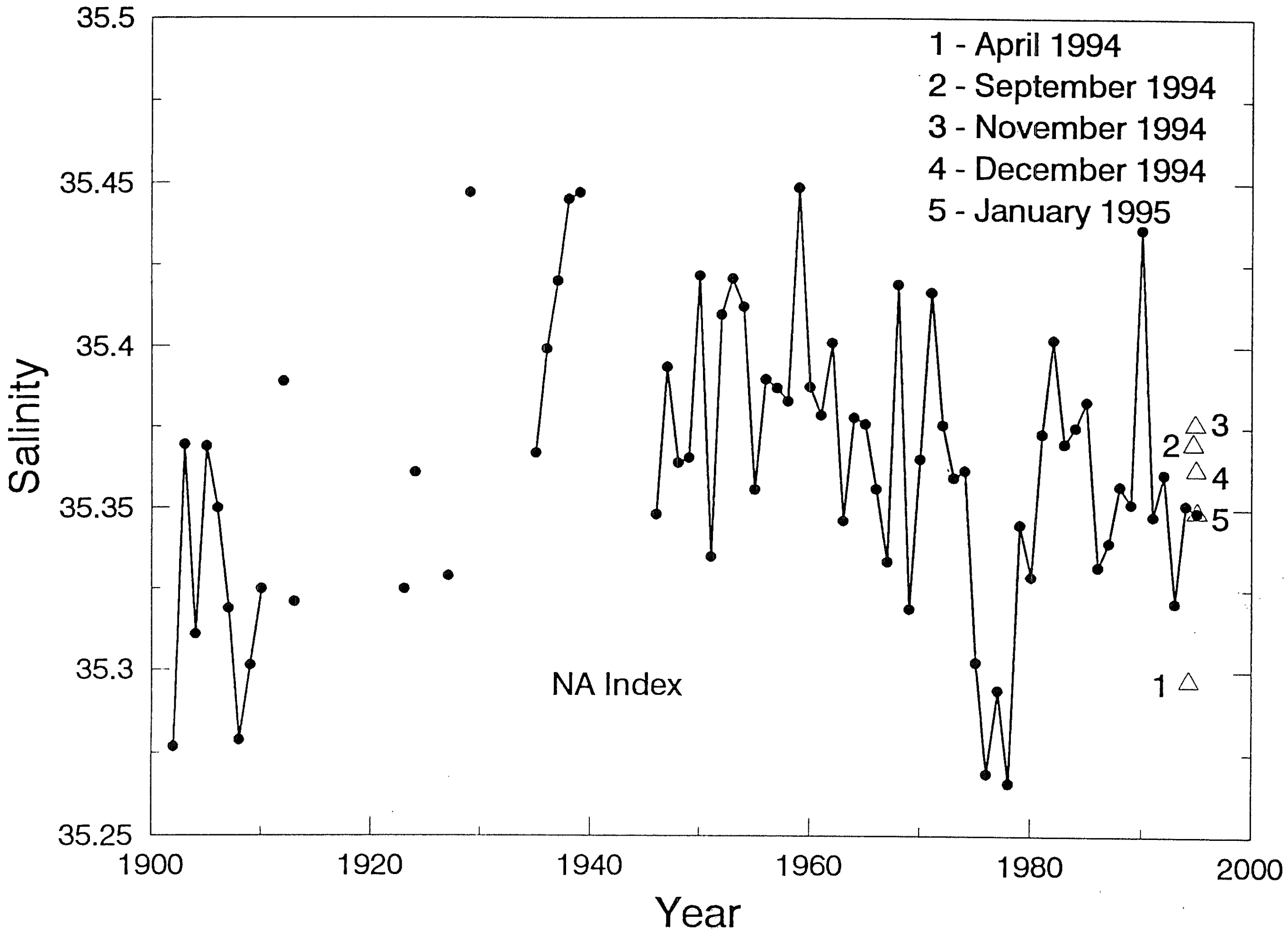

1 - April 1994
2 - September 1994
3 - November 1994
4 - December 1994
5 - January 1995
NA Index
Salinity
Year
35.5
35.45
35.4
35.35
35.3
35.25
1900
1920
1940
1960
1980
2000
1
2
3
4
5

Figure 5

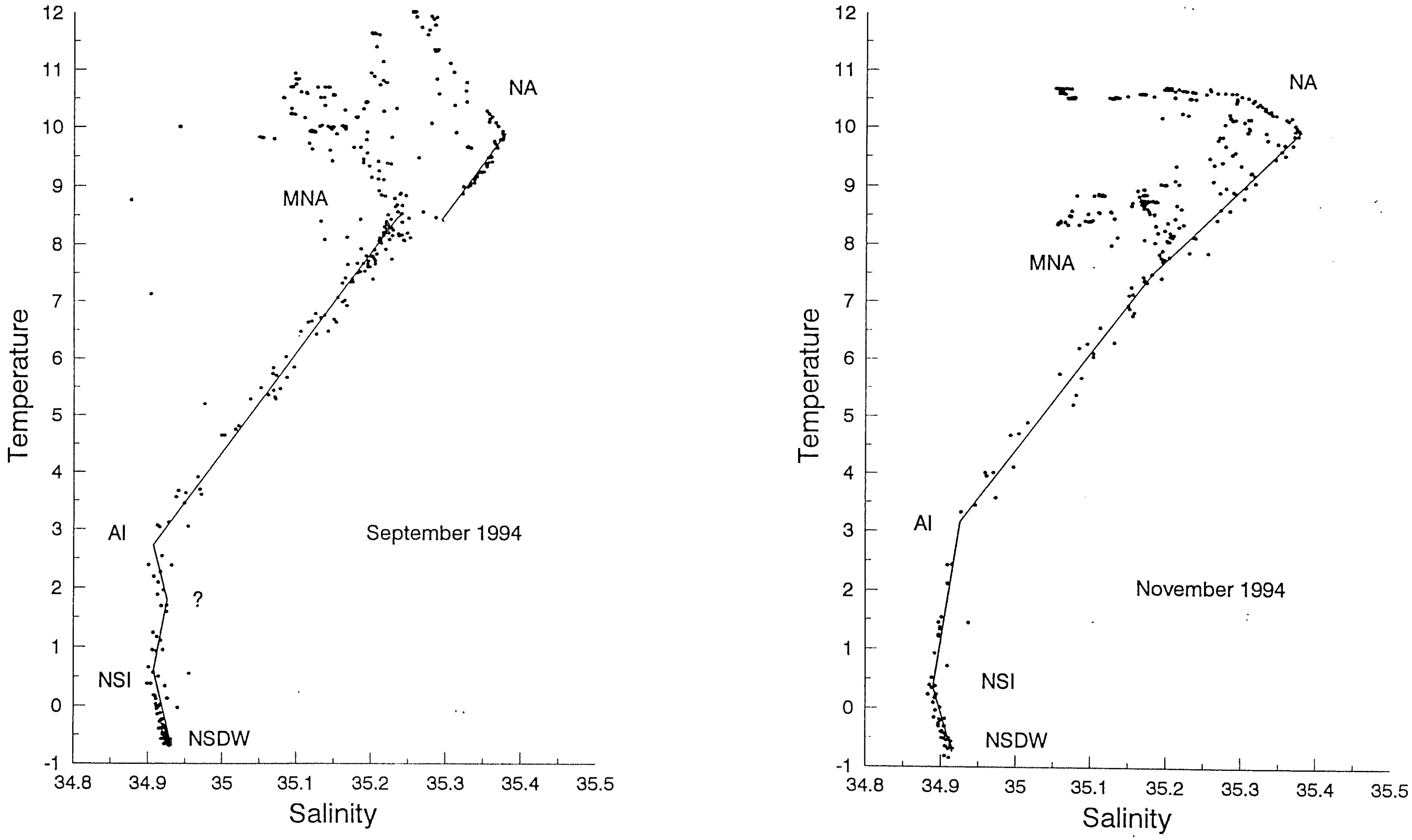
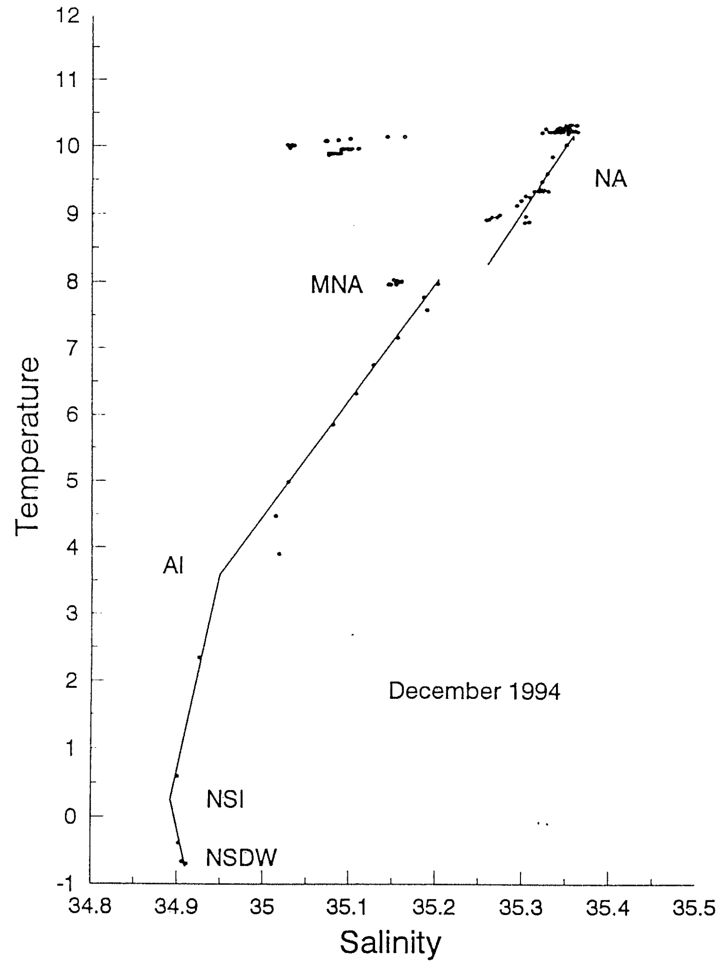

Temperature
Salinity
September 1994
NA
MNA
AI
?
NSI
NSDW
November 1994
NA
MNA
AI
NSI
NSDW
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
34.8
34.9
35
35.1
35.2
35.3
35.4
35.5

Figure 6


Temperature
Salinity
NA
MNA
AI
NSI
NSDW
December 1994

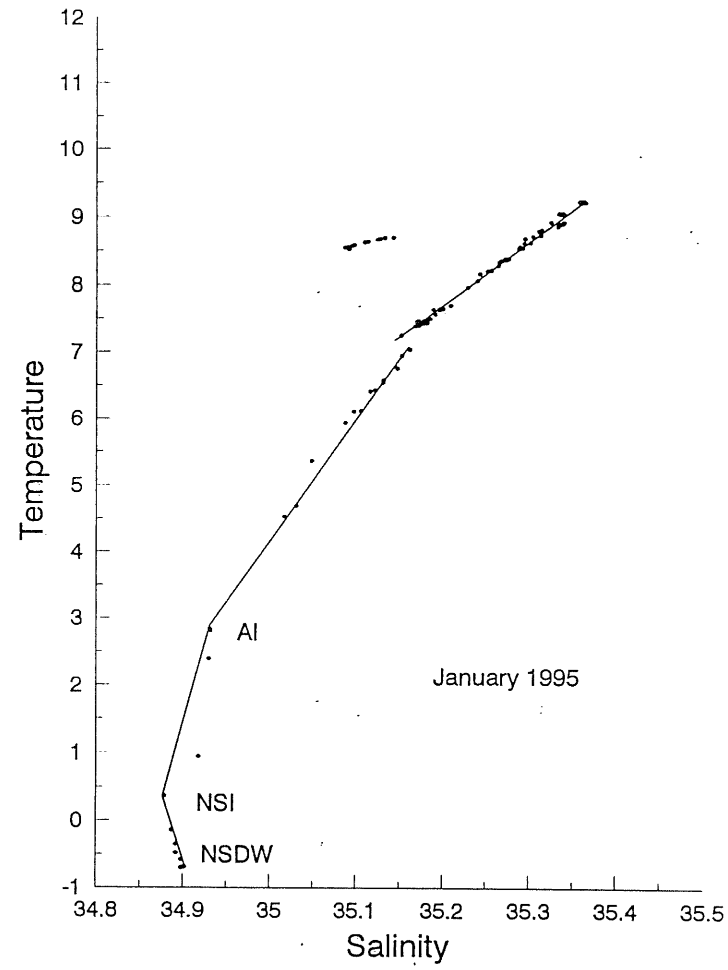

Temperature
Salinity
AI
NSI
NSDW
January 1995

Figure 7

Anton Dohrn Seamount standard section (David Ellett)

The eastern half of the Anton Dohrn Seamount CTD section, between the Scottish shelf-edge and the seamount, was worked during 17-19 March, when high oxygen saturation values showed that upper water from above the seamount had descended in the Rockall Channel to depths approaching 1000m. The complete section was worked in early May (Figure 1a-d) and mid-August (Figure 2a-d), and in November the eastern three-quarters was repeated. Some of the deeper stations of the Malin Head - Rockall section were sampled in May and August to provide comparisons with data from the mid-1960s. Numerous short slope / shelf-edge sections were worked during each of the cruises as part of the LOIS Shelf-Edge Study programme. Surface layer salinity values were a little below the 1951-80 levels in the first half of the year, but patches of relatively high salinity water were observed in August. At the level of the Labrador Sea Water salinity minimum (ca 1800m) salinity had increased slightly from the low values of recent years.

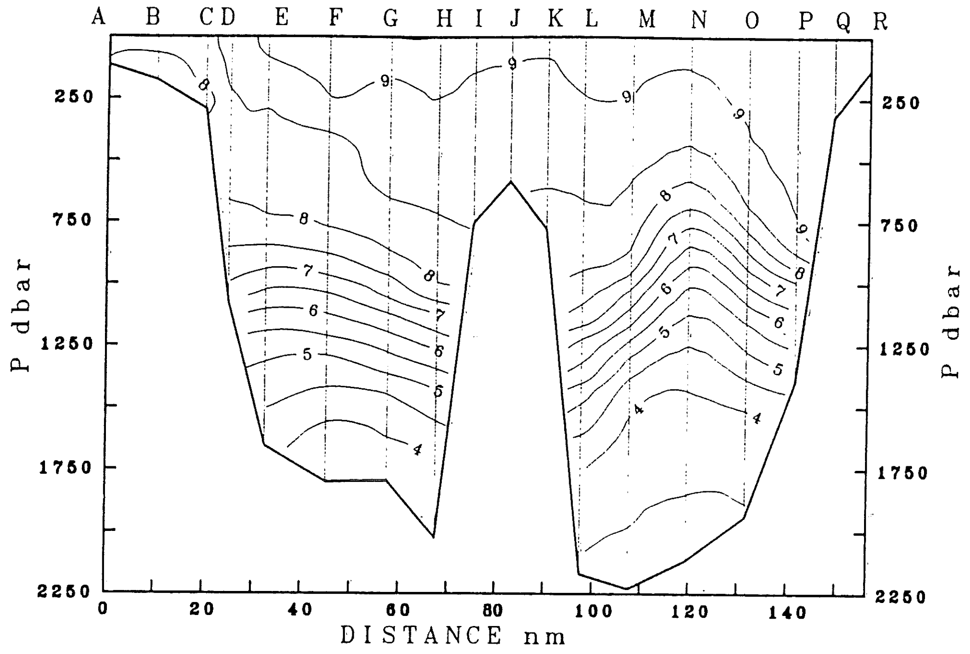


Figure 1 a. Anton Dohrn Seamount section, 2 - 4 May 1994. Temperature (°C).

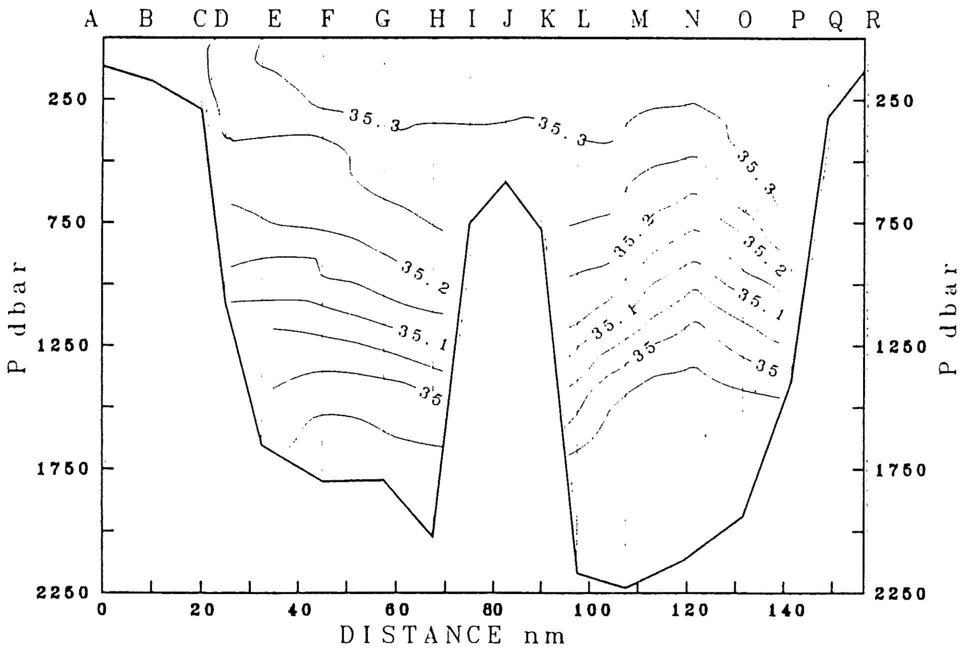


Figure 1b. Anton Dohrn Seamount section, 2 - 4 May 1994. Salinity (psu).

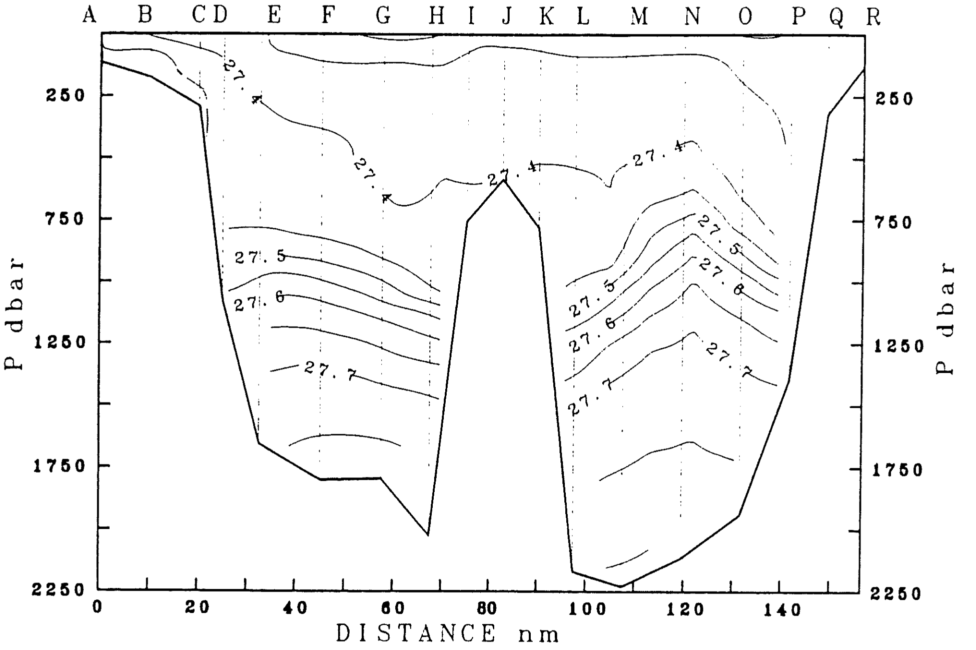


Figure 1c. Anton Dohrn Seamount section, 2 - 4 May 1994. Density (sigma-t).

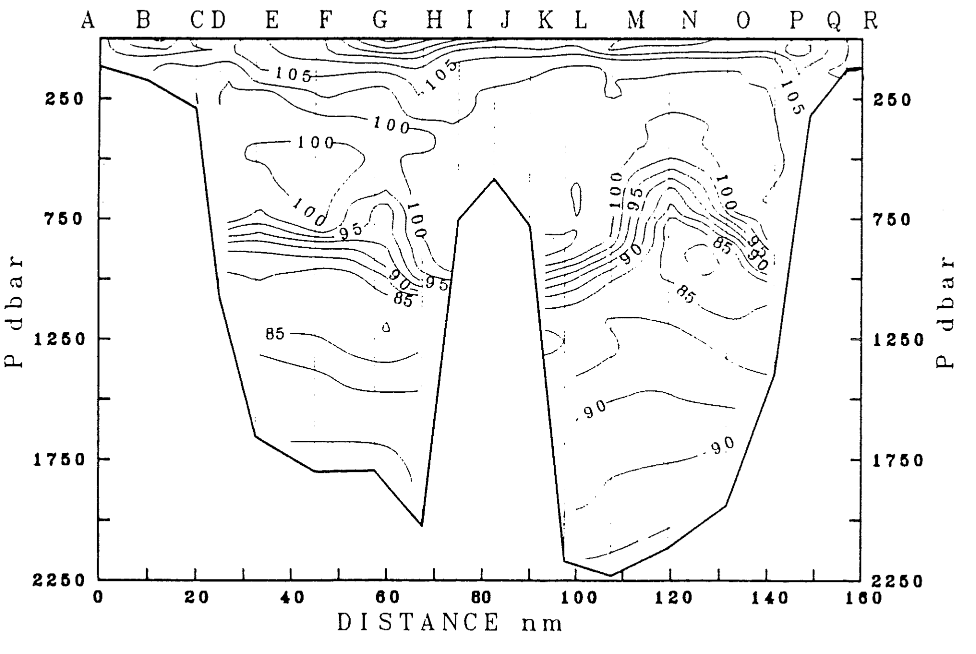


Figure 1d. Anton Dohrn Seamount section, 2 - 4 May 1994. Oxygen saturation (%)

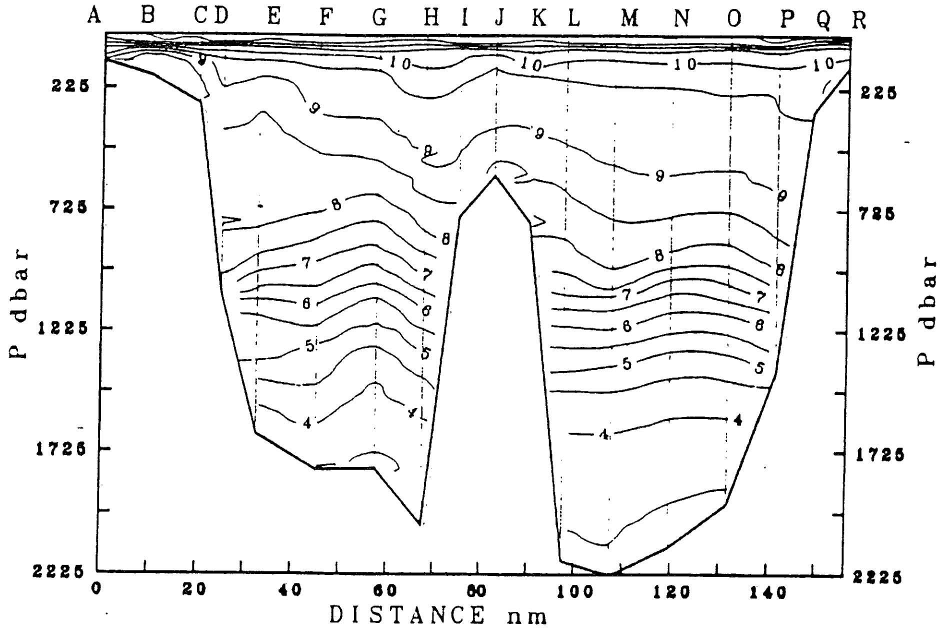


Figure 2a. Anton Dohrn Seamount section, 16 - 19 August 1994. Temperature (°C)

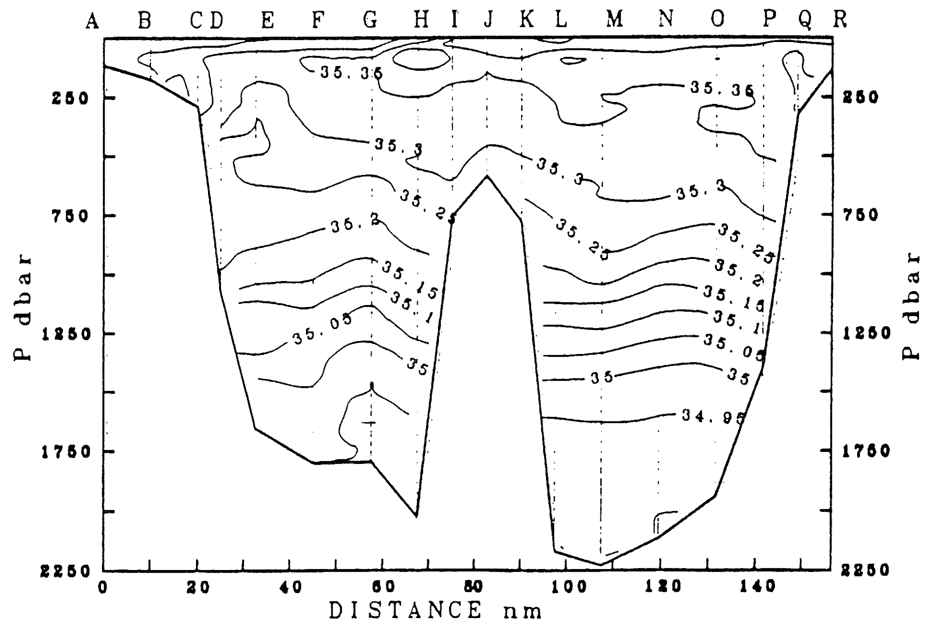


Figure 2b. Anton Dohrn Seamount section, 16 - 19 August 1994. Salinity (psu).

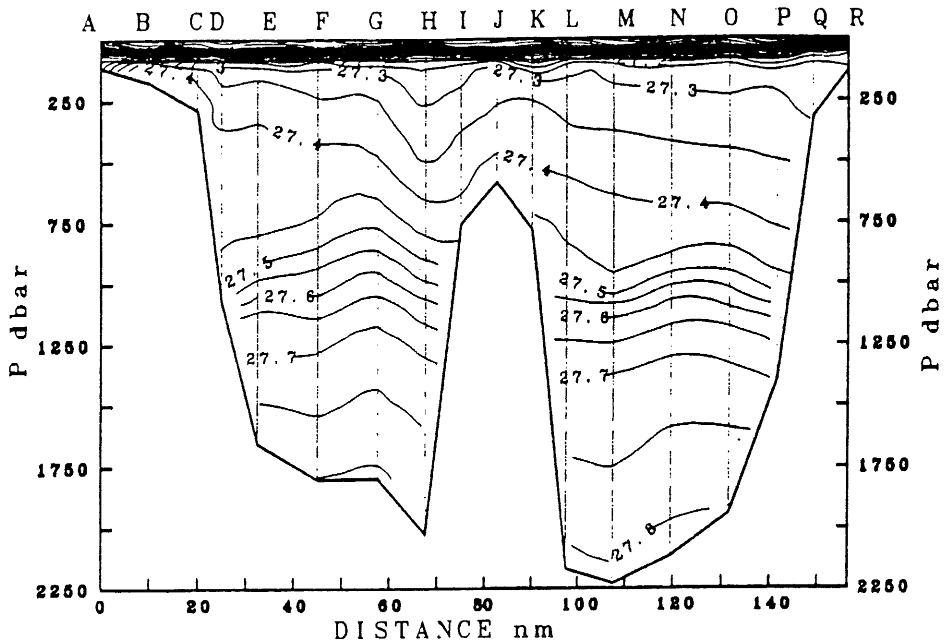


Figure 2c. Anton Dohrn Seamount section, 16 - 19 August 1994. Density (sigma-t).

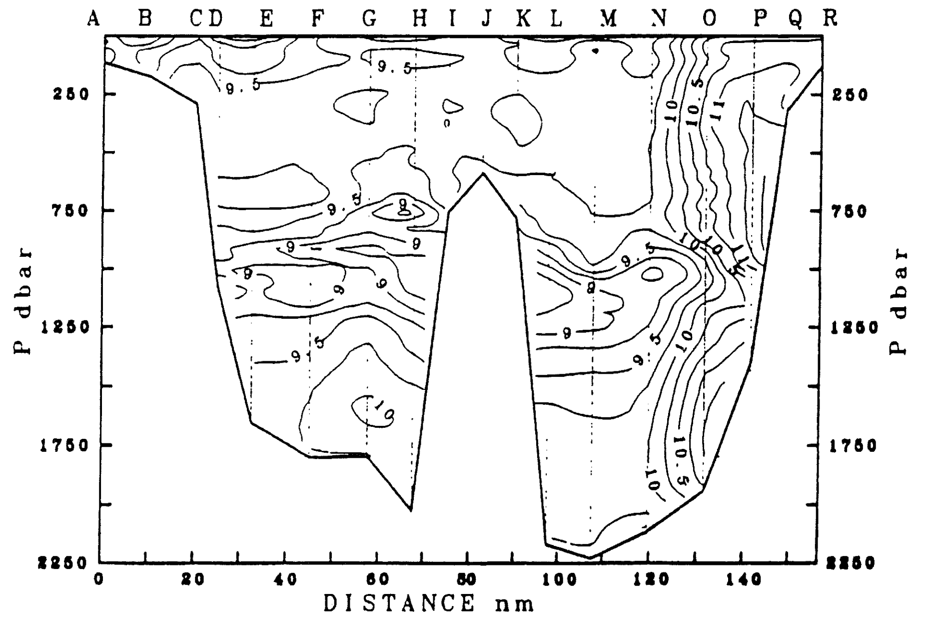


Figure 2d. Anton Dohrn Seamount section, 16 - 19 August 1994. Oxygen (mg/l).

SPAIN (Alicia Lavîn and J.M. Cabanas):

Four standard sections have been sampled monthly in the N and NW of the Iberian Peninsula (figure 1) for at least 3 years.

Results of 3 stations on the Santander Section from the shallowest (station 2, 26 m) to the deepest (station 6 on the shelf break) are presented.

In station 2, figure 2a and b, we can see slight stratification on the summer temperature. High salinity values appear in early winter 92 and 93 but not in 1994.

Station 4 (figure 3a and 3b) in the central part of the shelf shows a periodic cycle in the upper 40 m because of summer warming and a cold inflow in the bottom. This water was colder than 12ºC in 1992 but not so cold in 1993 and 1994. The salinity time series shows very high values (>35.7 psu) between 20 and 55m from June to October. 1992 was a high salinity year for this area, values as high as 35.80 psu were found, in 1993 salinity decreased to 35.65 with a few values over 35.70. In 1994 average values were around 35.60 psu.

The summer saltier water is probably due to the seasonal upwelling and can be seen in July 1992 (~ day 575) and August 1993 (~ day 950). In 1994 the sign is also presented but the values are only about 35.60 psu. In early winter it is also possible to see the decrease in salinity, with high values at the begining of 1992, intermediate in 1993 and lower in 1994.

Station 6, on the shelf-break, has only been sampled up to 700 m since the middle of 1993. In the upper 100 m, the picture is similar to station 4. In 1994 (figure 3) we can see the evolution of temperature and salinity with time through the year.

When we compare the T/S diagram of station 6, we see the decrease in salinity from the autumn of 1993 to the autumn of 1994 mainly in surface waters and up to the upper part of the ENACW (East North Atlantic Central Water) (figure 5a). Figure 5b shows this differences between 11.3 and 12.5 ºC.

With respect to the standard sections off Vigo, we present two stations, station 14 (inside the Rîa de Vigo) and station 11 on the shelf.

On station 14 (figures 6a and 6b) we can detect some upwelling events around days 160, 200 and 250. The sign of NEACW is clear both in temperature and salinity.

Behaviour of stations 14 and 11 (figures 7a and 7b) is similar mainly in the second part of the year.

Spanish Standard Sections

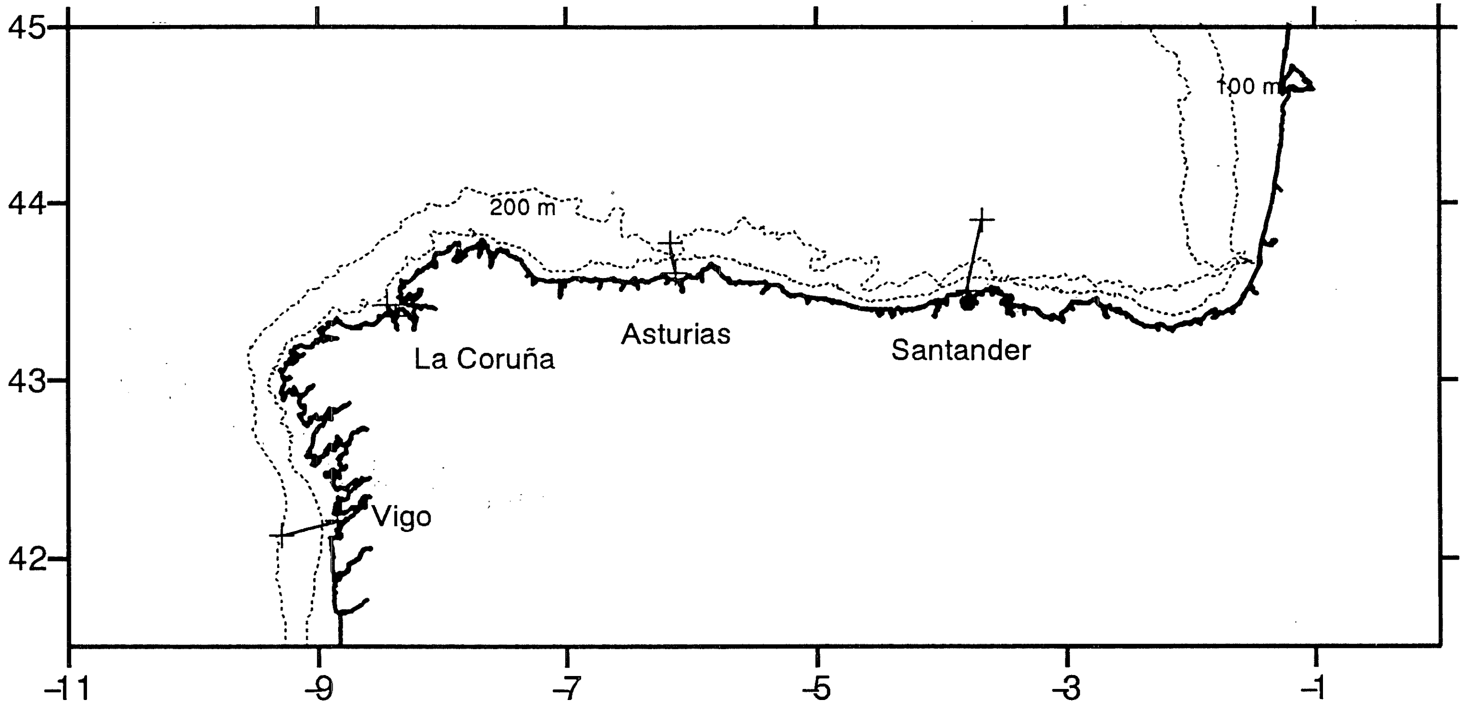


Figure 1. Location of the Spanish Standard Sections

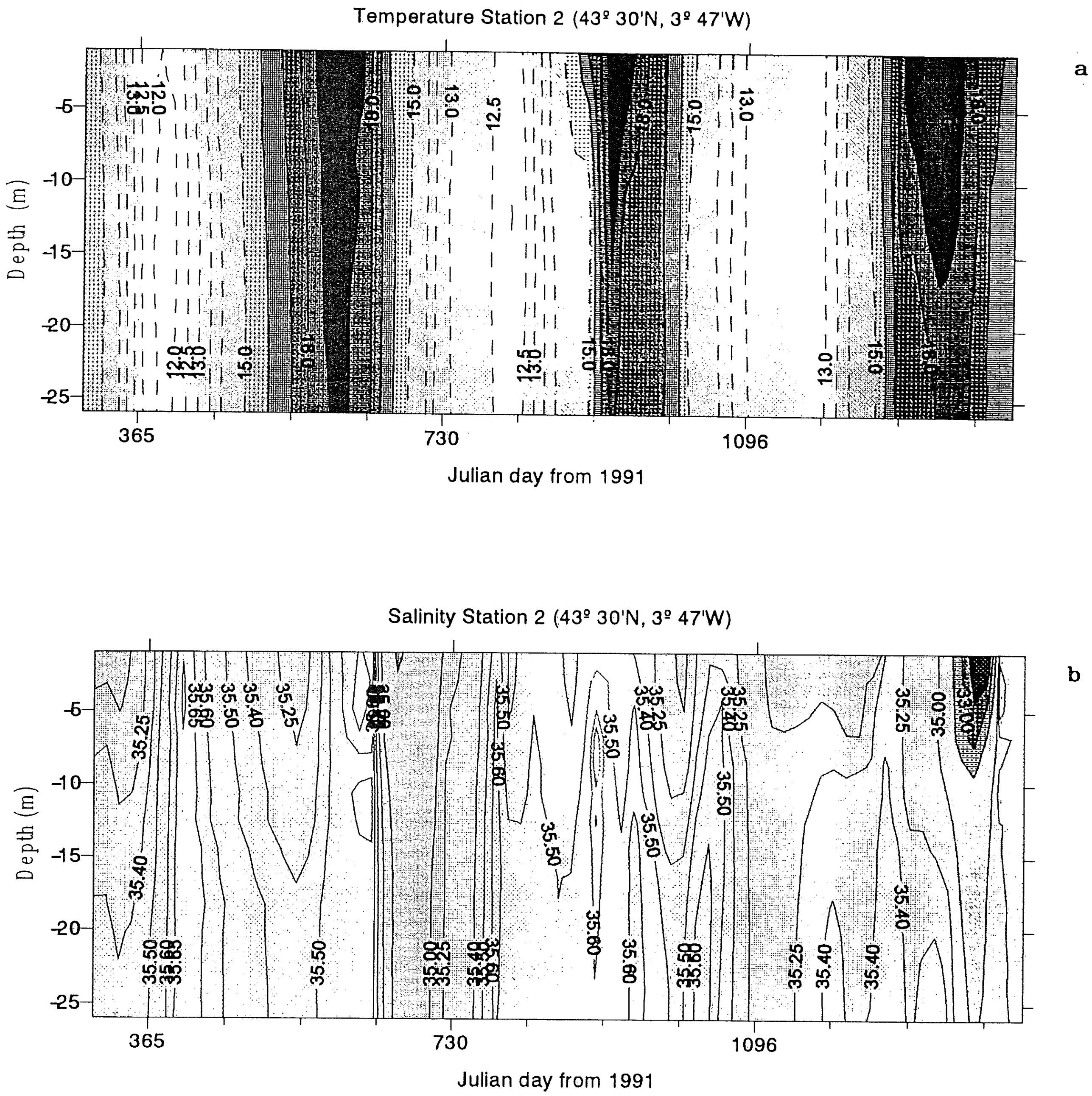


Figure 2. Distribution of a) temperature and b) salinity at station 2 (Santander section).

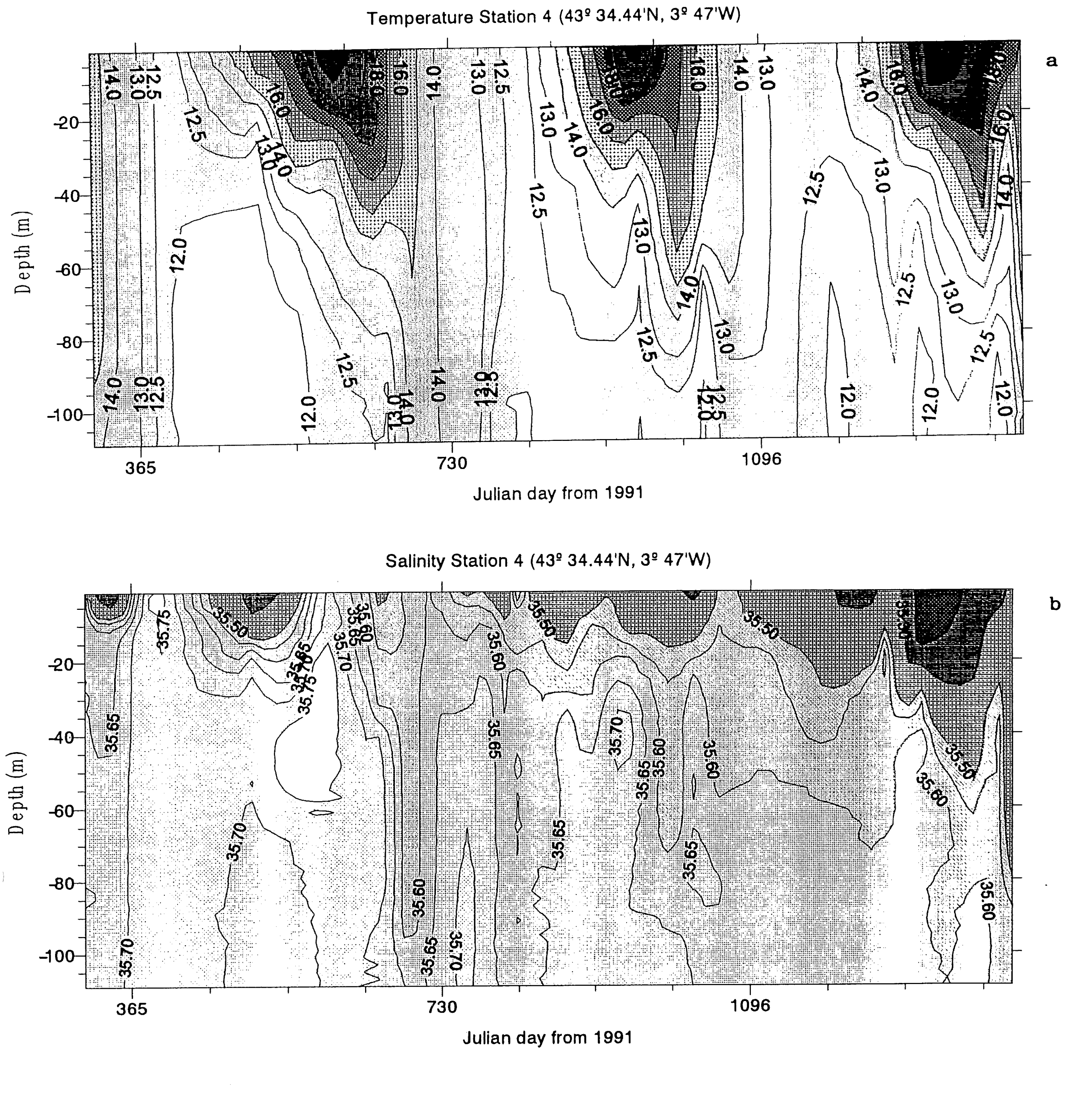


Figure 3. Distribution of a) temperature and b) salinity at station 4 (Santander section).

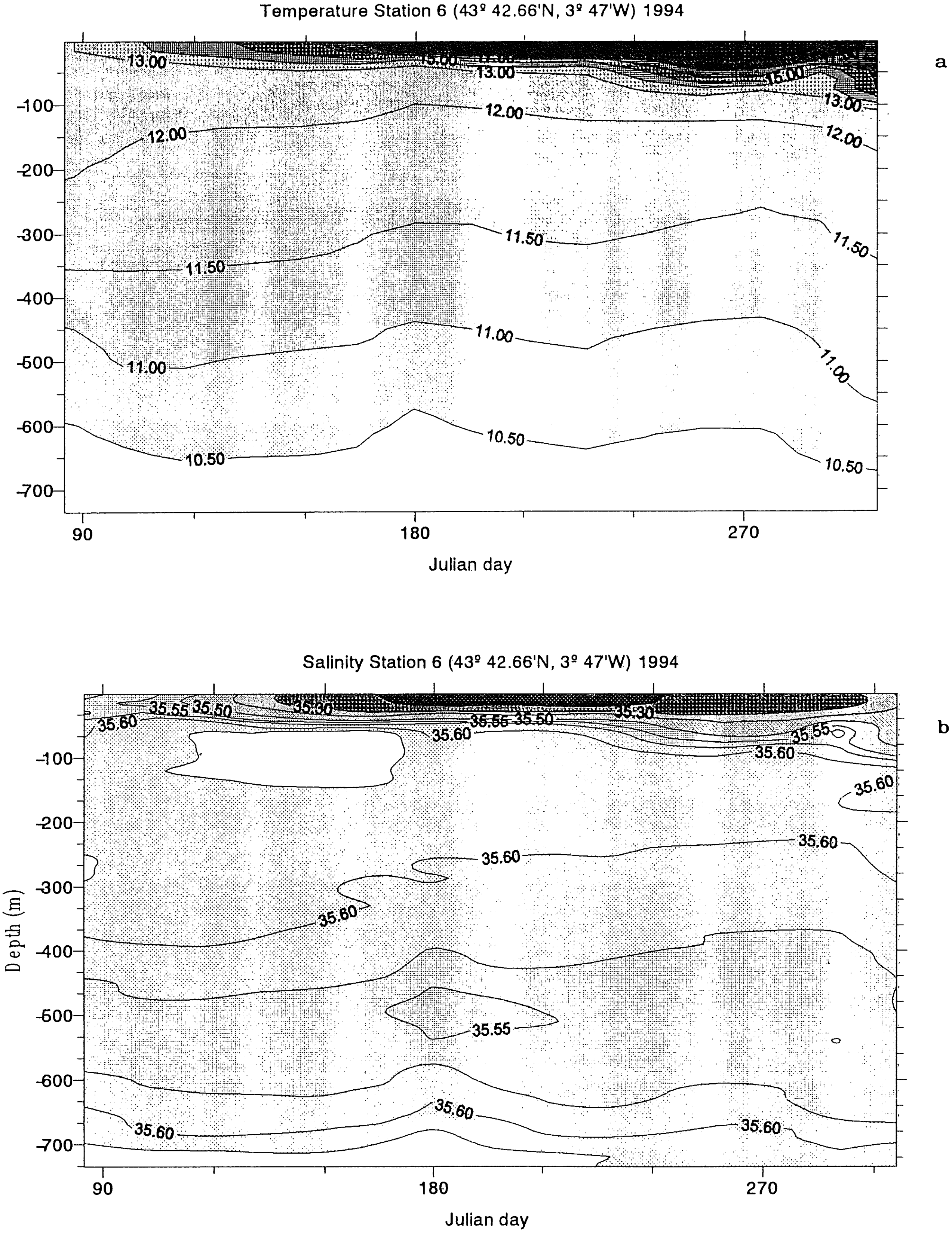


Figure 4. Distribution of a) temperature and b) salinity at station 6 (Santander section).

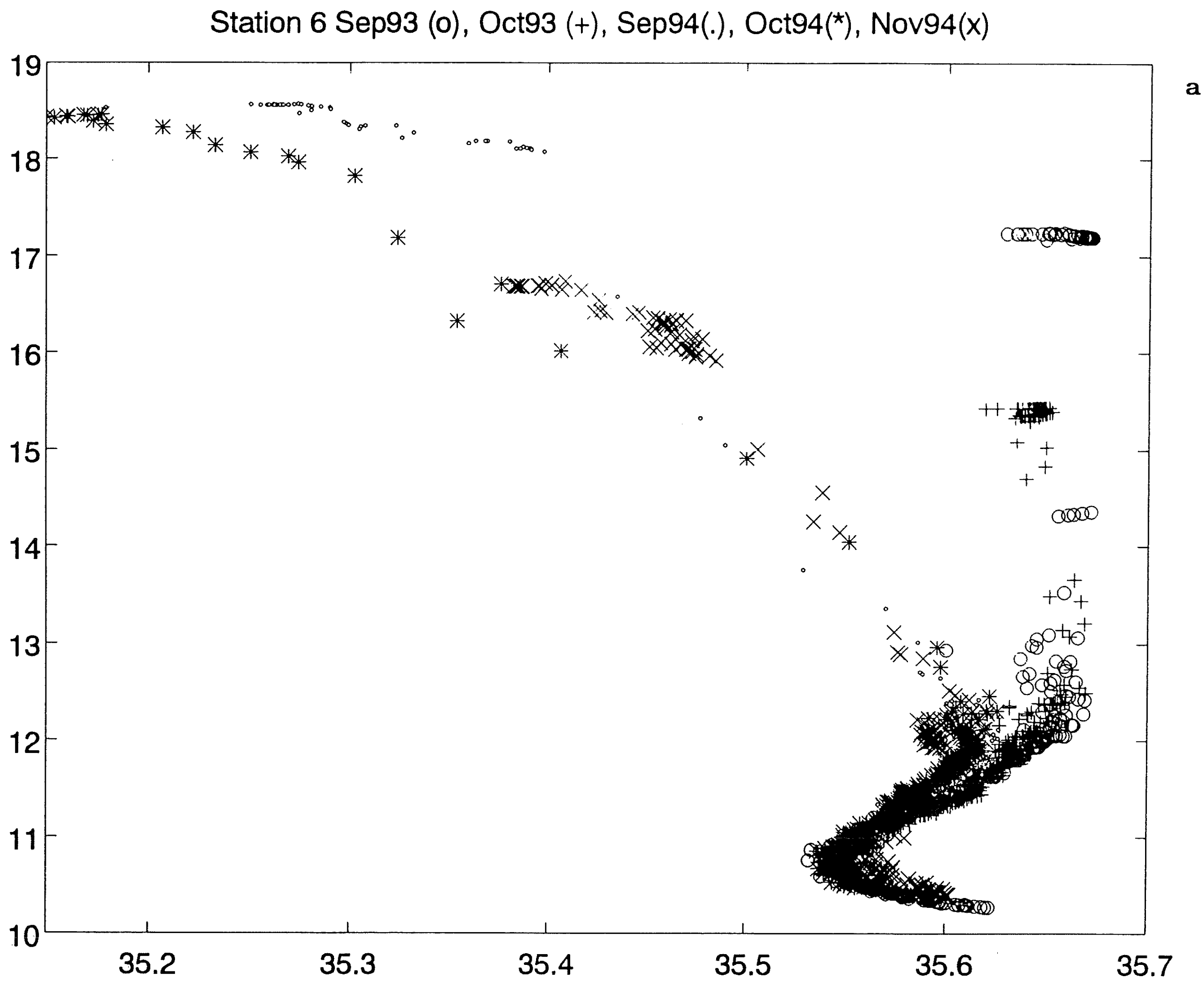
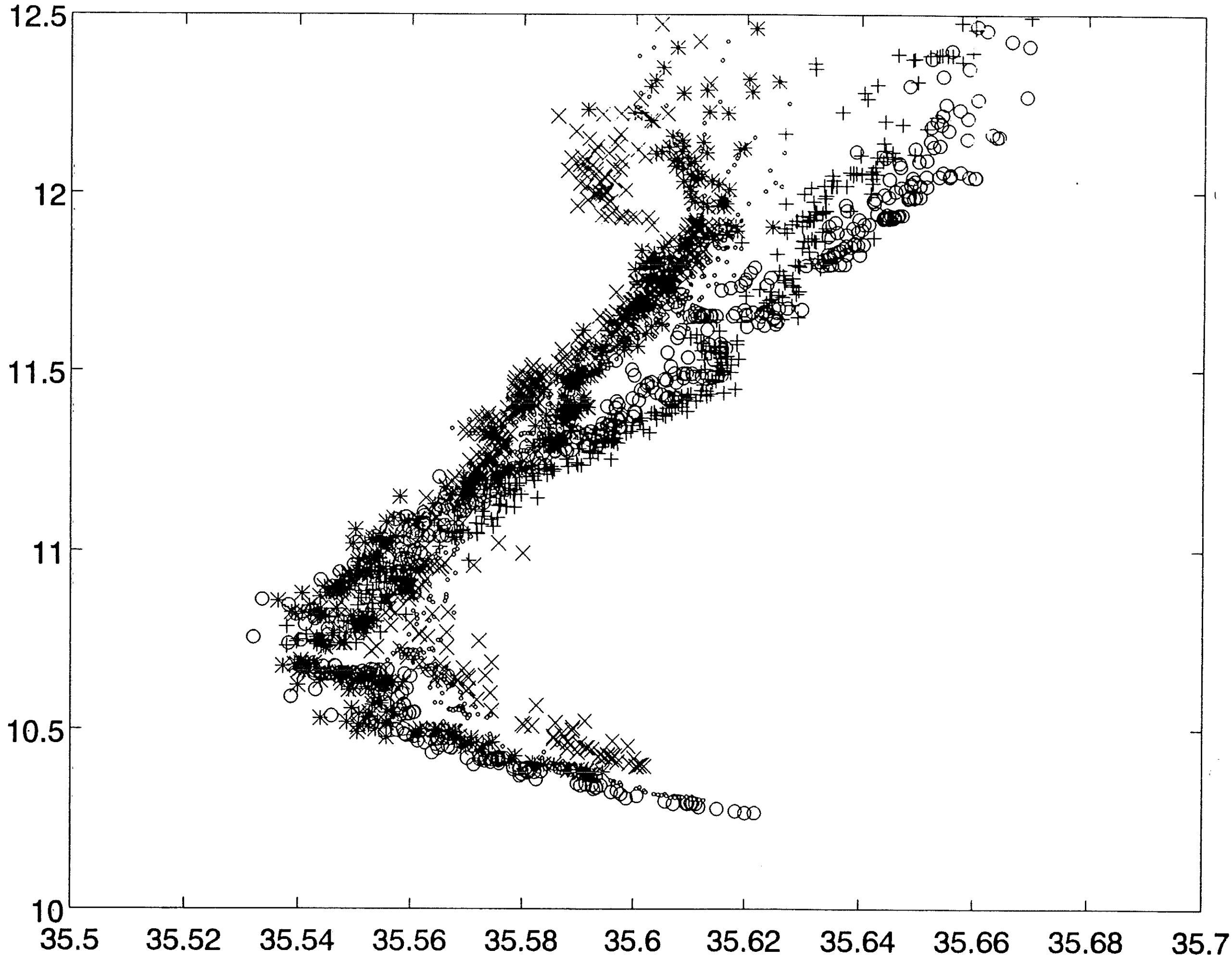
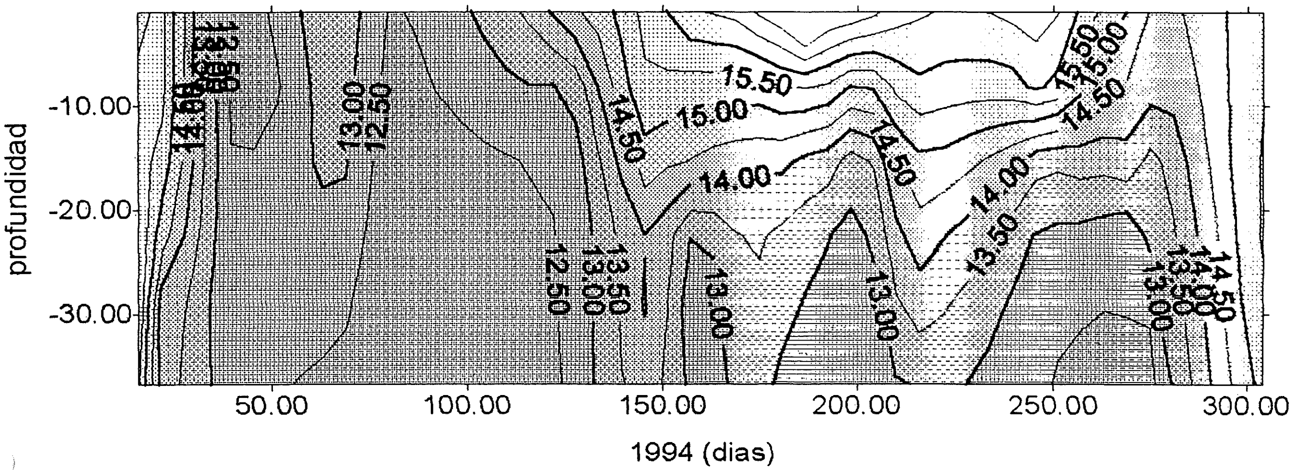


Figure 5. T/S diagram of station 6. a) all the values b) NEACW part.

Station 6 Sep93 (o), Oct93 (+), Sep94(.), Oct94(*), Nov94(x)

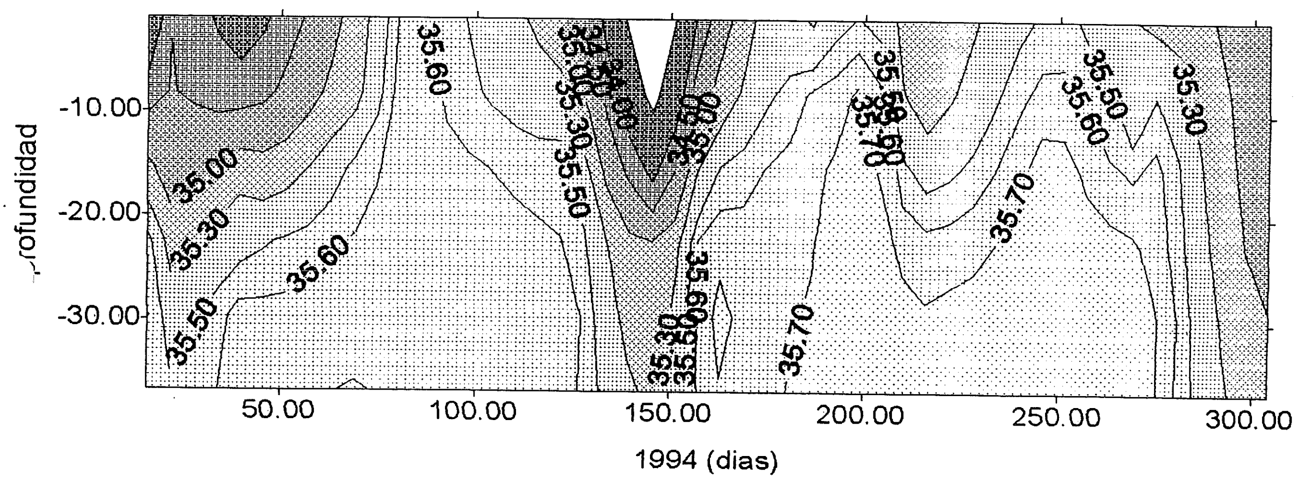


Temperatura en la estación 14.



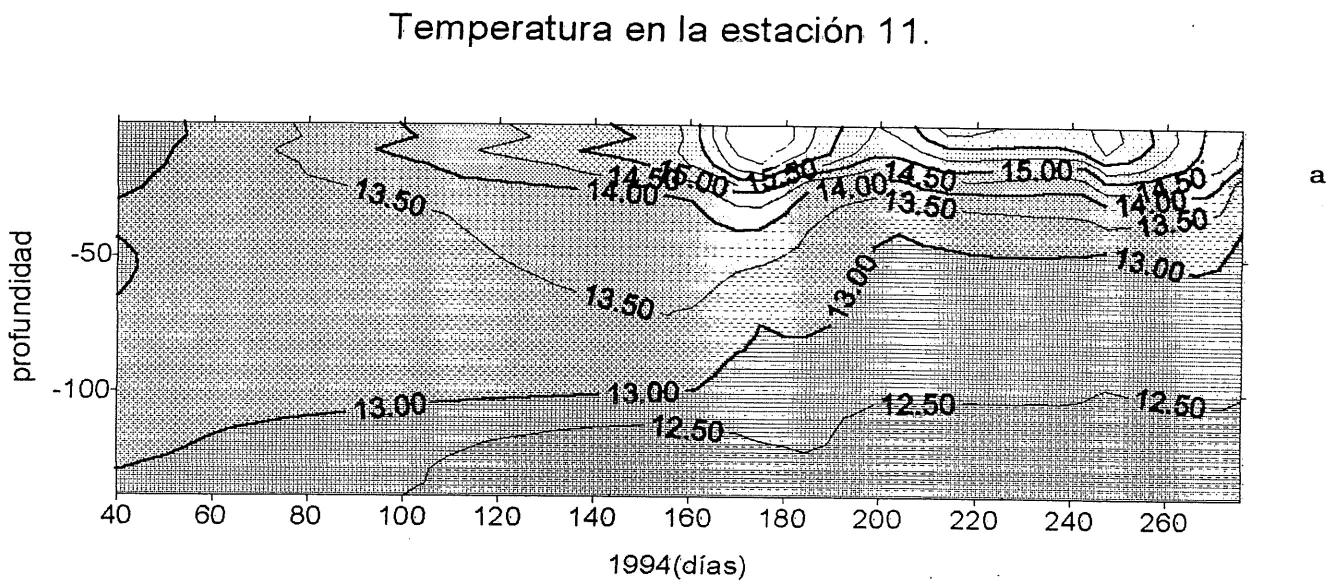
a

Salinidad en la estaciòn 14.



b

Figure 6. Distribution of a) temperature and b) salinity at station 14 (Vigo section).



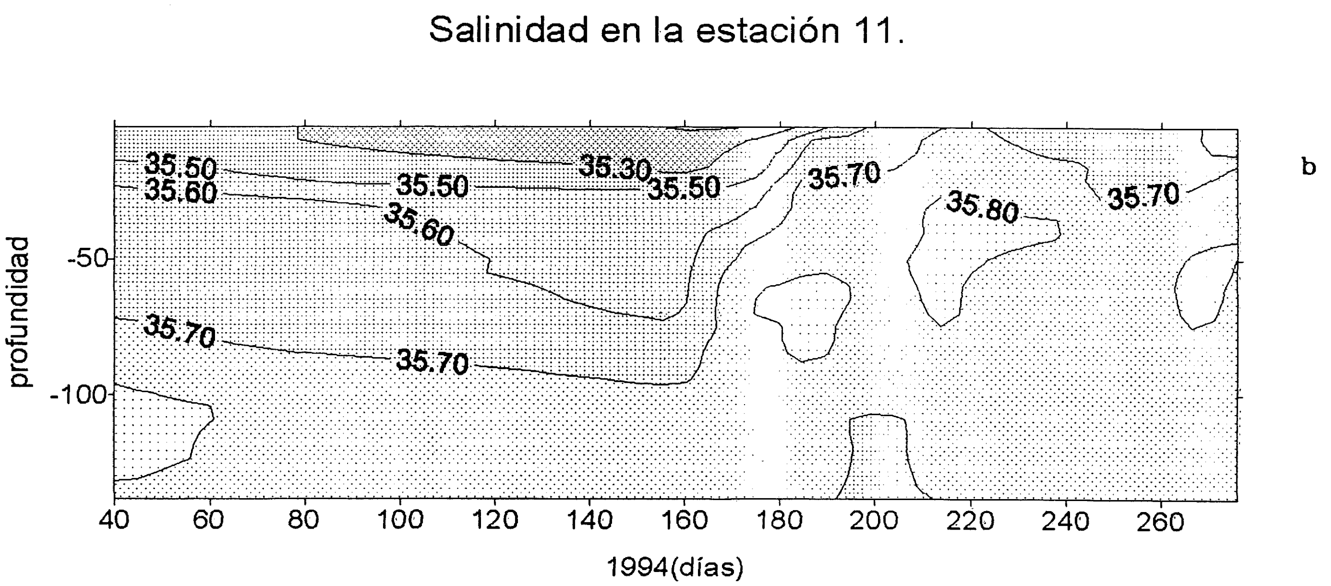


Figure 7. Distribution of a) temperature and b) salinity at station 11 (Vigo section).

GERMANY (K.P. Koltermann):

Status of hydrographic Work on 48° in the Atlantic

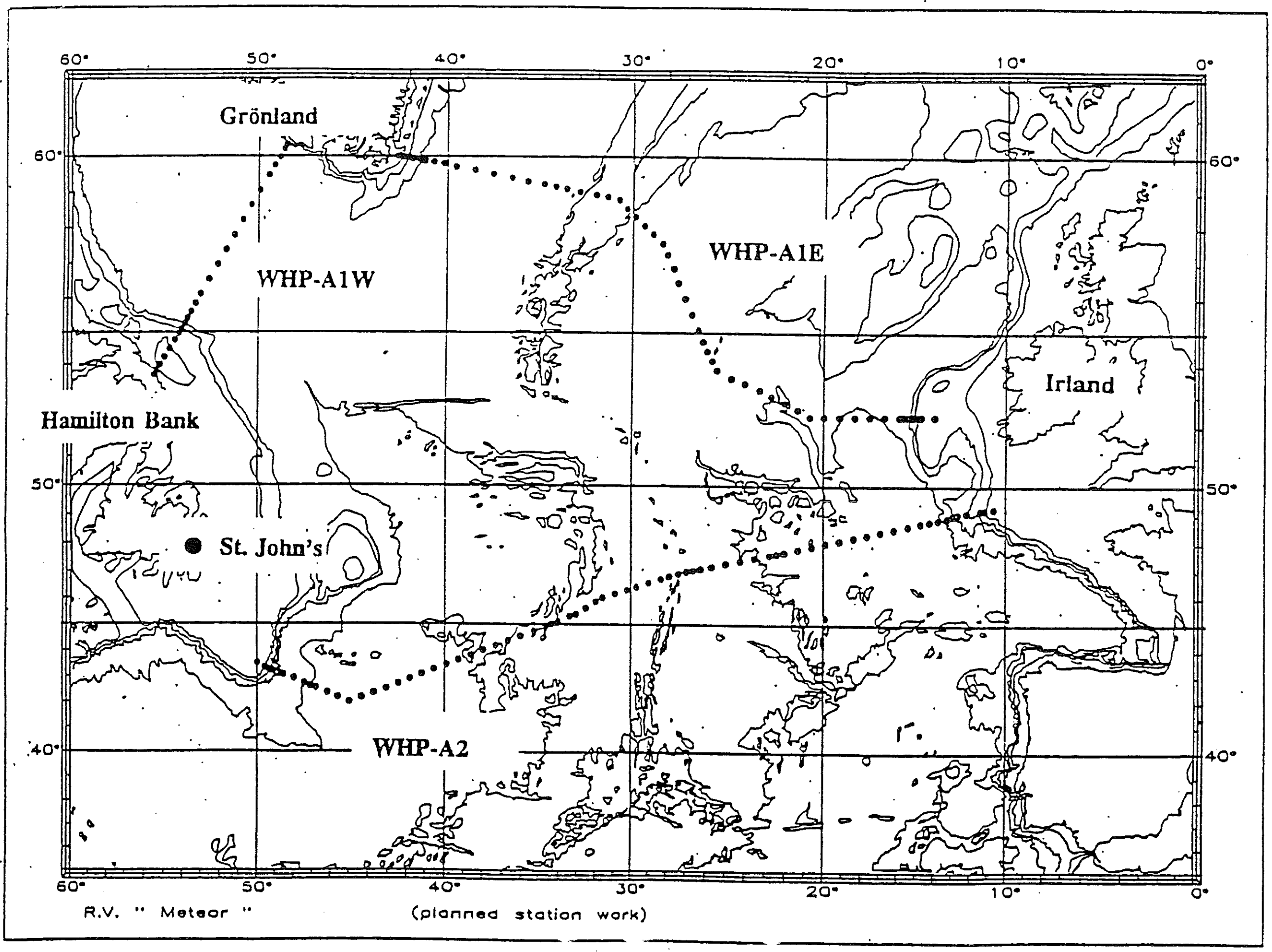
The transoceanic section along ca . 48°N has been occupied in the past in April 1957 by RRS Discovery, in April 1982 by CCS Hudson, in August 1993 by FS Gauss and in October/November 1994 by FS Meteor. Further occupations are presently planned for May 1996 with FS Gauss and May 1997 with FS Meteor.

The most conspicuous result of the these occupations are changes in the intermediate water particularly in the western basin. Since the 1982 occupation the LSW core properties have changed considerably, i.e. the potential temperature dropped by 0.46°C with only a minute freshening by 0.002, but a density increase of 0.055 kg/m^3 resulting in a depth increase for the LSW layer of ca. 700 m to 2100 m. These changes continued for the 1994 repeat with a further cooling of <0.1°C in the western basin, but also a remarkable cooling now also evident in the eastern basin.

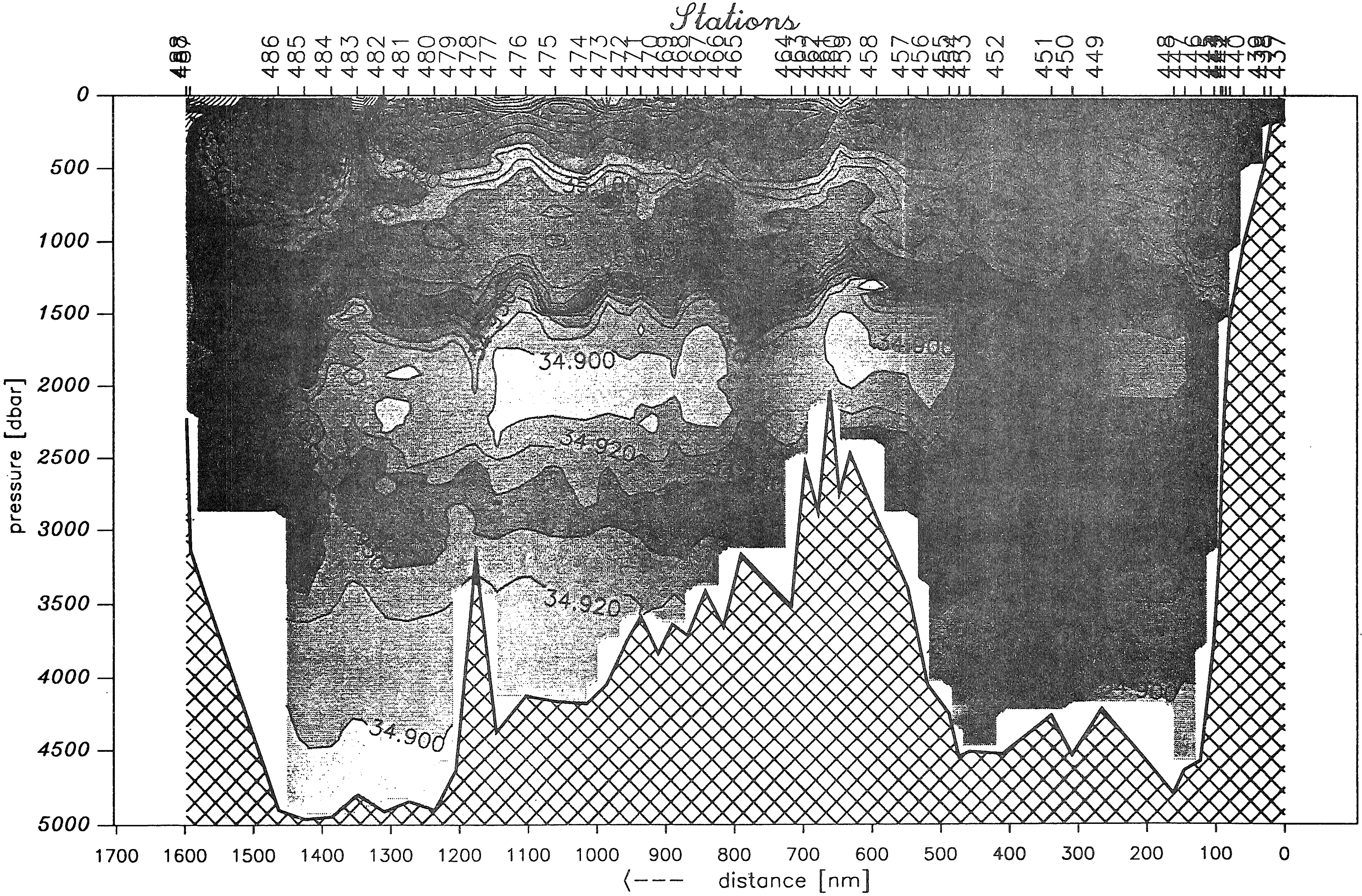
From the 1982 to the 1993/4 occupations the property characteristics of the Deep Western Boundary Current off Newfoundland have warmed and become slightly saltier. The horizontal gradients between the DWBC region and the ocean interior, and the LSW domain, are subsequently now greater.

In the surface layers of the eastern basin the increase in salinity observed since the 1982 occupation has continued.

Heat transport estimates are being prepared awaiting the recovery of a major Canadian/US currentmeter array off the Grand Banks this spring.



Stationskarte der WOCE-Fahrtabschnitte WHP-A1W und WHP-A1E WHP-A2,



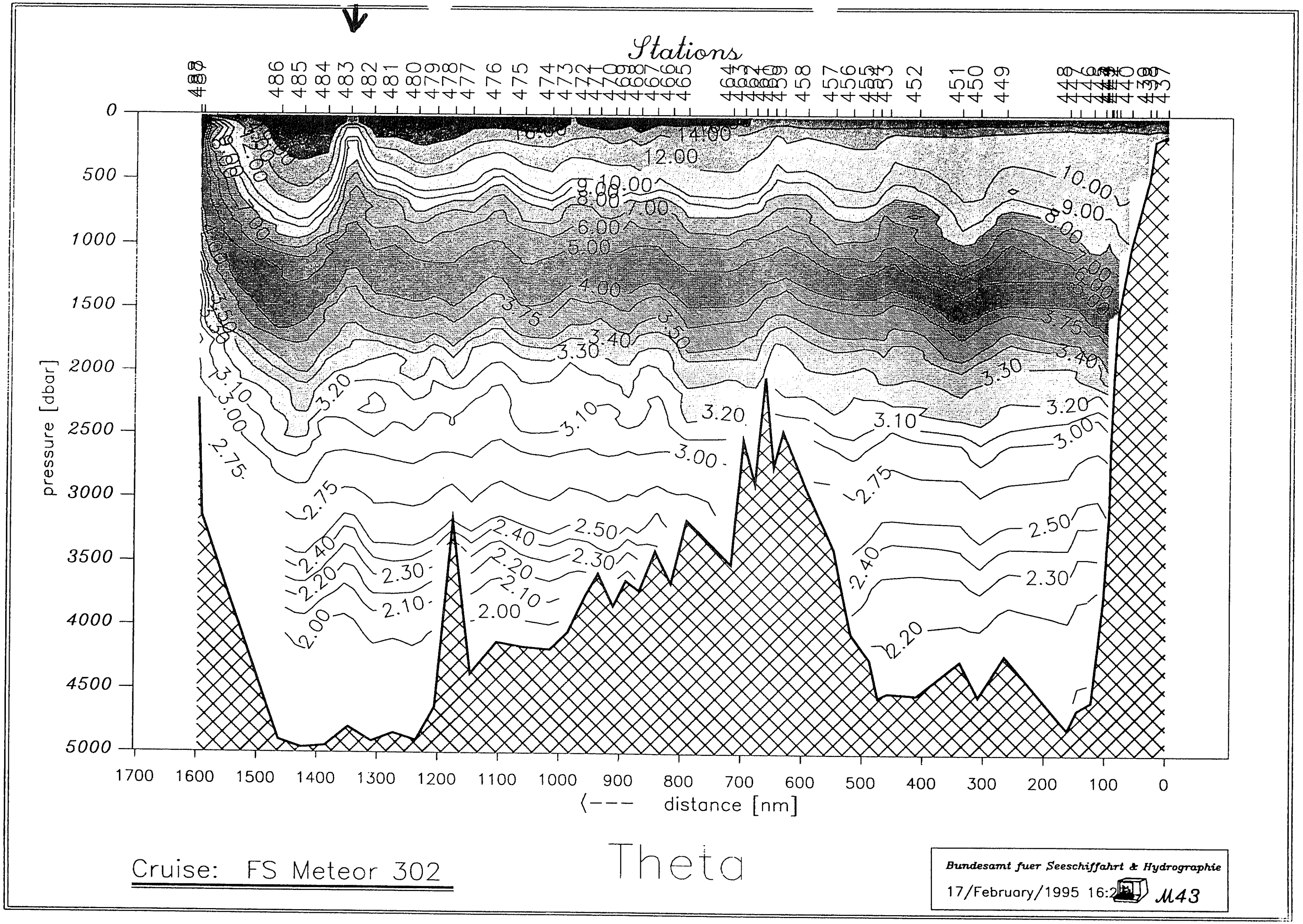
Salinity

Cruise: FS Meteor 302

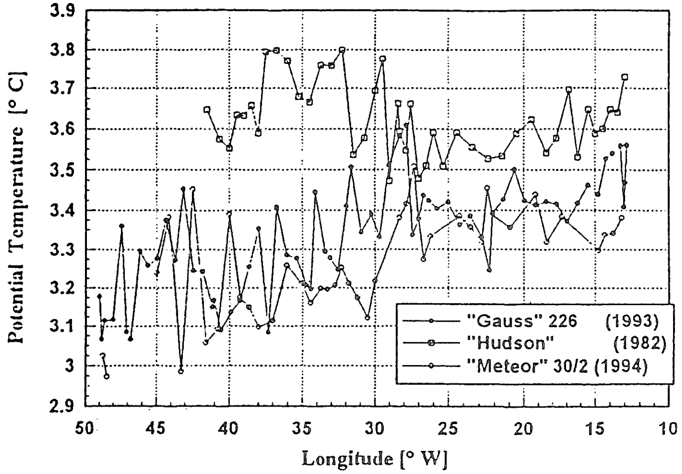
Bundesamt fuer Seeschiffahrt & Hydrographie

17/February/1995 15:4_ M43

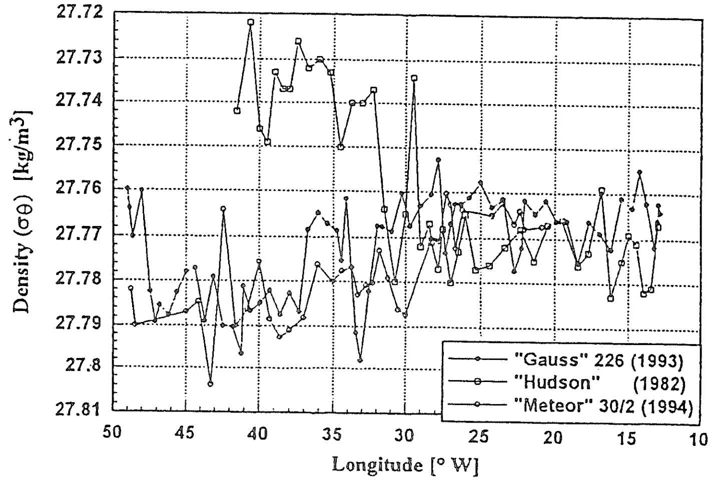
cold eddy down to 4000 m



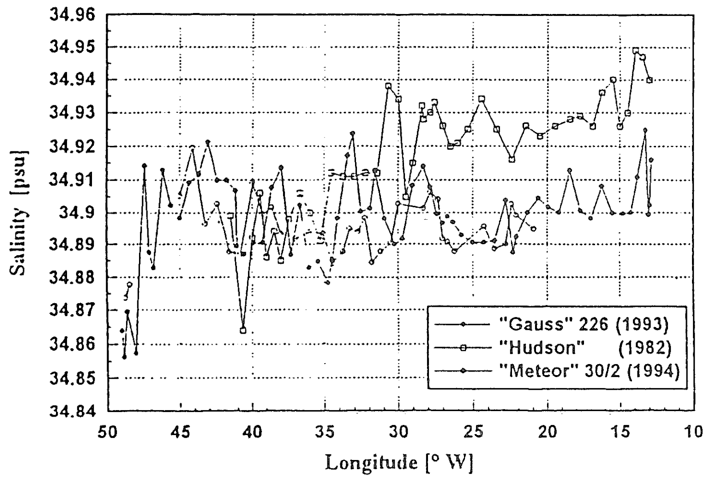
Temperature of Labrador Sea Water



Density of Labrador Sea Water



Salinity of Labrador Sea Water



Depth of Labrador Sea Water