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# Denmark (Greenland) Research Report for 1979

by

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This report contains information on the fisheries by Greenland vessels and on research carried out by the Greenland Fisheries Investigations (Grønlands Fiskeriundersøgelser) in the ICNAF/NAFO Area and at East Greenland (ICES Subarea XIV) in 1979. Various colleagues in the institute have contributed to the report. The information on ice has been reported by Mr. H.H.Valeur (The Danish Meteorological Institute).

## STATISTICAL AREA / SUBAREA 0

A small part of the commercial fishery for shrimp or northern deepwater prawn (*Pandalus borealis)* by Greenland trawlers took place in this area on grounds adjacent to those in Div. 1B, resulting in a catch of 256 tonnes of shrimp. The catch by the trawlers of the Royal Greenland Trade Department (KGH), included in the said figure, amounts to 149 tonnes caught in 531 hours in Div. OA while a small effort of 7 hours in Div. OB did not result in any landings.

Catches by Danish (mainland) trawlers in the same area have been reported as 66 tonnes of shrimp (preliminary figure from vessels' reports to the Greenland authorities).

No special research was made in the area.

## SUBAREA 1

### A. STATUS OF THE FISHERIES

#### 1. General trends

The nominal catches by Greenland vessels in 1979 are given in Table 1. Figures are provisional but not likely to be changed to any noteworthy extent. The figure for shrimp involves some estimates of inshore catches (not included in the offshore quota) for which some information was still not received when the report was produced.

Table 1. Nominal catches by Greenland vessels in Subarea 1, 1979 (provisional figures) and relative changes ( in %) from 1978 to 1979

| Species | Nominal catch 1979 (tonnes) | Percentage change from 1978 |
|---|---|---|
| Cod | 49 012 | + 31 |
| Greenland cod | 4 176 | - 6 |
| Redfish | 254 | - 62 |
| Wolffishes | 2 129 | - 1 |
| Grenadiers *(M.berglax* and *M.rupestris)* | 17 | - 47 |
| Greenland halibut | 5 335 | - 11 |
| Halibut | 135 | - 43 |
| Capelin | 301 | + 1 |
| Atlantic salmon | 1 394 | + 42 |
| Arctic char | 155 | + 12 |
| Lumpsucker roe (not converted to round fish) | 150 | - 59 |
| Herring | 5 | - 30 |
| Skates and sharks | 104 | not specified in 1978 |
| Industrial fish and fish not specified | 160 | + 15 |
| Shrimp | 22 800 | + 74 |
| TOTAL (rounded) | 86 100 | + 30 |

The nominal catch increased by about 30% from 1978 to 1979 to reach the highest level on record for the fishery by Greenland. Whereas the increase from 1977 to 1978 was due nearly entirely to improved catches of cod the increase from 1978 to 1979 is due both to a further, very large increase in catches of cod and to a considerable increase in catches of shrimp. For both these major species it is the highest catch so far in the Greenland statistics. The group of species with catches of some thousands tonnes (*i.e.* Greenland cod, wolffishes and Greenland halibut) did not change significantly from the 1978 level. Species with smaller landings were generally at a lower level than in 1978 except for the economically extremely important salmon.

The major part of offshore finfish catches were taken in Div. 1C while, for shrimp, Div. 1B was the major division as usual.

For the inshore catches it is remarkable that Div. 1F achieved the highest catch. This area has about quadribled its catch over the last two years, entirely due to an extraordinarily good fishery for cod in 1978 and especially in 1979.

Further details of the major fisheries are given below.

2. Cod

a. The fisheries. The nominal catch by Greenland vessels was 1/3 above that in 1978 despite a closure of the large trawlers' fishery by June and a decrease by 15% of their effort (hours fished) in direct cod fishing. Also, the trawlers experienced a lower catch rate than in 1978 so that their total catch of cod decreased by about 40% from 1978 to 1979. This decrease is, however, more than counterbalanced by nearly a doubling of small vessels' coastal and fiord fishery

(38 200 tonnes in 1979, 19 700 in 1978).

Cod made up about 60% of the total landings by trawlers as compared to about 76% in 1978, while shrimp accounted for 38% of their catch.

The major part (60%) of the offshore catch of cod by trawlers was taken in the southern part of Div. 1C, while about 39% of the inshore catch came from Div. 1F, mainly from an extraordinarily good pound net fishery. Also Div. 1E was important for the inshore fishery, accounting for about 26% of the inshore fishery.

The high proportion of the inshore catch in the southernmost divisions seems to be connected with a southward migration of individuals of the 1973 year-class. As shown in Figs 4-6 the proportion of this year class in the catches increased from north to south with a nearly total dominans in the southern divisions.

b. Forecast for 1980-81. Catches in the first quarter of 1980 have been well below those in the first quarter of 1979. For trawlers this is due mainly to management decisions. Most of the trawlers have been fishing shrimp since the beginning of March 1980. However, also catch rate of cod in 1980 in the important Div. 1C has been below that of last year. Part of the trawl fishing in this first quarter was taking place in the southernmost part of Div. 1B where shoals of young cod (mainly 5-year-old fish) were found in a period of some weeks.

Inshore fisheries are also below those in January-March 1979, but this comparison covers only 4% of the total 1979 inshore catch.

The fishery in 1978 and 1979 has to a great extent been influenced by the 1973 year-class. This year class has been rather extensively fished and it seems further to have a high rate of spawning migration from West to East Greenland and Iceland. It is likely that it will maintain its high proportion of at least offshore, probably also inshore catches in Div. 1E-1F in 1980. It seems, however, more likely that inshore fisheries in 1980 will be dominated by the 1975 year-class with a high degree of discard of fish of the 1977 year-class, especially north of Div. 1E. In 1981 both year classes mentioned are likely to be the major ones in the inshore as well as the offshore fishery. The rather northern distribution of the 1977 year-class could mean some expansion of the fisheries to Div. 1B where offshore cod fishery has nearly vanished in the last decade.

Further details on the cod stock and the fisheries are found in NAFO SCR Doc. 80/VI/72.

3. Shrimp *(Pandalus borealis)*

a. The fisheries. Nominal catch by Greenland vessels increased by about 3/4 from 1978 to 1979, and 1979 shows their highest catch so far. The increase is both offshore and inshore. Of the inshore fisheries that in the Disko Bay continues to be the most important, but inshore fishery of shrimp takes place on a number of smaller grounds, mainly fiords, between Nanortalik (1F) and the Umanak Fiord (Div. 1A).

Offshore fisheries remain concentrated in Div. 1B. The seasonal northward displacement of the fisheries inside this division seems a regular phenomenon,

but there seems also to have been a tendency over the last 3-4 years to go fishing in the northern part of Div. 1B, in the deep north and northwest of Store Hellefiskebanke, but the "low-quota box" off the Disko Bay means some restriction on vessels' movements.

b. Forecast for 1980-81. The stock situation on the offshore shrimp grounds was assessed by the Working Group on Shrimp in November 1979 (NAFO SCS Doc.79/XI/2). Information presented and discussed at that meeting pointed towards a rather stable situation from 1978 to 1979, and no change in TAC (29 500 tonnes covering also adjacent parts of Subarea 0) was proposed. Forecast of shrimp fisheries is difficult to give due to lack of observations of pre-recruits and due to the few age groups in the major part of the catch.

See also the section on East Greenland.

4. Other fish

The catch of Greenland cod seems to continue its downward trend although it was nearly stable in 1978-79. Landing of Greenland halibut and of wolffishes were also rather stable in 1978-79.

Landings of redfish decreased considerably, but the species as such is not very significant in the present fishery of Greenland.

The catch of salmon exceeded the quota of 1191 tonnes by about 200 tonnes. This was due to unexpected high catch rate in the last few days before a closure of the fishery could be effective. The catch was taken in 5 weeks and fishermen reported very good fishing in contrast to the 1978 situation when the quota was not reached over the normal season of about three months.

## B. SPECIAL RESEARCH STUDIES

1. Environmental studies

a. Hydrography. Work has been carried out on some of the ICNAF Standard Oceanographic Sections off West Greenland, especially the Fylla Bank Section. Due to an extraordinarily long time in shipyard for the R/V ADOLF JENSEN the amount of data is, however, relatively limited in 1979. Data were passed through ICES to Marine Environmental Data Service (MEDS). Fig. 1-3 illustrate the major temperature observations in 1979.

Generally speaking 1979 showed relatively high water temperatures. Over the shallow part of Fylla Bank temperatures in February were $-0.4^{\circ}C$ in mean, slightly higher than the mean of $-0.7^{\circ}C$ in 1978. In June the mean on the same station was $2.2^{\circ}C$ while only $0.9^{\circ}C$ in 1978. The temperature measured here in June is used as a reference temperature for a first prediction of the cod year-class of that year. Temperatures above $1.8^{\circ}C$ seem favourable for survival of larvae (the strength of the year class is, of course, also influenced by other factores, *e.g.* most likely by the size of the spawning stock). Also, in July, temperatures were higher in 1979 than in 1978.

In the deeper water west of the bank the observed temperatures were also higher in 1979 than in 1978 but observations are so few that a description

covering the year as such cannot be given. In July the mean temperature in the 0-500 m depth interval was 3.07°C which is 0.18°C higher than the mean for the warm period 1950-66.

b. Observations on ice (supplied by Hans H.Valeur, The Danish Meteorological Institute). Regular aerial observations of the sea ice around Greenland is carried out by the Danish Meteorological Institute. Observations in 1979, as usual, concentrated on the waters around Kap Farvel, while other areas have been observed periodically according to navigational need. In addition to the aerial observations satellite images have been used increasingly, especially for the waters off East Greenland.

The ice conditions were very close to or slightly lighter than normal. Particularly, it should be mentioned that during April and May the conditions in the Kap Farvel area were considerably lighter than usually, and so were the conditions off East Greenland north of 70°N lat. during May and June.

c. Plankton. Oblique hauls with 2 meter stramin net (each haul 30 min., 225-0 m wire, app. 50-0 m depth) were taken in July on the same standard stations where hydrographic observations were made. Furthermore, plankton hauls were made regularly throughout the year at the standard station at the entrance to the Godthåb Fiord.

Despite the relatively warm water in 1979 the volume of plankton on the Fylla Bank section was less than in the relatively cold year of 1978 (mean of five stations was 480 ml fresh volume in 1978, only 405 ml in 1979 as compared to 1580 ml in the warm year of 1977). Like in 1978 a considerable part of the plankton was made up by medusae and ctenophores.

The number of cod and shrimp larvae was higher than in 1978, whereas larvae of fish species other than cod were less abundant than in 1978. The shrimp larvae were found mainly at stations close to the shore and at the northern section of those occupied (the Holsteinsborg Section). Table 2 illustrates the number of shrimp larvae per 30 min. haul on the sections operated in the years 1971-72 and 1977-79.

Table 2. Mean number of shrimp larvae caught per 30 minutes haul with stramin net ( 2 m diameter) in the Davis Strait.

| Year | Mean number of shrimp larvae per 30 min. | Number of hauls |
|---|---|---|
| 1971 | 36 | 14 |
| 1972 | 152 | 15 |
| 1977 | 49 | 15 |
| 1978 | 2 | 15 |
| 1979 | 48 | 16 |

d. Other environmental studies. Monitoring studies of the marine disposal of tailings from the lead-zinc mine and mill in Umanak Fiord (Div. 1A) have been continued on a routine basis, including chemical analyses of seawater, sediments, seaweed, mussels, fish and ringed seals. The level of lead, zinc, cadmium and copper is measured. As part of the study tagging experiments on fish are made to evaluate to what extent they are stationary or migrate. In 1979 14 Greenland cod,

21 spotted wolffish, 13 American plaice and 50 Greenland halibut were tagged.

Baseline studies at a uranium ore deposit (so far mining is only on a test scale) in South West Greenland were initiated in 1979, following a general baseline study carried out over a wider area in the years 1974-76 in a project financed by state funds. The level of lead, zinc, cadmium , uranium and others is measured in fish, shrimp, mussels, sea water and sediments. The baseline level of radioactivity is also measured. In the fiords around the site the Danish Hydraulic Institute has started hydrographic investigations.

The Commission for Scientific Research in Greenland initiated an environmental study at a molybdenum deposit and a closed lead mine in East Greenland. The level of lead, zinc and cadmium is measured in sea water, sediments and seaweed.

2. Biological studies

a. Cod

Eggs and larvae. The number of cod larvae found in the plankton in July was 1.2 per 30 min. haul, which is more than in the cold year 1978 (0.3 larvae per 30 min.) but still a very small number, especially in the light of the relatively high temperatures. The possibility that the low level of spawning stock is a limiting factor for the production of larvae cannot be ruled out. The occurrence of cod larvae in the plankton is illustrated in Fig. 4.

Occurrence of pre-recruit cod. Cod at age-group 1 (the 1978 year-class) have not yet had a real chance to be observed since few research hauls were made at grounds where small cod is likely to occur, and since the individuals are too small to be caught by the commercial pound nets. From hydrographic data and plankton surveys in 1978 the year class is considered a very poor one.

2-year-old cod (year-class 1977) have occurred as discards in many cases in the pound-net fishery, mainly in the northern divisions. A remarkable observation was that shoals of cod were found and fished by a trawler in February-March, 1980, in the Holsteinsborg Deep (Div. 1B, southernmost part). The major part of the catch consisted of 5-year-old cod (year-class 1975) but there was also a significant amount of individuals of the 1977 year-class caught and discarded.

The 1976 year-class still seems to be a poor one although some commercial pound-net catches have had a significant inflow of this year class in landings as well as in discarded (undersized) fish.

Details on the observation of pre-recruit cod are found in a research document presented to the June 1980 Meeting of the NAFO Scientific Council.

Cod in commercial landings. The 1973 year-class , which made up about 80% by number of the landings in 1978, was still a significant contributor to the fisheries in 1979. It did, however, occur mainly in the southern divisions (1E-1F), and seems to have started spawning migration from West to East Greenland and Iceland. In Div. 1C-1D the recruiting 1975 year-class was a major contributor to catches, but offshore fishery did not extend farther north than to the southern part of Div. 1C. In January-February, 1980, cod was fished offshore in the Holsteinsborg Deep, with the major part of the catch being cod of year-class 1975.

Thus, for 1979, there has been a gradual change in year-class composition from north to south, as clearly illustrated by Fig. 5-7.

Further details of the cod stock by 1979 are found in the above mentioned research document.

Tagging experiments. A total of 162 cod were tagged in 1979 in the Godthåb area (Div. 1D). Tagging lists have been supplied to and distributed by the NAFO Secretariat.

Participation in cruise by other nations. A scientist from the institute participated in the survey with the R/V WALTHER HERWIG of Federal Republic of Germany survey specially concentrated on occurrence of cod and redfish.

b. Atlantic salmon. Scales of about 680 salmon were sampled from the small research cutter TÔRNAQ from mid September to mid November in the coastal area of Godthåb (Div. 1D). The scales are analysed in Canada, and results are incorporated in material presented to the April 1980 Meeting of the ICES Working Group on North Atlantic Salmon.

A biologist from the Greenland Fisheries Investigations participated in the Canadian salmon cruise at West Greenland in August.

c. Capelin. Research hauls by midwater trawl were made in the outer part of the Godthåb Fiord (Div. 1D) in January. Samples for determining the age-length composition were taken from all catches.

d. Sand eel. Samples from an experimental fishing for sand eel in the area between Disko Bank and Fiskenæs Bank (Div. 1A-1D) in 1978 are being worked up. A special research document on the results is likely to be presented in 1981.

e. Other fish. Age and/or length samples of commercial species other than those already mentioned have been taken from research vessel hauls and for redfish, Greenland halibut and wolffishes also from commercial landings.

The following species (besides those already mentioned) were sampled on a routine basis: Greenland cod, redfish, striped and spotted wolffish, American plaice, Greenland halibut, Atlantic halibut.

Studies of change in weight during storage have been initiated for cod.

Sampling of wolffishes also aim at quantifying the relation between the two commercial species in the various fisheries, whereas as far as possible sampling of redfish now is by species *(S. mentella* and *marinus)*, no distinction having been made earlier.

Tagging experiments in 1979 include Greenland cod (15 specimens) spotted wolffish (21 specimens), Greenland halibut (54 specimens) and American plaice (13 specimens), most of them tagged in Div. 1A as part of the environmental program mentioned above.

f. Shrimp *(Pandalus borealis)*. Like in previous years, the research on shrimp had high priority in the program of the institute. As the major part of the research and the results were presented in research documents and working papers to the November shrimp assessment meeting only a list of the activities is given here.

i) Sampling of catch statistics from the commercial shrimp fishery.

ii) Bottom photography was carried out on the offshore shrimp grounds in Div. 1A-1B to assess the density of shrimp. Due to some technical difficulties with the equipment only a very small amount of successful exposures were made (160 photographs). In all nine sampling sites were occupied during July and August (NAFO/SCR Doc. 79/XI/9).

iii) Research vessel hauls and sampling on a number of offshore standard stations of which some have been operated since 1968.

iv) Monthly observations and sampling on board commercial shrimp trawlers from May to December to elucidate a.o. the nature of the diurnal migration of shrimp and the amount and species composition of by-catches.

g. Queen crab *(Chionoecetes opilio)*. Experimental fishing and sampling continued on a routine basis in the Godthåb area.

h. Squid *(Gonatus fabricii)*. Some planned research hauls by a specific squid trawl had to be postponed due to technical difficulties with the research vessel, but sampling of *Gonatus* whenever it occurs in plankton samples or in catches by trawl is made for a specific study of this species by a scientist at the Zoological Museum of the University of Copenhagen.

i. Marine mammals. The sampling program of harp and hooded seals was continued, and an analysis of the age composition of recent years' catches of harp seal in North West Greenland was presented at the November 1979 Meeting of STACRES as SCR Doc. 79/XI/10, together with a review of recoveries in Greenland of harp seals tagged at Newfoundland (SCR Doc. 79/XI/13).

Sampling of biological material of minke whale, and observations of this and other species were carried out in June-September on a Norwegian whaler operating in the Davis Strait.

3. Gear and selectivity studies

Nothing to report.

## EAST GREENLAND

### A. STATUS OF THE FISHERIES

Total Greenland landings from this area (ICES Subarea XIVb) amount to 3040 tonnes in 1979 (preliminary figure), an increase of about 40% from 1978.

Besides the local fishing at Angmagssalik, which resulted in landings of 1496 tonnes of cod and 5 tonnes of salmon (approximately the same as in 1978) also some of the large Greenland trawlers fished in the area in the last part of the year, their cod fishing at West Greenland having been stopped. Their landings from East Greenland waters total 1540 tonnes of which 1525 tonnes of cod, 3 of halibut and 12 of wolffishes.

Norwegian vessels undertook some experimental fishing for shrimp in the area, but Greenland vessels have not fished shrimp in the area in 1979. However,

some experimental fishing conducted in the beginning of 1980 has shown good shrimp catches of extraordinarily large shrimp (*Pandalus borealis)* in the area around 66°N lat. Thus besides cod and redfish the future catches in the area may show landings of shrimp.

## B. SPECIAL RESEARCH STUDIES

No special research was carried out by the institute apart from sampling of commercial cod landings. For 1980 it is planned occasionally to have observers on board commercial vessels conducting shrimp fishing.

In April-May a scientist from the institute participated in a cruise by the Federal Republic of Germany with the R/V WALTER HERWIG, specially concentrating on redfish and cod.

## SUBAREAS 2 - 5

No fishing and no research by Denmark(G) in 1979

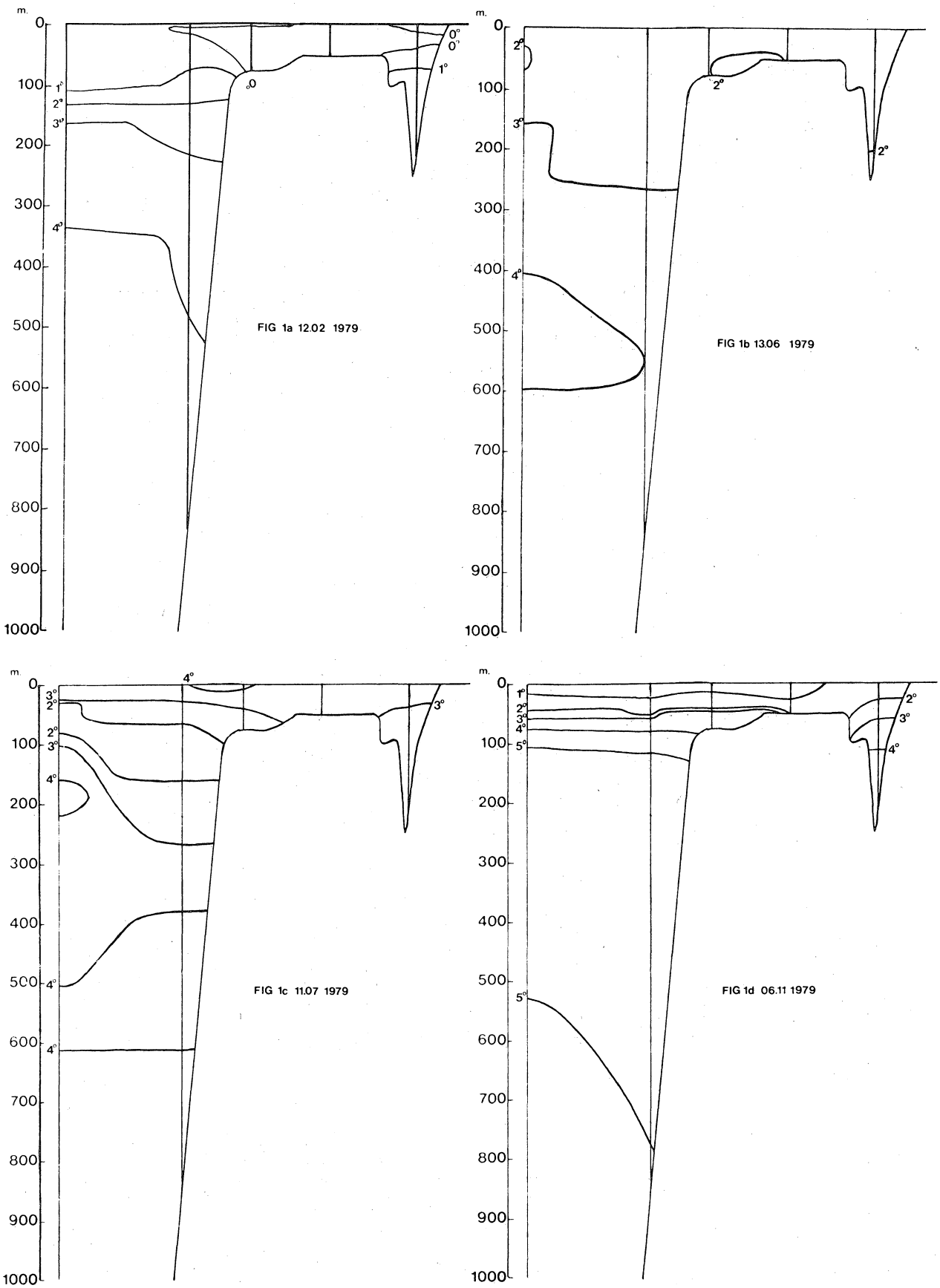


Fig. 1 Temperature sections across Fylla Bank (Div. 1D), 1979.

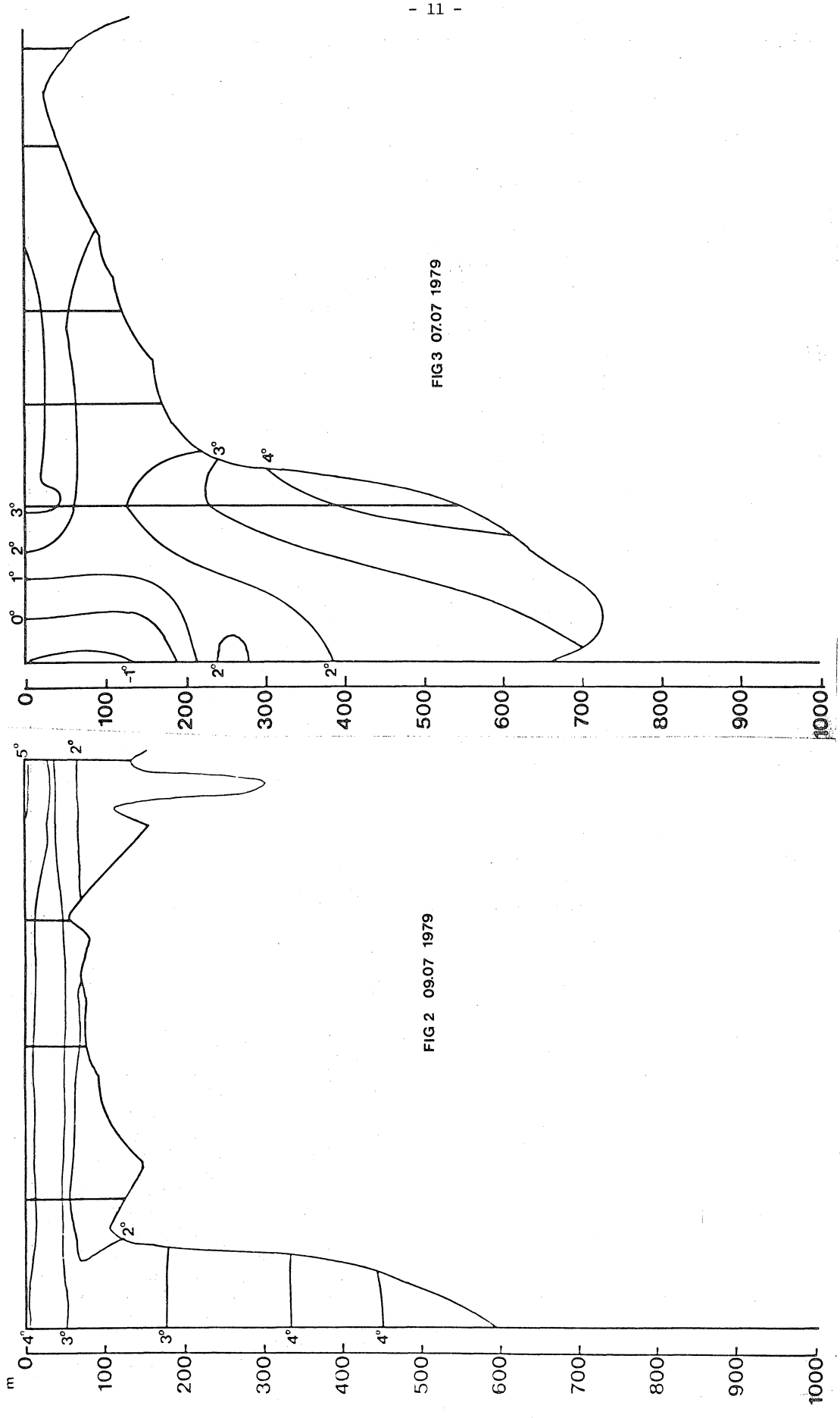


Fig. 2. Temperature section across Lille Hellefiskebanke off Sukkertoppen (Div. 1C), 9 July 1979.




Fig. 3. Temperature section off Holsteinsborg (Div. 1B), 7 July 1979.

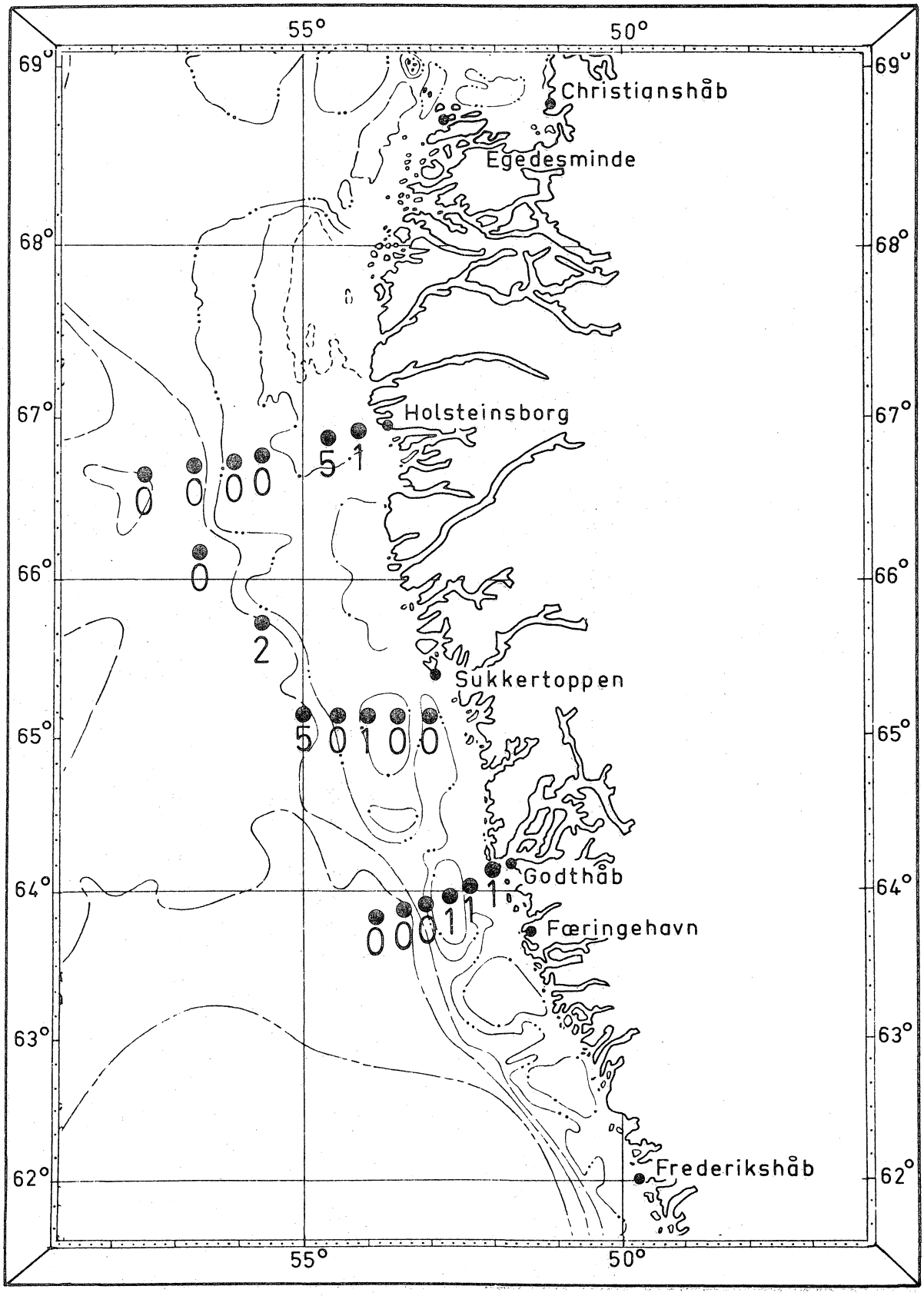


Fig. 4. Cod larvae (number per 30 min.) taken by 2-m stramin net in the upper water layers (max. depth 50 m) in July 1979.

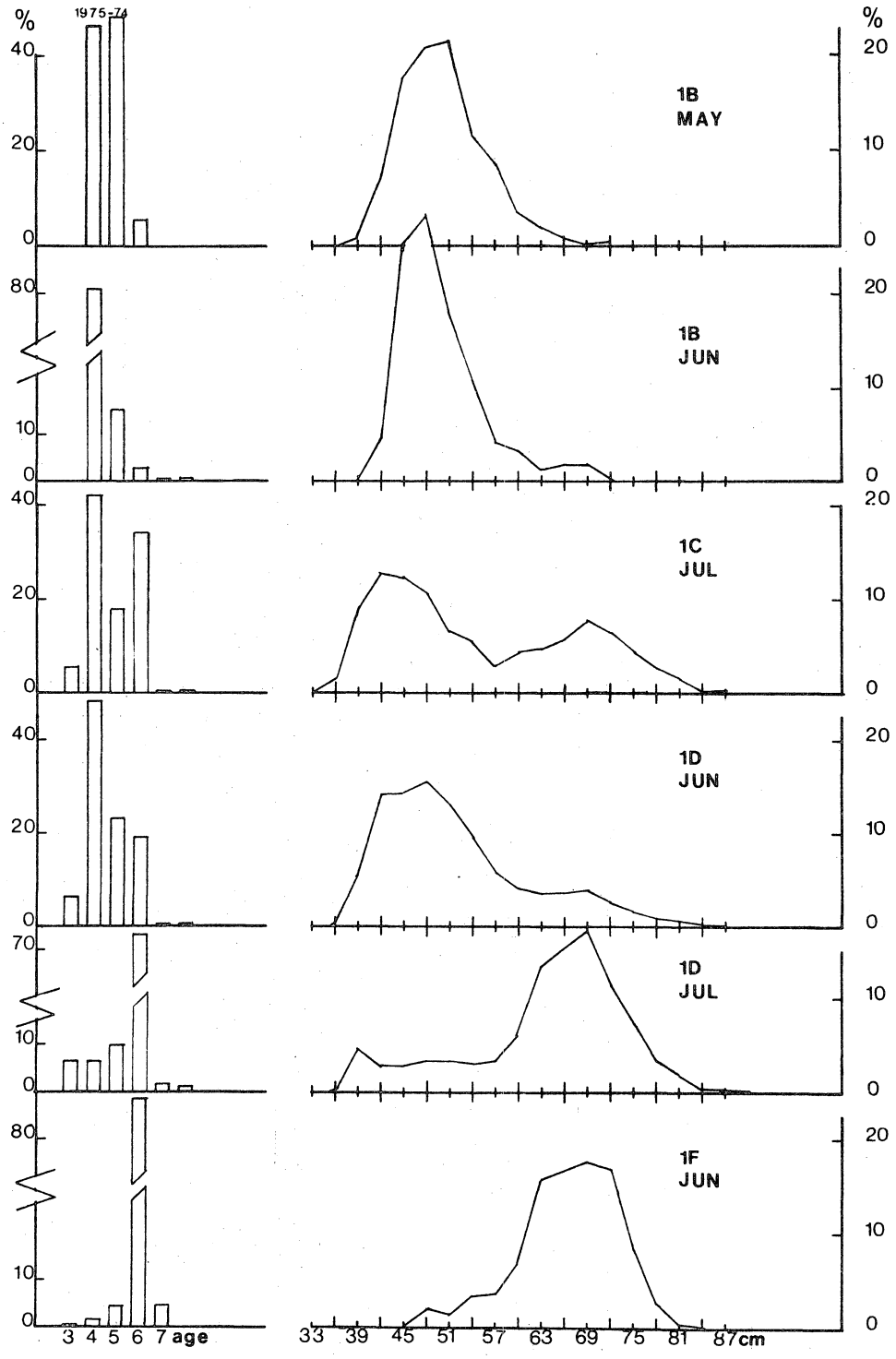


Fig. 5. Age and length frequency diagrams of cod caught inshore by pound net 1979. The June sample from Div. 1D is from the northern part of the division while the July sample of Div. 1D is from the southern part. All the samples are landings after discarding fish below 40 cm length.

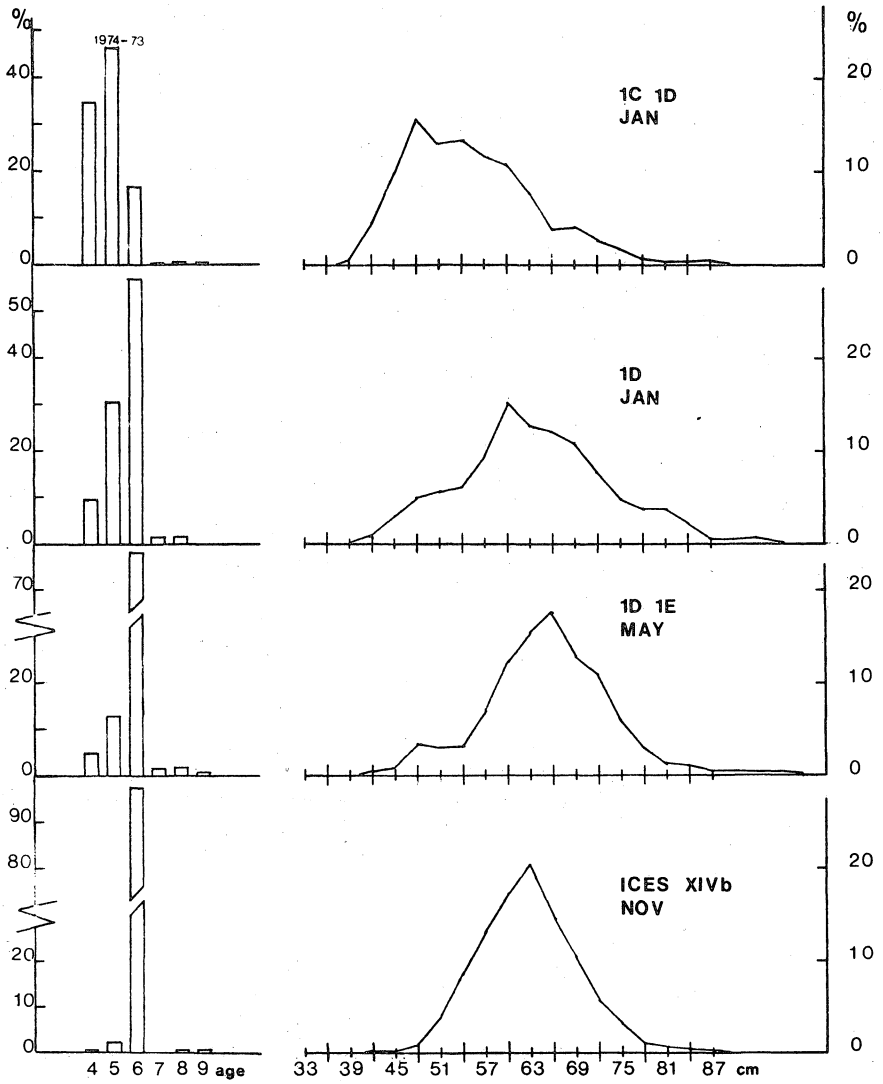


Fig. 6. Age and length frequency diagrams of cod caught offshore by commercial trawlers (OTB). Samples are of landings.

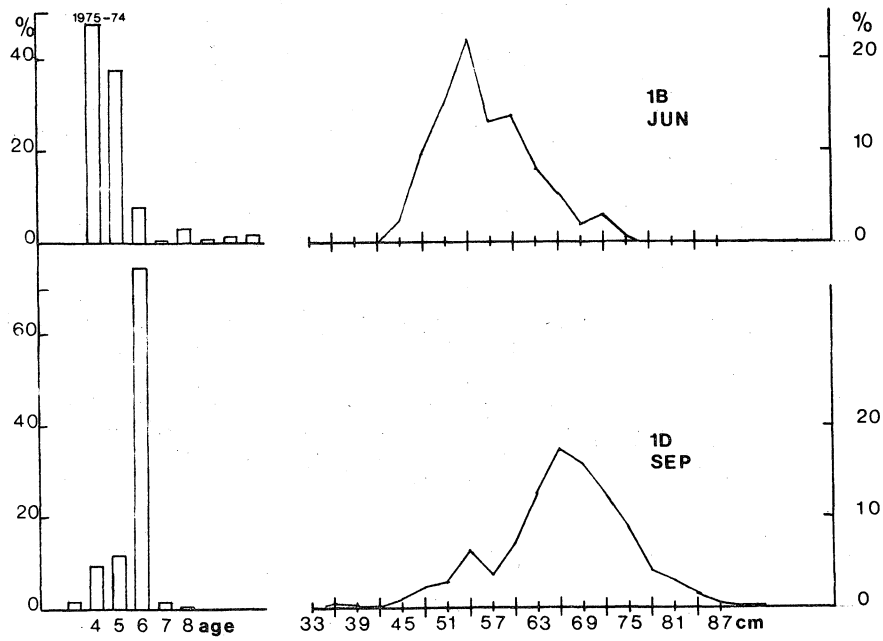


Fig. 7. Age and length frequency diagrams of some commercial landings of cod by small boats, fishing with hand line, 1979.