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French Research Report, 1966

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State of the Fishing

In 1966, the French vessels took 140,000 tons of cod, of which 41,000 were taken in Subarea 1, 31,000 in Subarea 2, 53,000 in Subarea 3 and 15,000 in Subarea 4.

The main captures were made in Div. 1B in May-June and in September-October in Div. 2J, 3K and 3L, particularly in March-April and from September to October, and in Div. 4R in February and June.

Subareas 2 and 3

Observations were made in this area from R/V Thalassa in August-September, between 47°00 and 56°30'N, from north of the Grand Bank to north of Hopedale Channel.

I. Environmental Conditions

Four oceanographic sections of 46 stations were made as follows:

1. At the 47th parallel of latitude from Flemish Cap to the Avalon Peninsula, across the north of the Grand Bank and the Woolfall Bank, from 9 to 11 August 1966.

2. From Cape Bonavista NE, at 1,500 m depth across the plateau NE of Newfoundland, above 300 m depths from 19 to 21 August.

3. From Seal Island NE at depths of 1,500 m, across the south of Hamilton Bank, from 4 to 6 September.

4. From Nanuaktok Island (at the mouth of Hopedale Channel), at depths of 1,500 m, across the southern extremity of the N plateau of Labrador, from 13 to 15 September.

A total of 483 salinity and temperature measurements were made on these sections. At the same time 115 temperature observations were made with the bathythermograph at fishing sites. These data make it possible to prepare a good chart of environmental conditions in the region studied.

Temperature distribution at different depths

Surface. The map of surface conditions (Fig. 1) shows in relief the opposition of the cold water of the Labrador Current which flows toward the south (minimum temperature observed: 4° in the north) to that of the warm Atlantic water which covers the Grand Bank (maximum observed: 14°5 in the Avalon Channel).

This invasion from the south, originating from the North Atlantic drift and well known since the work of Beaugé (1928-29), is particularly important at this time, as much for its higher temperature as for its extension toward the north which splits the Labrador waters into two lobes, the one which runs along the eastern side of Newfoundland and the other, more important, which develops along the shores with a temperature from 6 to 13°.

The progression of the tongue of warm water is broken to the south of Hamilton Bank where one observes it as a strong gradient zone between the 6 to 10° isotherms. The warm tongue is then found deflected toward the west, in the coastal section, but a northerly finger is detached which extends as far as Hopedale

section with a temperature of 5°, showing that to this time the influence of the superficial water of the slope is felt as far as the Labrador section.

The main cold current overruns the banks to the north and flows down the length of the coast.

One will notice that in the Belle Isle section the coldest water lies along the Labrador side where one finds a minimum temperature of 4° indicating a certain moving upward of the sub-surface layer, while the warm water (11.7°) which has progressed along the eastern side of Newfoundland from Cabot Strait maintains its position against the coast of the island.

In general, in the southeast section, the influence of the North Atlantic drift is felt equally on Flemish Cap where it rises to a temperature of 14.5°. A little to the east, over the deep waters, the 16° isotherm is found.

Minimum Temperature Distribution. Figure 2, made up from the bathythermograph observations of minimal temperature, without taking the depth into account, makes it possible to follow the advance of the coldest waters from the Labrador Current.

One sees that its axis, represented by a temperature down to -1° is located a little off the coast, along which one verifies a certain warming up again in the neighbourhood of 1° and doubtless very important to the shallower inner bays. This very cold tongue; -1.4° to -1°, spreads over the shelf in finger-like projections along the coast as can be seen on Hamilton Bank and on the Grand Bank. Although it occupies an important part - on an extension of 600 miles in the section studied - one does not observe any significant variation from north to south in the interior of this lobe. Its temperature only begins to increase to the southeast of the Grand Bank.

The depth of this minimum temperature is unsteady enough: when it is found between 40 and 100 m in the Labrador section, it has a tendency to rise again from the Newfoundland deeps to 23 m in the north of the Grand Bank.

The pushing of the wide band of waters in the section of the slopes northeast of Newfoundland is characterized by a minimum thermal warming to 1°.

Onshore, the temperature gradient is important, notably northeast of Hamilton and of Grand Banks. In these sections, the temperature minimum is selected on the basis of the thermocline.

Near bottom temperature. Figure 3 is especially important for the establishment of correlations between the distribution of fauna and the temperature conditions. It shows that in the littoral zone and on the greater part of the shallower depths, Labrador water predominates with a lower temperature of 0° from the Labrador fringe to the north of the Grand Bank.

By contrast, below 200 m there is an extensive penetration of colder water and the temperature increases to 4° to 4.6° with depth. The isothermal gradient is thus very weak over the gradual sloping bottom, such as that of the depression situated to the north of the Grand Bank and is very strong over the steep slopes.

It seems, however, that on the Labrador section certain depressions escape the penetration of the cold waters, notably those situated in the northwest of the banks. This situation suggests a general movement of cold water to the south, with deviation toward the right in the valleys and then the presence of Atlantic water from West Greenland running out of the Irminger Current, which makes a circular movement to the south of the sill of Davis Strait.

About 500/600 m the temperature decreases again and tends toward that of the mixed water of the Labrador Basin.

On Flemish Cap the situation is different and the 4.5° temperature in the upper layers marks the direct influence of the Atlantic derivative in this section.

Section from Seal Island to the northeast passing over Hamilton Bank. This is the only section illustrated in Fig. 4 because it sums up the vertical temperature distribution. The axis of the Labrador Current is clearly marked by a cold intermediate lobe at 90 m with a minimum temperature of -1° to 0°. This cold layer largely covers the slope where it undergoes warming and overlies the Atlantic vein from Davis Strait which presents a maximum temperature of 4.63° at 400 m. It is covered by a film of water warmed by the local insulation and the influence of the superficial Atlantic formation and of which the temperature varied from 6° over the slopes to 8° seaward.

From 400 m a decrease of the temperature is shown which stabilizes itself around 3.45° in the neighbourhood of 1000 m with the presence of homogeneous waters of Davis Strait, formed by the mixture from the different formations which meet again in this section.

One should note that Labrador-Newfoundland section, the thermal stratification is appreciably the same from north to south. This is why the upper depths of Newfoundland, which are more elevated than Hamilton Bank, are washed by the coldest waters of the intermediate layer of the Labrador Current in front of which they are present like a "screen" which only lets through the waters from the upper layers.

Comparing these results to the previously published works by the Americans and Canadians, one can say that the extension of Atlantic waters is more important in 1965 in that which concerns the direct influence of the North Atlantic Strait in the south of the banks of Newfoundland as well as that of the Irminger Current of which one meets the leading edge in the Labrador section. This influence is marked against the slope by an increase in temperature to 4°.

Elsewhere, the works of the Soviet scientists in 1961 (Buzdalin and Elizarov, 1962) show that in the second fortnight in August those temperatures have not been reached in Flemish Channel. This phenomenon is worthwhile pointing out because it can have had an influence on the fishing to the extent that it has modified the habitual distribution of the cod and the capelin.

II. Observations on Fishing

The study of the trawl yields by location and by depth was made on 79 of the 89 trawl hauls made. Ten hauls were considered of no value, having been made to test or regulate fishing material or having been made useless as the result of major damage during the haul. Elsewhere, a fishing trawl was lost to the south of Hamilton Bank.

Most fishing was completed in one hour trawl hauls in order to compare the yields obtained during the cruise. Those hauls which did not reach or exceed this time were calculated to one hour of fishing.

Comparative trawls, made to the north of Grand Bank and to the south of Hamilton Bank by French trawlers, showed that this method of procedure was valid, the yields obtained by the R/V Thalassa being comparable to those of the commercial trawlers.

Most hauls were made with a trawl of "Lofoten" type, of 31.20 m headline and a stretched mesh of 140 to 110 mm. To allow the capture of individuals of small length and of samples of the benthic fauna, the codend had meshes of 50 mm and the bait meshes of 60 mm.

Major commercial catches were represented by cod (Gadus morhua), redfish (Sebastes marinus mentella), American plaice (Hippoglossoides platessoides), Greenland or black halibut (Reinhardtius hippoglossoides), witch or grey sole (Glyptocephalus cynoglossus), wolffish (Anarhicas lupus, A. minor and Lycichthys denticulatus). One can add to this list the shrimp (Pandalus borealis) captured in significant abundance in certain areas.

1. Bathymetric distribution of the principal species. The average yields obtained of cod and redfish, in kg per hour of fishing at the different levels studied, can be summed up in two illustrations (Fig. 5). Their examination indicates that in August-September, cod had its greatest abundance between 150 and 275 m on the Labrador Shelf (400 kg/hr) and between 175 and 250 m on the Newfoundland Shelf (700 kg/hr) with, in this second region, a tendency to again be relatively

abundant toward 400 m (100 to 200 kg/hr).

Concerning the redfish, it appears in the fishery from 275 m and makes up nearly the whole catch down to 550 m where it is mixed with the macrurids (Macrourus berglax and M. bairdii) known as the ratfishes and that a haul of more than 10 tons was made northeast of Makkavik Bank. The best yields of redfish were between 300 and 400 m (1,500 to 3,800 kg/hr) and around 550 m (1,400 kg/hr).

American plaice was abundant from 75 to 200 m (200 to 300 kg/hr) and disappeared between 300 and 350 m.

Witch, taken always in small quantities, was found on the Newfoundland Shelf down to 450 m, particularly between 200 and 300 m (10 to 20 kg/hr).

Regarding Greenland or black halibut, it is distributed between 150-525 m with a maximum abundance toward 500 m on the Labrador Shelf (80 kg/hr).

Among the other species, one should mention the wolffishes which were present at all depths, with yields varying from 10 to 75 kg/hr and skates, generally in very small quantities, on the Newfoundland Shelf where very irregular catches varied from 2 to 60 kg/hr.

2. Yields by Divisions and zone of fishing and diverse observations. Yields varied greatly according to the regions and the depth as shown in Table 1

	Nbre Stat. [1]	Morue [2]	Balai [3]	Fletan noir [4]	Plie cyno-glosse [5]	Sebaste [6]	Loups [7]	Raies [8]
Secteur 2 H :								
N Hopedale 130 m	1	10	8				36	
320 - 440 m	2	30	7	35		995	65	
Makkovik 195 - 220 m	3	47	100	42		3	8	
360 - 490 m	2	5	0,5	57		1 975	56	
Secteur 2 J :								
O Makkovik 170 m	1	30	40				13	
Bulldog 157 m	1	500	65	10			59	
205 - 210 m	2	185	291	12			56	1
ONO Hamilton 160 m	3	468	372	8	0,3		35	2
175 - 200 m	3	691	243	46	0,3	17	76	1
ESE Hamilton 185 - 250 m (215 m)	14	449	35	12	0,5	10	45	2
295 - 500 m	4	69	6	23		561	33	1
Banc Russe 175 - 225 m	3	503	3	2	0,3		43	2
NE Belle-Isle 175 - 225 m	2	267	32	95			16	
Secteur 3 K :								
E Belle-Isle 180 - 245 m (205 m)	7	702	9	31	4	3	10	2
Baie N. Dame-Fogo 225 - 250 m	2	42	6	6	24	17	19	2
S Banc Russe 260 m	1	10	70	13	5	110	20	16
Plateau Terre-Neuve 225 - 250 m	4	684	9	4	17	166	13	0,5
E Plateau T.N. 280 - 500 m	5	30	13	10	2	390	34	4
Secteur 3 L :								
Cap N du Grand Banc 95 - 175 m	6	43	200	4	4		8	21
N Grand Banc 215 - 240 m	3	1 071	59	1		12	36	8
NE Grand Banc 250 - 305 m	2	392	27	20	10	191	10	64
325 - 505 m	4	53	2	11	2	824	6	18
NE Bonavista 305 - 320 m	2	144	10	23	41	114	11	10
Secteur 3 M :								
Bonnet Flammand 150 m	1	7	47			2	15	
O Bonnet Flammand 250 m	1	100	48			1 302		

Table 1. Catches in kg per hour of fishing in ICNAF Divisions. (1 = No. of stations; 2 = cod; 3 = American plaice; 4 = Greenland halibut; 5 = witch; 6 = redfish; 7 = wolffish; 8 = rays).

These yields have also been reported in Fig. 3 in relation to the environment. The yields are shown in quintals per hour's fishing for the principal species.

(a) Cod. Cod captured between the north of Grand Bank and Labrador belong to a complex stock but have, according to Templeman (1962), some characteristics which distinguish them from the stocks of cod of the Grand Bank or the Flemish Cap. Labrador cod, in particular, have a slow growth and rarely goes beyond a length of 80 cm. The same is true, to a certain degree, of the cod of the Newfoundland Shelf, while those to the north of Grand Bank can reach 120 to 140 cm. In this region, cod spawn in May-June, while in Labrador spawning is later and can continue to July. After spawning, the cod move toward the coast during the summer warming looking again, in particular, for the capelin which it actively feeds on.

Best cod fishing takes place during the first part of the year while the fish are concentrated on the spawning grounds. At Labrador, however, a good autumn season has developed since 1955 in the region of Hamilton Bank.

Generally, in August-September the cod were well dispersed, best concentrations being located along the 3° isotherm in zones of contrast created by the neighbouring waters at 0° or 1° on the bottom similar to the north of the Grand Banks (1,071 kg/hr), at Belle Isle (702 kg/hr) or in the Hamilton region (450 to 690 kg/hr) (Fig. 3). In these regions shoals of capelin are detected by the sounder, principally to the north of the Grand Bank and in the region from Belle Isle to Hamilton Inlet, where the capelin are concentrated while approaching the coast for the spawning period, which takes place from the end of June to mid-August in the Labrador region (Fig. 2).

In the other regions, as on the Newfoundland Shelf, where, from 225-250 m, catches of 684 kg/hr were made. The concentrations seem to be associated with an abundance of myctophids, ordinarily known as luminous anchovies.

The majority of the fish captured were from 20 to 70 cm and presented two principal length modes. The first mode was at 31 cm at Labrador and at 28 or 34 cm in front of Belle Isle Strait and on Newfoundland Shelf; the second was observed at 55 cm on Hamilton Bank and at 55,52 or 46 cm on the Newfoundland Shelf (Fig. 6).

(b) Redfish. The mentella-type constitutes the main part of the catches at Newfoundland and Labrador. Best fishing takes place during the first half year at the time of pre-maturation and spawning concentrations, but because of apparently limited migrations which this fish makes and also because males and females do not make up separate stocks outside of the period of fertility, the catches have a satisfying yield all year. The vertical distribution especially changes in relation to hydrological conditions on the Continental Shelf.

Three stocks seem to exist in this region: one between Labrador and the Newfoundland Shelf another in the region of Flemish Cap and the third to the south of Newfoundland.

The males rarely reach a length beyond 48 cm, the females 60 cm.

Redfish have been found in great abundance between 250 and 550 m, with medium yields of 390 to 560 kg/hr of fishing between Hamilton and the Newfoundland Shelf. The best catches have been made to the north of Makkovik (1 to 2 tons/hr), to the northeast of Grand Bank (824 kg/hr) and to the west of the Flemish Cap (1,302 kg/hr) in some zones where the bottom temperature was in the neighbourhood of 4° (Fig. 3).

Unfortunately, in the region of Makkovik, redfish are heavily parasitized, particulary by a copepod (Sphyrion lumpi), which the fisheries know by the name "doorkey", and by worms which make the catches unusable.

In the whole zone studied, the stock was composed of fish of 20 to 45 or 50 cm, of which the dominant modal length varied between 35 and 38 cm according to the predominance of males or females. Two other modes, generally less well represented, existed around 25 and 30 cm from Labrador to the Newfoundland Shelf at greater depths to 365 m. At greater depths to 275 m in the Hamilton region, and to 365 m in those of the Newfoundland Shelf, one also found females of 60 cm length.

Regarding the young, they have only been observed in the area of Makkovik, with a modal length of 9 cm and on the Newfoundland Shelf around 16 cm at 180 to 365 m.

This distribution suggests that the redfish of great length, males and females, representing the mature part of the stock were found especially at intermediate depths between 275 and 450 m, while the immature young were dominant at less than 350 m between Labrador and north of the Newfoundland Shelf and while, especially elsewhere, the intermediate classes were distributed between 180 and 550 m.

(c) American plaice. This species reaches a length of 50 to 60 cm. The majority of catches are represented by some individuals from 20 to 30 cm. The best catches were made between 75 and 175 m along the steep shelf in the cold Labrador Current at temperatures down to 1° (Fig. 3).

(d) Capelin. Numerous shoals of capelin which have been recorded by the echo-sounder were detected pelagically to the north of the Grand Bank and on the the Newfoundland Shelf, and at the same time on the bottom and between two waters off Labrador and off the Belle Isle Strait (Fig. 2).

In this last region, they were particularly numerous between 40 and 100 m in generally deeper waters to -1°. Less abundant to the north of the Grand Bank, they were equally concentrated in the neighbourhood of the thermal minimum which, in this region, was at a depth of about 25 m.

This detection was often identified thanks to the catches of capelin made by the bottom trawl and by the catch of a ton of this fish by the pelagic trawl, on detection between two waters in the region of Odon Bank off Belle Isle.

(e) Shrimp. The presence of the shrimp, Pandalus borealis, in 50 trawl hauls seems to indicate a wide distribution of the species. Indeed only 11 hauls gave good catches, which reached a maximum of 30 kg per fishing hour. However there were interesting results since these catches were made with a trawl of 50 mm meshes. The shrimps were located principally to the north of Grand Banks on the Newfoundland Shelf off Bonavista Bay and Labrador to the northeast of Hopedale.

These interesting catches of shrimp were made between 200 and 500 m, with a maximum catch about 350-400 m on the bottom ranging from the silty sands to the sandy silt, the pure silt being more favourable. The temperature at these depths varies between 3 and 4°. At colder temperatures one finds especially young small-sized shrimps.

A more profound study of this stock and of the yields that it can give would merit trials with a trawl especially adapted for the fishing of shrimps because these shrimps are of commercial interest and value.

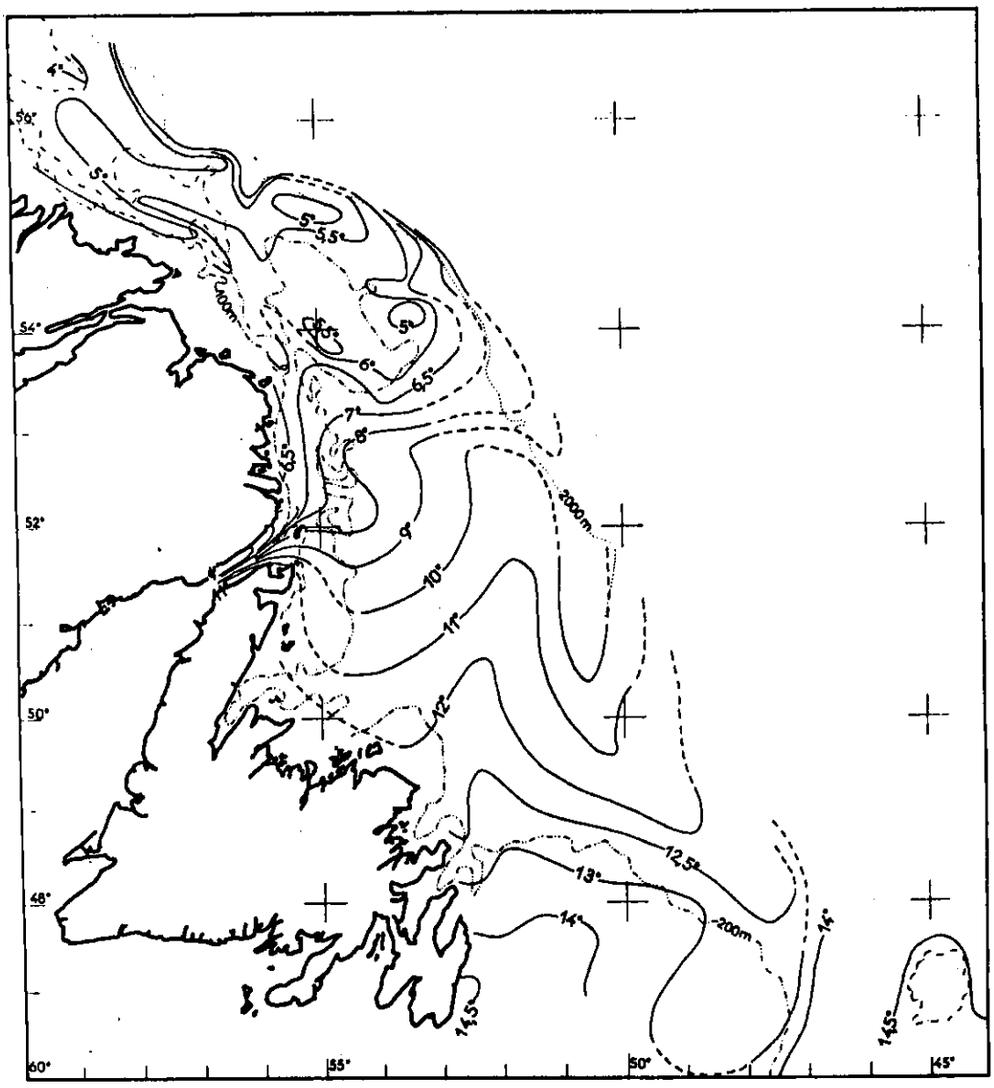

Fig. 1. Surface temperature distribution.

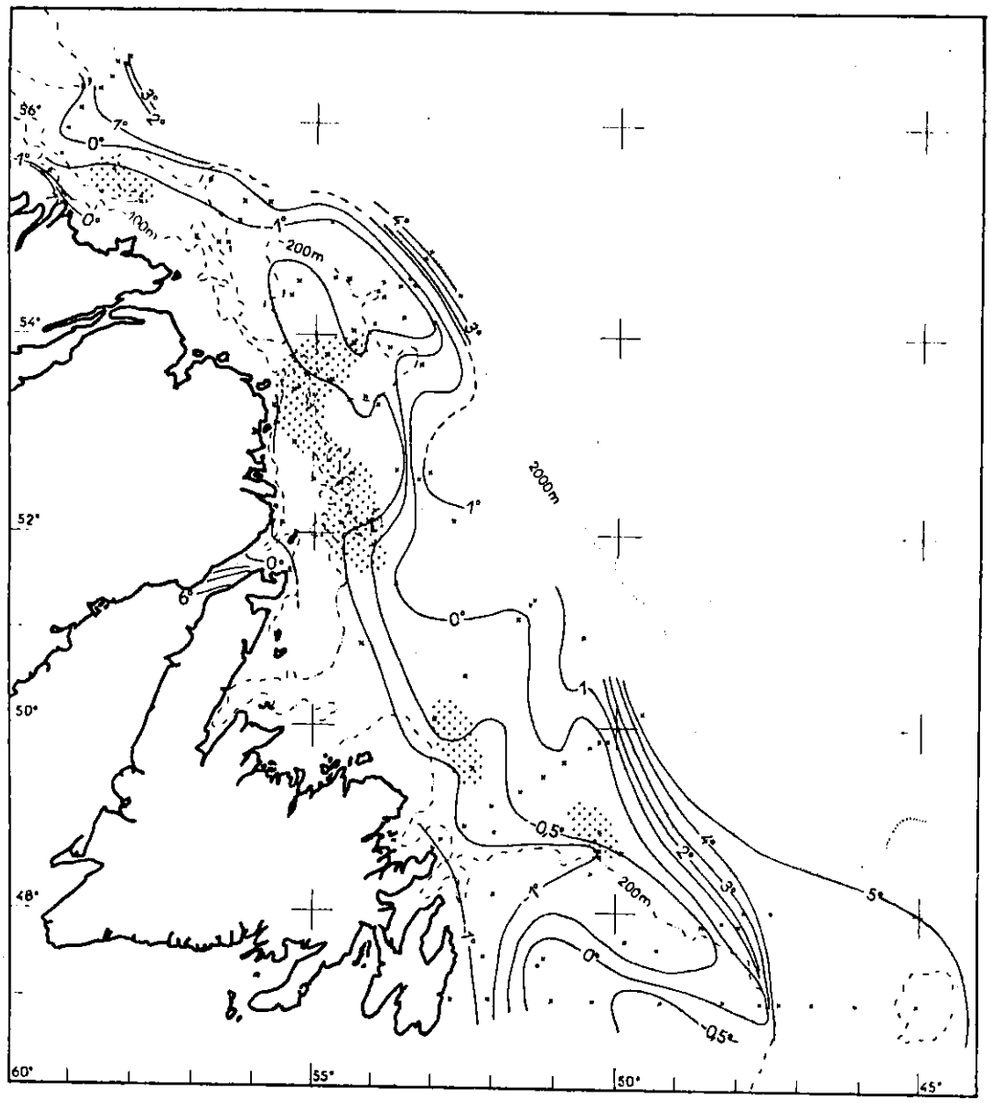

Fig. 2. Distribution of minimum temperature and location of capelin concentrations.

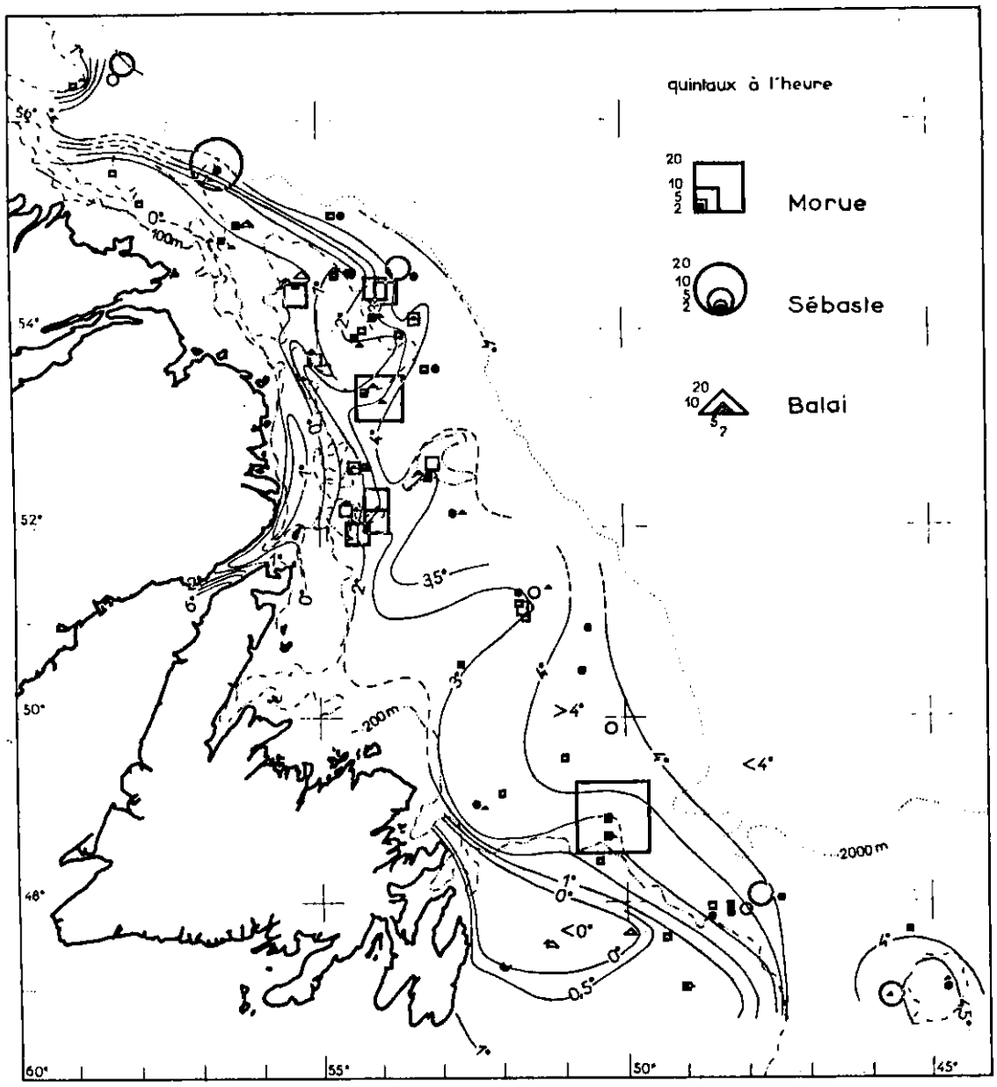

Fig. 3. Bottom temperatures and yields of cod, redfish and American plaice.

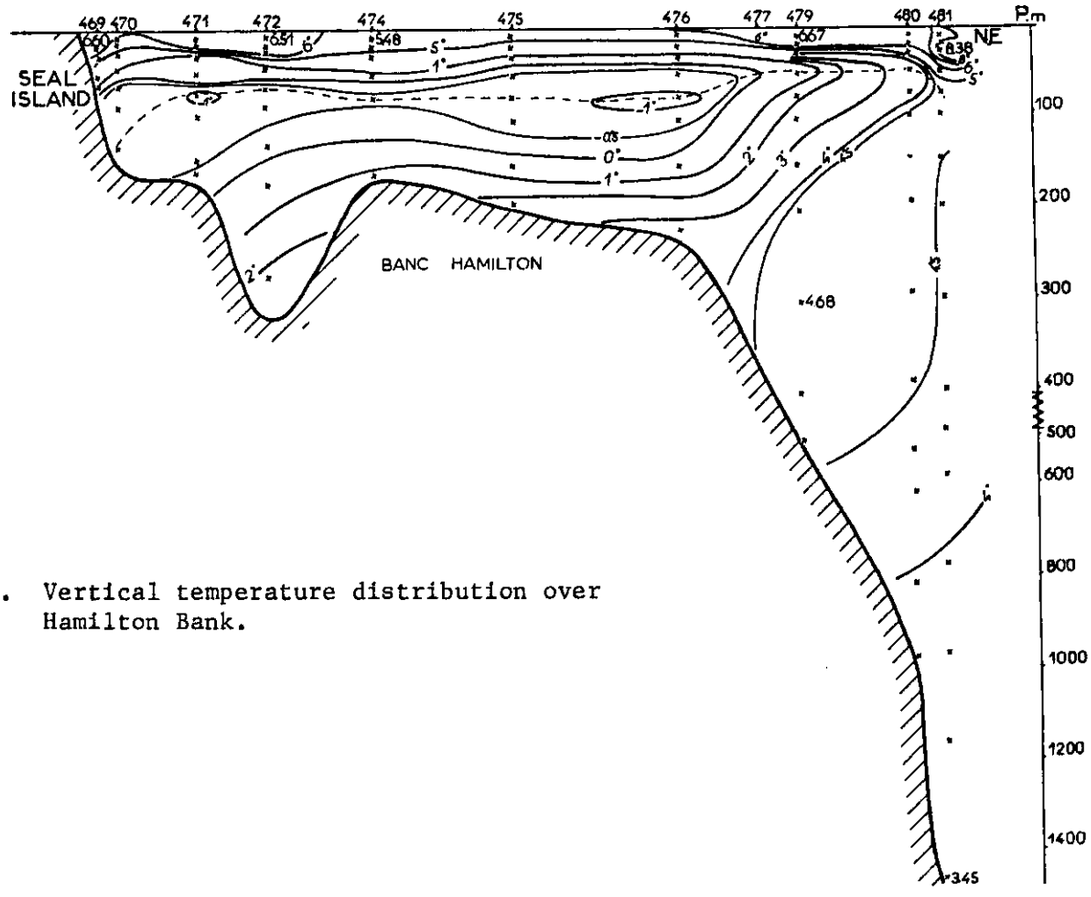

Fig. 4. Vertical temperature distribution over Hamilton Bank.

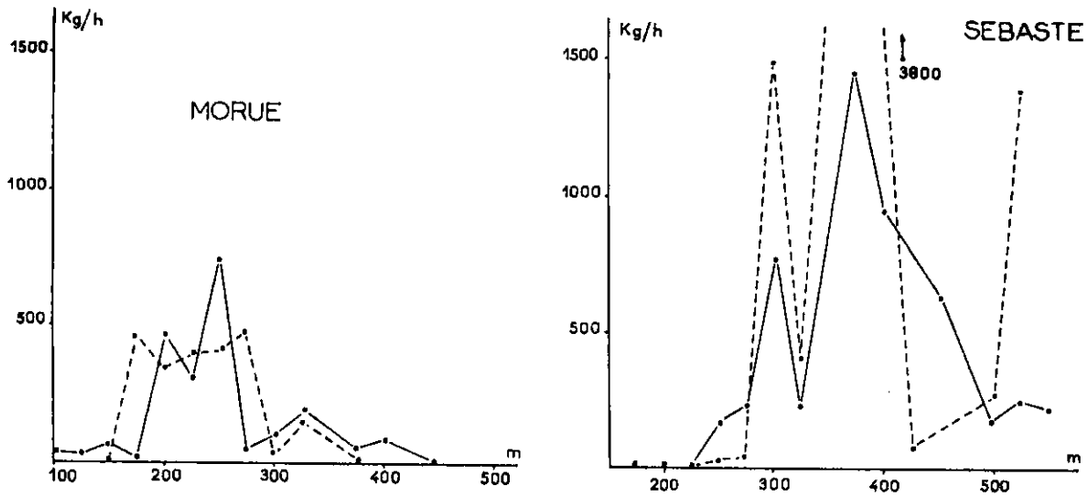

Fig. 5. Yields of cod and redfish (kg/hr) at different depths at Labrador (broken line) and north of the Newfoundland Shelf (solid line).

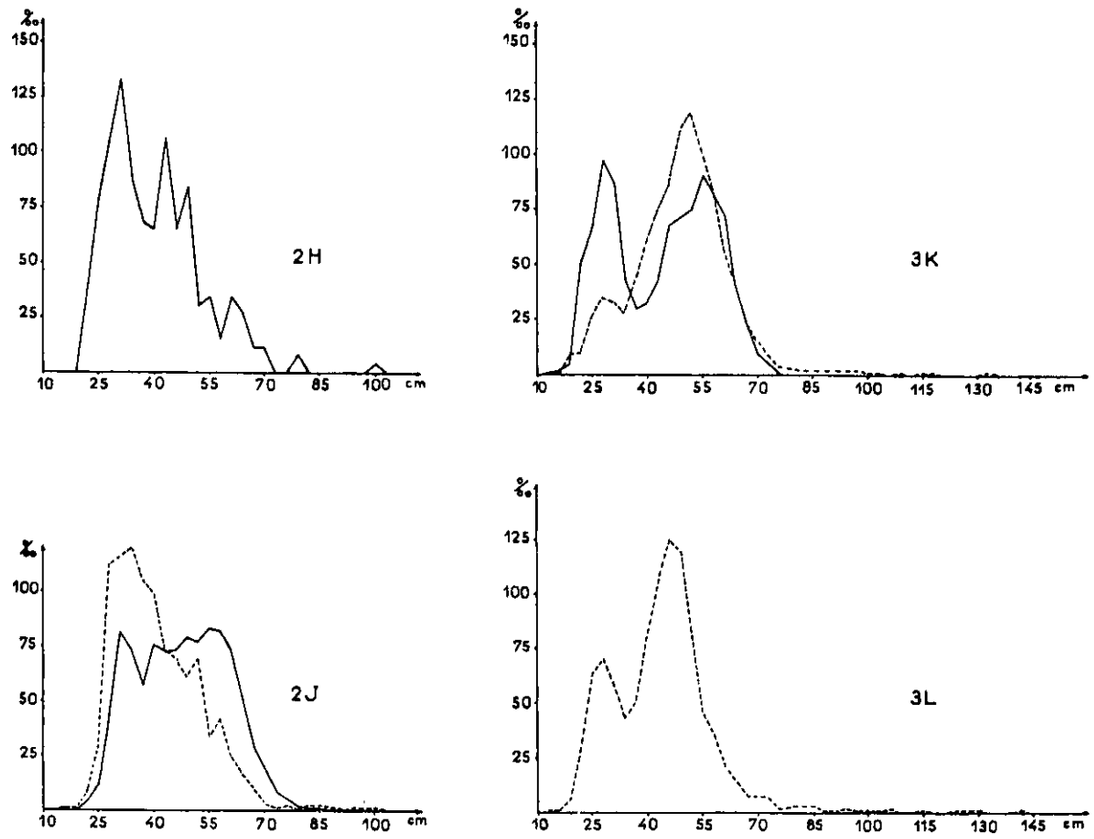

Fig. 6. Length frequencies for cod from central and south Labrador (Div.2H and 2J) from the northeast Shelf (3K) and north of the Grand Bank (3L). August (broken line). September (solid line).