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SPANISH RESEARCH REPORT

Report on the cruise carried out by the Spanish vessel "Vendaval" in the waters off Newfoundland February-April 1953. *

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INTRODUCTION

Object of the Cruise. With this work Spain begins its scientific collaboration as to the carrying out of the general research program of the International Commission for the Northwest Atlantic Fisheries.

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Areas Investigated. The region in which research work was carried out was the southern part of the Great Bank of Newfoundland, the St. Pierre Bank, and Banquereau. (see Figure 1).

Duration of the Cruise. The cruise began during the first days of February and was concluded during the first days of April of the year 1953.

Vessel. The Spanish cod fishing motor vessel "Vendaval", belonging to the fishing company PYSBE, San Sebastian, was used for the researches. The vessel has a diesel motor of 8 cylinders with 1,300 horsepower. The length of the vessel is 65 m., and the holds carry 1,000 tons of fish. It is equipped with radio telegraphy and radio telephony, goniometer, echo sounding apparatus IMSD down to 1,000 m. and the German fish lupe ELAC down to 600m. The trawl used was a Vigneron-Dahl trawl with slight modifications. The meshes in the trawl were 150 mm. for the wings and 130 mm. in the tunnel and the cod end. The opening of the trawl was about 40 m. The trawler had of course to work on a commercial scale and therefore the scientific researches had to a certain degree to be carried out so as not to interfere too much with the commercial fishing.

We wish to state here the fact that the fishing company PYSBE, the captain of the "Vendaval", and its crew gave us every possible help with the installation of the scientific gear in port as well as the working of it at sea.

Species Studied. Cod, haddock, pollock, white hake.

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* A short preliminary report of this cruise was prepared for the Annual Meeting 1953 and published in the Annual Proceedings Volume 3, 1953.

PART 1 - BIOLOGY

1. The Temperature and the Yield of the Fishery.

As it has been found that the temperature of bottom water is a factor of the highest importance for the fishery, the necessary gear was made available for measuring temperatures: a winch and inversion thermometers as well as water samplers.

During the work some difficulties were met with in the operation of the hydrographic winch, and the researches were therefore not carried out to the extent originally planned. Tables and figures giving observations of temperature of air, of surface water, and of bottom water are attached. (Table 8 and figures 4, 5 and 6).

The results of the temperature observations show that there is a very close relation between water temperature and fishing results. We here consider solely the four species already mentioned.

Cod. This is the one of the four species preferring the colder water, however, as a rule not below 2°C. Between 1 and 2°C we caught some large cod, but nearly always in small quantities.

The largest catches were made between 2 and 3°C. This temperature is therefore considered optimal for the cod. Here it should, however, be remembered that this observation is based exclusively on investigations carried out in March 1953 on the Great Bank of Newfoundland.

Haddock. In water layers from 3-4-5°C the quantities of haddock increase at the same time as those of the cod decrease. The optimal temperature observed for this species was between 5 and 6°C.

Pollock and White Hake. These two species were only fished in small quantities, and therefore we cannot ascertain with certainty the optimal temperature for these two species. However, the scarcity indicates that the temperatures are too low for them.

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The use of the inversion thermometer has always been a very great help to the fishery. On the other hand with some biological knowledge a rapid glance at the fishes in the trawl is sufficient to get a fairly accurate impression of the temperature of the water where the fishing was carried out, and thus assess the probability of the presence of larger shoals of the fishes which are object of exploitation. We have thus often captured thermophil species such as the hake, the spiny dog-fish and the porbeagle etc. The occurence in the trawl of these species coincides as a rule with a small yield of cod.

In this connection we can mention the following phenomenon. On the 9th of March the barometer registered an alarming depression, 780 mm., which was followed by a violent hurricane from the south, lasting several hours. When the sea again permitted fishing we found that the yield was very scarce just where we a few

hours earlier had fished with good results. Further we now observed with surprise the total absence of cod, while hake, dogfish and porbeagle were relatively abundant. These species indicated a considerable high temperature of the water and when measured we also registered no less than 5°C.

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2. Main Species.

The following is a list of the species captured by us in the cruise around Newfoundland. We give the Spanish name, the English name, as well as the name in Latin.

Common Name		Scientific Name
Spanish	English	Latin
Bacalao	Cod	Gadus callarias L.
Eglefino, borrico	Haddock	Melanogrammus aeglefinus (L)
Colín	Pollock	Pollachius virens (L.)
Locha	White Hake	Urophycis tenuis (Mitch.)
Cabra, gallineta	Redfish	Sebastes marinus (L.)
Merluza americana	Hake	Merluccius bilinearis (Mitch)
Fumador	Lump-sucker	Cyclopterus lumpus L.
Perro	Wolffish	Anarhichas lupus L.
Perro	Eelpout	Lycodes terre-nove Coll.
Sapo	Rock-fish	Scorpaena americana Gm.
Capelán	Capelin	Mallotus villosus (Müll.)
Rata	Rat-tail, grenadier	Macrourus rupestris (Gun.)
Rape	Monk, Angler	Lophius piscatorius L.
Raya de púas	Starry Ray	Raia radiata, Donov.
Colayo, mielga	Spiny Dogfish	Acanthias vulgaris (Risso.)
Marrajo	Porbeagle	Lamna cornubica Gm.
Lamprea	Hag	Myxine glutinosa L.
Hipogloso, fletan	Halibut	Hippoglossus hippoglossus (L)
Platusa, falso lenguado	Witch, gray sole	Glyptocephalus cynoglossus (L)
Platusa, falso lenguado	Long rough Dab	Hippoglossoides platessoides (Fbr.)
Platusa, falso lenguado	Yellowtail	Limanda ferruginea (Storer)

Of all these species, only cod, haddock, pollock, and white hake are used by the Spanish trawlers. These are the fishes that are best suited to salting.

It is of interest to stress the fact that as the other species mentioned are returned to the sea, the Spanish fishing operations do not threaten the stocks of such fishes as redfish, halibut, flat fish, wolffish, etc. Of course it cannot be avoided that these species in varying quantities are occasionally taken by the trawl, but as they are not used by our fishermen areas where they are abundant are avoided.

3. Size of Fish Commercially used, Cullings.

In culling one used terms as large cod, medium cod and small cod. However, generally the length corresponding to each of these size categories is not defined.

As the cruise was carried out on board one of the boats belonging to PYSBE we shall here deal with the categories for culling used by that firm. The control of the cullings is carried out by means of metallic sheets in various sizes and formed as a bacalada. Bacalada (verbally that which comes from the cod) is the Spanish name used for split cod (or other species of the cod group) as it appears from the stage when ready for salting. From measurements carried out we can give here the length of the fish as fresh round, corresponding to the dimensions of the metallic sheets used in the culling.

	Dimensions of sheet		Length of fish fresh round
	a	b	
Big	80	42	from 95 cm.
Big, medium	70	37	80-94 cm.
Medium	60	29	70-79 cm.
Small	50	27	60-69 cm.
Barajilla (Smallest)	45	26	50-59 cm.

As a rule this classification is simplified to cover only three categories;

Big	80	42	from 95 cm.
Medium	60	29	from 70 cm.
Small			those below 69 cm.

The lowest minimumsize of fish used varies around 40 cm., somewhat depending on personal judgement. However, the large experience of the crew hardly leaves room for personal deviations in cullings. (In the appendix of this report are given tables showing the total length of the fish as it comes from the sea, compared to the dimensions of the corresponding bacalada just before salting and later when landed. The tables A-D deal with cod, haddock, pollock and white hake.)

4. Catches per Unit of Fishing Effort.

One of the problems to which we have paid special attention has been the yield of the fishery, and we have collected all data which could be of interest in this connection. Often hours of the day are lost through accidents with the gear, or whole days are wasted on account of bad weather. Therefore, it would hardly serve any purpose to know the daily yield nor even the total yield of the fishery during our stay on board.

For these reasons we have arranged the material collected so as to give the yield per hour of trawl fishing. However, we had only spent few days on board when we observed that the fishery was more scarce during night than during day. Therefore we further calculated the yield a) per trawl hour during the day

b) per trawl hour during the night.

The results are shown in table 1, which gives figures for day and night fishing. This material is shown also graphically in figure 2.

The unit of weight used in the calculations of the yield has been the "Cesto". The cesto equals about 70 kg. of fish without entrails, head, 1/3 of backbone and cleaned, viz. fish ready for salting. This cesto of about 70 kg. corresponds approximately to 36 kg. of salted landed fish and to about 125 kg. of fresh round fish as coming from the sea. The curves show very clearly the daily and nightly yields of the fishery from 28 February to 26 March. The maximal yield, 36 cestos per hour, was found on the 24th March, during day time; the minimal yield, 1 cesto per hour, on the 15-16 during night time.

Also in general the yield of the fishery during the day is superior to that of the night. We explain this phenomenon as caused by the cod moving away from the bottom during the night in search of food.

Thus we find by means of the fish lupe that the capelin, the principal food of the cod, was concentrated far from the bottom during the night, and this was obviously the reason for the diurnal migrations causing the smaller nightly catches. There are however some exceptions from this rule. On the 8th March the nightly yield was 17 cestos per hour against 4 only in day time. However, these big catches during the night of the 8-9 were not cod, but pollock, a species which is more migratory than the cod.

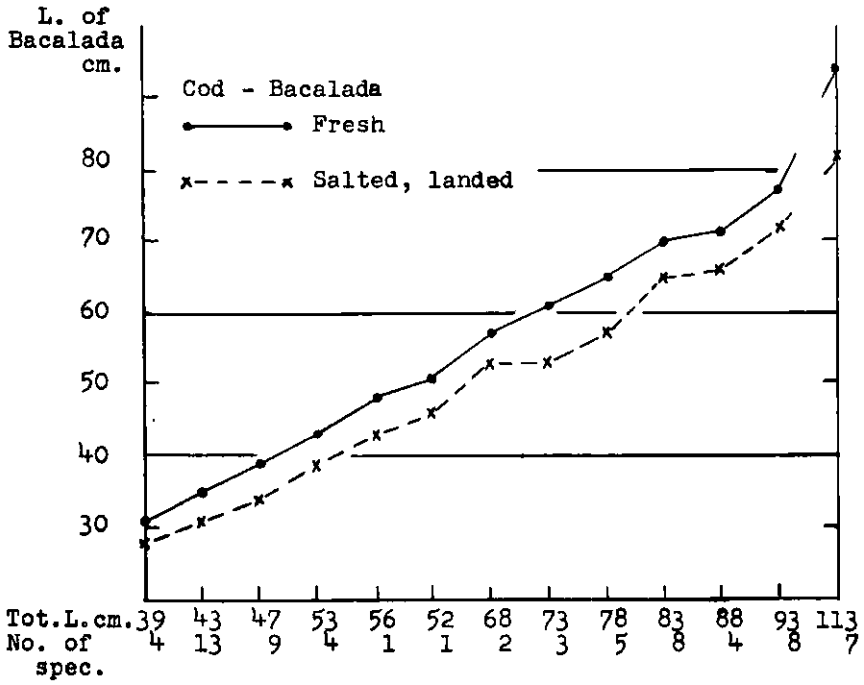
5. Cod.

Size. The cod captured is in general small. We have measured, from the point of the snout to the hind margin of the tail fin, 600 specimens taken at random from the various hauls. In the following these specimens are arranged as to length in 5 cm. groups.

cm.	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
freq.	24	117	231	123	45	13	13	13
%	4%	19.5%	38.5%	20.5%	7.5%	2.16%	2.16%	2.16%

cm.	71-75	76-80	81-85	86-90	91-95	96-100	More than 100
freq.	6	6	3	2	2	1	1
%	1%	1%	0.5%	0.33%	0.33%	0.16%	0.16%

From these results, presented graphically in Figure 3, it is observed that the dominating sizes of cod are from 36-55 cm. the most common size being from 41-50 cm. The curves in the figure below have been plotted from the tables of measurements of fresh round cod and of the corresponding bacaladas (given in the appendix). These curves give an idea of the relation between the length of the fish as fresh round and the dimensions of the bacalada fresh and landed. It is seen that the total length of the bacalada suffers a notable decrease during salting. This decrease in length amount to 3-5 cm. according to the length of the fish.



Sex and Stage of Maturity. For the determination of the stage of maturity we have used the scale in use in St. John's, Newfoundland for the family of cod fishes. Our observations are given in the following scheme:

Grand Bank of Newfoundland (March 1953)

Stage of Maturity	I	II	III	IV	V	VI	No. of specimens
Males	101	4	5	-	9	-	119
Females	71	8	5	-	7	-	91

St. Pierre Bank (25,26,27 March 1953)

Stage of Maturity	I	II	III	IV	V	VI	No. of specimens
Males	3	2	-	-	10	2	17
Females	1	3	-	-	15	6	25

Daily observations of the many thousand individuals handled on board confirmed the picture given in the above table.

The stages of sexual maturity I and II correspond to individuals below 55 cm. length. In general all individuals of stage V are cod of a size of 60 cm. or more.

Two tables giving length, sex, and stage of maturity for each individual from Grand Bank and from St. Pierre Bank are attached to the original report. These tables are not reproduced here, but kept at headquarters for reference. A summary of 5 cm. groups is however given in tables 2 and 3. It appears that the cod from the St. Pierre Bank are considerably larger than those from the Grand Bank, and nearly all of them are mature.

Judged from the stage of maturity the spawning should principally take place in April and May.

Food. The cod being a very voracious fish has a greatly varied stomach content. This especially holds good for the larger individuals. In the stomachs were found crustaceans, molluscs and various species of fish, mainly haddock, flatfish and small cod. In the small cod the stomachs were often filled with capelin.

6. Haddock.

Size. The general size found varies between 50-55 cm. Only exceptionally have we met individuals smaller than 32 or larger than 70 cm. On the whole the specimens caught correspond to the classicication of PYSBE named barajilla. The stage of maturity is shown in the following survey:

Stage of Maturity	I	II	III	IV	V	VI	No. of specimens
Grand Bank of Newfoundland (1 March 1953)							
Males	8	7	13	12	4	-	44
Females	9	5	6	16	2	-	38
St. Pierre Bank (1 March 1953)							
Males	13	12	10	13	-	1	29
Females	16	4	1	-	9	1	31

Tables 4 and 5 show the length distribution in 5 cm. groups for males and females of the different stages of maturity caught on the Grand Bank and the St. Pierre Bank. Detailed tables are given in the original report, kept at headquarters for reference. The tables show that mature haddock (stage IV to VI) were not found below a size of 50 cm.

Food. This species is not as voracious as the cod. In its stomach fishes are rarely found. The content principally consists of echinoderms, crustaceans, worms and molluscs.

7. Pollock.

This species carries the Spanish name Colin or "Fogonero y Palero". Its migratory habit was confirmed by our observations of its greatly changing abundance in trawl hauls from the same place within few hours.

Size. The following survey gives the length distribution in 10 cm. groups:

cm.	30-40	41-50	51-60	61-70	71-80	81-90	91-100	Total
No.	2	2	20	40	4	20	4	98

In general the size of the specimens caught in one and the same haul was very much the same.

Sex and Stage of Maturity.

Stage of Maturity	I	II	III	IV	V	VI	No. of specimens
Males	1	1	1	-	-	13	16
Females	2	2	-	1	3	20	28

In table 6 these 44 individuals are arranged in 5 cm. groups. Mature specimens are found down to a size of 54 cm. All specimens from 66 cm. and upwards are mature (Stage IV-VI). The table giving length by individuals is attached to the original report. In this report however only a table by 5 cm. groups is given, the other is kept at headquarters for reference. The sexual glands of the pollock caught and investigated differed in appearance from that of the other species considered. They had a slimy content, often mixed with whitish, residual eggs showing that they belonged to the Stage VI, the stage following spawning. The distinction between stage II and VI was not always easy and it is well possible that some of the specimens of these stages have been interpreted wrongly.

Food. The smallest specimens feed on crustaceans. In the stomachs of the larger were found mostly fishes, cod, haddock, and capelin.

Parasites. The surface of nearly all the livers observed was infested by a little worm (Nemathelminth) rolled in a spiral.

8. White Hake.

This species is, owing to its loose flesh, of inferior quality. Only small quantities were caught during the cruise. Its presence in the trawl is easily ascertained by the trawl rising to the surface during hauling. This is caused by the fact that the belly of the white hake is easily inflated.

Size. The results of the measurements carried out is given in 10 cm. groups in the following scheme:

cm.	40-50	51-60	61-70	71-80	81-90	91-100	above 100	total
no.	1	11	14	17	4	4	1	52

The sizes of white hake are thus considerably higher than those found for the three other species, as the majority of individuals exceed 70 cm.

Stage of Maturity. The following survey gives the results of the investigations:

Stage of Maturity	I	II	III	IV	V	VI	No. of specimens
Males	-	-	2	14	5	-	21
Females	-	6	4	3	5	-	18

As seen from this survey the stage of maturity is rather advanced, and males and females are already found in the act of spawning. In table 7 the individuals measured are arranged in 5 cm. groups. Specimens ready for spawning or approaching spawning were found down to a size of about 60 cm. A table giving lengths by individuals is attached to the original report. It is not given here, but kept at headquarters for reference.

Food. The white hake is a voracious fish. The food found in the stomachs varied considerably, consisting however principally of fishes (redfish, haddock, cod and hake). In one specimen of 70 cm. length the weight of the stomach content amounted to no less than 600 grams.

9. Other Observations.

a) Plankton. By means of a special plankton indicator constructed by the Instituto Español de Oceanografia and by means of nets, samples of plankton were collected for the study of distribution of eggs and larvae of the principal food fishes.

b) Fauna. Animals from the bottom and from stomach contents, mostly fish, molluscs, and crustaceans, were collected and conserved.

c) Age of fishes. From the four species treated in the preceding pages were collected otoliths and scales.

d) The data of the physical chemical kind. Temperature, salinity, determination of phosphates etc. are dealt with in the following hydrographic part of this report.

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PART II - HYDROGRAPHY

The hydrographic work during the cruise was centered on measurements of temperature (air, surface water and lower water layers), the determination of content of oxygen and phosphates, and of salinity. Moreover chemical analyses of cod liver oil and of the salt used were carried out.

1. Observations on temperature and salinity.

The observations on temperature in connection with the fishing carried out showed a close relation between catches of cod and other fish and the water temperature as already reported in the preceding biological part.

In planning the cruise and in working up results we have adopted the divisions of the area in zones used by the French hydrographers: The Eastern Slopes, the Banks, the St. Lawrence Estuary, and the Nova Scotian Banks (see figure 1).

The hydrographic data collected during the cruise are given in table 8. The observations were made in the period from the end of February to the end of March, viz. during winter and during the period of "invernal stabilization" of the water. Our observations showed that this invernal stabilization occurred over most of the area and that consequently the highest temperatures were found in water layers below 50 m. However, there were a few exceptions among the stations taken in the Halibut Channel (see figure 4). Here the bottom temperatures were low, between -0.2 and +0.6°C, against +0.2 to +1.0°C for the surface layers. These exceptions can be explained from the lability of the isotherms, which in this southern area are close together, owing to the northward drive of the Gulf Stream, and from the comparatively low salinity (32.5‰) facilitating a rapid thermal change. Thus these exceptional cases are caused by the lower water layers (slope water) having preserved their characteristics 34‰ and 2-10°C), whereas the upper water layers have been modified by the Gulf Stream sufficiently for a momentary breaking off of the winter inversion.

The salinity of the bottom water was in the ten first stations below 33‰, which is in agreement with the general case for this area and season. The same agreement was found for the salinity of the surface water along the whole area investigated between the meridians 50°W and 57.30°W.

The yield of the cod fishery is, as already mentioned, dependent on water temperatures. In certain years it has been observed that the summer temperature has caused the isotherms of +4°C to be replaced from its normal position over the 200 m. depth curve south and east of the Great Bank to a position closer to land, over depths of 50-75 m. In such cases the yield of the cod fishing in the following winter and spring is prejudiced by the increase in water temperature.

During the "Vendaval" cruise we found temperatures above +1,°C and over less depth than 200 m. only on the following stations:

St. 20, Op. 39, 85 m. 5.5°C
St. 22, Op. 43, 82 m. 4.8°C
St. 25, Op. 49, 85 m. 6.6°C
St. 26, Op. 51, 88 m. 6.3°C
St. 27, Op. 53, 85 m. 5.5°C

These stations were all located along the south-western edge of the Great Bank where the Gulf Stream makes itself felt rather strongly. Therefore these higher temperatures are no indication of higher temperatures on the Great Bank itself, caused by a replacement of the 4°C isotherm. Part of these higher temperatures were in fact, as earlier mentioned, caused by a southerly hurricane in March; they were thus of a sporadic, exceptional character.

The general result of the hydrographic observations during the cruise can be given as follows: the temperatures and salinities found are normal for that season and show that no unfavourable temperature increases of the Bank water had occurred during the latter half of 1952. Therefore a good cod fishery could be expected for the winter, spring and summer of 1953. In fact the results of the Spanish fisheries verified this prediction.

2. Phosphates.

The methods used in the valuation of phosphates is the one generally adopted. The norms for it were however especially adjusted and unified by Dr. Ricardo Montequi from the Instituto Español de Oceanografia.

The data obtained are given in table 8. They comprise observations from the surface waters as well as from water layers farther down and close to the bottom. The figures found are those that could be expected for that season of the year, when a marked decrease is to be found compared to the high values for the early winter months. The values observed were below 10 mg/m^3 and there is little variation from surface to bottom.

3. Analyses of cod liver oil and of salt used.

The efficiency of the two methods for the preparation of cod liver oil (cooking by vapour and by pressure and super-centrifugation) was investigated. Chemical analyses carried out showed that the latter method gave the best results, but on the whole the vitamin A content was found to be low for the two methods, respectively 60 and 1180 international units.

The reason for the low vitamin A content is considered to be the oxydation of the oil in the tank caused by aeration from the movements of the vessel.

The salt used was analysed in the Laboratorio Oceanografico in Vigo for the salts of calcium and magnesium, these being the chemicals interfering with the curing process. The contents of these salts were within satisfactory limits.

The curing of the fish during salting in the hold was controlled, and it was observed that in ten days the salted cod specimens under control had dehydrated to the constant weight. This rapid dehydration hampers the enzymatic process and the corresponding development of putrifying bacteria.

- THE END -

TABLE 1

Yield of Fishery per Hour and Day
(Night and day trawlings given separately.)

Date	Position	m.	No. of hauls		Trawl hours			Catch in Kgs.			Per trawl hour		
			Day	Night	Day	Night	Total	Day	Night	Day + Night	Day	Night	Day + Night
28/2/53	42°55N-50°05W	120-150	5	2	9.15	3.30	12.45	9,520	1,050	10,570	1,040	318	849
1/3/53	42°55N-50°10W	145-205	4	4	8.37	7.45	15.82	7,560	4,760	12,320	903	639	779
2/3/53	42°55N-50°24W	143-158	4	5	8.00	9.55	17.55	10,150	7,210	17,360	1,269	755	989
3/3/53	42°55N-50°18W	140-170	4	5	7.30	9.30	16.60	5,530	5,390	10,920	758	580	655
4/3/53	42°55N-50°24W	124-165	5	4	8.05	7.45	15.50	13,370	6,160	19,530	1,661	827	1,260
5/3/53	42°55N-50°24W	139-158	3	2	5.45	4.00	9.45	5,670	4,270	9,940	1,040	1,068	1,052
6/3/53	42°55N-50°24W	140-175	4	5	8.00	10.00	18.00	3,990	7,560	11,550	499	756	642
7/3/53	43°09N-51°00W	115-162	4	4	8.15	8.00	16.15	9,100	6,720	15,820	1,117	840	980
8/3/53	43°00N-50°55W	113-200	4	5	8.10	9.20	17.30	2,450	11,270	13,720	302	1,225	793
9/3/53	43°05N-50°45W	202-212	-	2	-	3.30	3.30	-	6,440	6,440	-	1,952	1,952
10/3/53	43°05N-50°45W	202-200	-	1	-	1.30	1.30	-	840	840	-	646	646
11/3/53	43°05N-50°45W	130-220	4	5	7.30	10.90	18.20	2,170	3,640	5,810	297	334	319
12/3/53	43°07N-51°09W	100-210	4	3	8.45	6.25	14.70	2,030	2,030	4,060	240	325	276
13/3/53	44°08N-52°00W	85- 90	4	2	8.00	3.45	11.45	6,020	1,610	7,630	753	467	666
14/3/53	-	-	-	-	-	-	-	-	-	-	-	-	-
15/3/53	44°19N-57°25W	62- 80	2	1	2.00	1.00	3.00	490	140	630	245	140	210
16/3/53	44°45N-53°00W	86- 92	2	1	3.00	1.45	4.45	2,730	140	2,870	910	97	645
17/3/53	44°12N-52°40W	102-153	3	3	6.00	6.00	12.00	3,360	1,540	4,900	560	257	408
18/3/53	44°25N-52°15W	81- 90	4	5	8.15	10.00	18.15	7,140	4,270	11,410	876	427	629
19/3/53	44°28N-52°30W	89- 29	4	6	8.15	12.00	20.15	9,870	8,050	17,920	1,211	671	889
20/3/53	44°21N-52°15W	88- 98	4	3	8.15	5.45	13.60	4,970	4,480	9,450	610	822	695
21/3/53	45°19N-55°05W	127-170	3	2	4.30	3.00	7.30	3,850	2,030	5,880	895	677	805
22/3/53	45°08N-55°05W	140-175	6	4	7.45	5.35	12.80	9,310	1,330	10,640	1,250	249	831
23/3/53	45°15N-55°05W	139-144	2	2	1.55	2.30	3.85	2,870	2,520	5,390	1,852	1,096	1,400
24/3/53	45°04N-56°04W	165-195	5	4	7.30	6.30	13.60	19,320	5,600	24,920	2,647	889	1,832
25/3/53	45°04N-56°08W	111-200	5	4	9.20	6.30	15.50	12,320	4,200	16,520	1,339	667	1,066
26/3/53	45°07N-56°05W	146-202	4	5	7.10	7.30	14.40	10,290	4,970	15,260	1,449	681	1,057

Table 2.

Cod, Great Bank of Newfoundland, March 1953

Length, sex, and stage of maturity.

St. of Mat.	I		II		III		IV		V		VI		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
cm.													
31-35	4	1											5
36-40	24	14											38
41-45	37	34											71
46-50	18	10	1										29
51-55	6	8		4		1							19
56-60	8	2		2					1				13
61-65	5				1	1							7
66-70			1		4	1							6
71-75													0
76-80			1	1		1							3
81-85	1		1						3	1			6
86-90				1					2				3
91-130						1			3	5		1	10
Total	103	69	4	8	5	5	0	0	9	6	0	1	210
	172		12		10		0		15		1		

Table 3.

Cod, St. Pierre Bank, 25-27 March 1953

Length, sex, and stage of maturity

St. of Mat.	I		II		III		IV		V		VI		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
cm.													
41-45		1											1
46-50													0
51-55	1		1									1	3
56-60	1								1				2
61-65	1												1
66-70			1	1					2	2		1	7
71-75									2	4			6
76-80									1	2		2	5
81-85				1						1			2
86-90				1					4	2	2		9
91-95										3		2	5
96-102										1			1
Total	3	1	2	3	0	0	0	0	10	15	2	6	42
	4		5		0		0		25		8		

Table 4.

Haddock, Great Bank of Newfoundland, March 1953

Length, sex, and stage of maturity.

St. of Mat.	I		II		III		IV		V		VI		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
cm.													
33-35	1	2	2										5
36-40	5	5	1	3	1								15
41-45	2	2	1	2	2								9
46-50			2		6	3	1	3		1			16
51-55			1		3	3	7	4	2				20
56-60					1		3	4	2	1			11
61-65							1	5					6
Total	8	9	7	5	13	6	12	16	4	2	0	0	82
	17		12		19		28		6		0		

Table 5.

Haddock, St. Pierre Bank, March 1953

Length, sex, and stage of maturity.

St. of Mat.	I		II		III		IV		V		VI		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
cm.													
33-35		1	1		1								3
36-40	1	5	5	2	2								15
41-45	2	8	6	2	1								19
46-50		2											2
51-55							2						2
56-60							1			2			3
61-65					3					4			7
66-70					2	1				1			4
71-75					1					2			3
76-80											1	1	2
Total	3	16	12	4	10	1	3	0	0	9	1	1	60
	19		16		11		3		9		2		

Table 6.

Pollock, St. Pierre Bank, 20-22 March 1953

Length, sex, and stage of maturity.

St. of Mat.	I		II		III		IV		V		VI		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
cm.													
37	1												1
51-55		2									1		3
56-60				1				1			3	3	8
61-65			1	1							4	10	16
66-70												4	4
71-75												1	1
76-80													0
81-85									1		1	1	3
86-90									1		3	2	6
91-96									1		1		2
Total	1	2	1	2	0	0	0	1	0	3	13	21	44
	3		3		0		1		3		34		

Table 7.

White Hake, Great Bank of Newfoundland, March 1953

Length, sex, and stage of maturity.

St. of Mat.	I		II		III		IV		V		VI		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
cm.													
52-55				1	2								3
56-60				1		1							2
61-65				1			1	1					3
66-70				2		1	3		1				7
71-75						1	3		1	1			6
76-80				1		1	4	1	2	1			10
81-85							1	1	1				3
86-90							1						1
91-95													0
96-100								1		2			3
101-105										1			1
Total	0	0	0	6	2	4	13	4	5	5	0	0	39
	0		6		6		17		10		0		

TABLE 8

List of Stations Worked with Meteorological and Hydrographical Observations, February-March 1953.
(For location of stations, compare the map fig. 4)

Date	Hour	Wind	Sea	Air Pres.	Depth m.	Sky	Station	Oper.	Position	m.	Temperature C° Air	Temperature C° Water	Salinity	σ 17'5	Phosp. mgr/m³
28/2/53	08.40	W5	-	-	145	10	I	1*	42°55N-50°05W	-	-	-	-	-	-
28/2/53	08.40	W5	6	747	146	10	II	2	42°55N-50°05W	0	3.0	0.1	32.94	25.15	-
1/3/53	15.50	NW3	4	756	152	10	III	3	42°65N-50°34W	0	2.0	1.7	32.86	25.10	7'0
2/3/53	11.30	W2	3	751	156	10	IV	4*	42°55N-50°30W	0	-1.0	-0.8	32.81	25.06	3'3
3/3/53	09.30	NW3	3	762	126	6	V	5	42°57N-50°24W	0	1.5	0.1	32.88	25.11	3'0
3/3/53	-	-	-	-	-	-	-	6	42°57N-50°24W	100	-	2.7	33.42	25.53	3'0
3/3/53	-	-	-	-	-	-	-	7	42°57N-50°24W	150	-	2.7	33.30	25.43	3'5
4/3/53	10.15	N3	3	771	125	0	VI	8*	42°55N-50°25W	0	1.0	1.0	32.88	25.11	5'0
4/3/53	-	-	-	-	-	-	-	9	42°55N-50°25W	50	-	1.1	32.90	25.13	3'0
4/3/53	-	-	-	-	-	-	-	10	42°55N-50°25W	100	-	2.0	-	-	-
5/3/53	15.15	WSW6	6	752	-	10	VII	11	42°55N-50°30W	0	6.0	1.5	32.81	25.06	3'5
6/3/53	11.15	S2	4	758	160	10	VIII	12	42°55N-50°24W	0	4.0	0.1	-	-	-
6/3/53	-	-	-	-	-	-	-	13	42°55N-50°24W	75	-	0.2	32.72	24.99	5'6
6/3/53	-	-	-	-	-	-	-	14	42°55N-50°24W	125	-	0.8	33.48	25.57	3'6
7/3/53	10.00	W6	4	763	125	10	IX	15	43°10N-51°00W	0	3.0	1.0	33.95	25.93	-
7/3/53	-	-	-	-	-	-	-	16	43°10N-51°00W	50	-	1.3	33.06	25.25	6'4
7/3/53	-	-	-	-	-	-	-	17	43°10N-51°00W	100	-	1.3	33.15	25.32	6'2
8/3/53	11.10	W3	4	758	114	10	X	18*	43°05N-50°55W	0	-2.0	1.0	33.06	25.25	3'8
8/3/53	-	-	-	-	-	-	-	19	43°05N-50°55W	50	-	2.3	33.06	25.25	6'4
8/3/53	-	-	-	-	-	-	-	20	43°05N-50°55W	100	-	2.3	33.51	25.60	5'5
9/3/53	16.00	SSW12	8	719	-	10	-	-*	43°12N-51°00W	-	6.0	-	-	-	-
10/3/53	12.00	WNW7	7	752	-	8	-	-*	43°03N-50°35W	-	1.0	-	-	-	-
11/3/53	15.30	NE3	3	761	215	10	XI	21*	43°06N-51°02W	0	-1.5	5.0	33.01	25.21	2'8
12/3/53	09.30	NNW4	4	777	205	4	XII	22	43°27N-51°27W	0	-1.0	1.9	32.94	25.15	2'2
12/3/53	-	-	-	-	-	-	-	23	43°27N-51°27W	200	-	2.8	-	-	-
13/3/53	11.20	NNW3	3	774	85	10	XIII	24	44°18N-52°13W	0	2.0	2.5	33.15	25.32	4'0
14/3/53	04.00	ESE1	1	780	-	10	-	-	44°18N-52°13W	-	-1.0	-	-	-	-
15/3/53	09.15	WNW6	5	761	-	9	XIV	26	44°25N-57°30W	0	-1.0	0.5	-	-	-
16/3/53	15.10	NE5	4	769	88	10	XV	28	44°48N-53°03W	0	-1.0	0.1	-	-	-
16/3/53	-	-	-	-	-	-	-	29	44°48N-53°03W	25	-	1.4	33.51	25.60	3'1
16/3/53	17.45	-	-	-	88	-	XVI	30	44°48N-53°03W	0	-	0.1	33.51	25.60	5'1
16/3/53	-	-	-	-	-	-	-	31	44°48N-53°03W	85	-	0.2	-	-	-
17/3/53	11.00	SSE2	2	760	105	10	XVII	32	44°20N-52°40W	0	0	1.1	-	-	-
17/3/53	-	-	-	-	-	-	-	33	44°20N-52°40W	100	-	2.3	32.60	25.66	5'1

TABLE 8 (continued)

Date	Hour	Wind	Sea	Air Pres.	Depth m.	Sky	Station	Oper.	Position	m.	Temperature C° Air	Temperature C° Water	Salinity	σ 17'5	Phosp. mgr/m³
18/3/53	07.50	W3	3	759	82	10	XVIII	34	44°25N-52°20W	0	3.5	2.3	32.61	24.91	6'5
18/3/53	-	-	-	-	-	-	-	35	44°25N-52°20W	77	-	3.1	-	-	-
18/3/53	10.40	-	-	-	83	-	XIX	36	44°23N-52°18W	0	4.0	2.8	32.63	24.92	6'4
18/3/53	-	-	-	-	-	-	-	37	44°23N-52°18W	77	-	3.3	-	-	-
18/3/53	15.45	-	-	-	90	-	XX	38	44°26N-52°15W	0	3.0	2.8	32.68	24.96	6'3
18/3/53	-	-	-	-	-	-	-	39	44°26N-52°15W	85	-	5.5	-	-	-
18/3/53	21.00	-	-	-	-	-	XXI	40	44°28N-52°30W	0	3.0	2.8	32.68	24.96	6'2
18/3/53	-	-	-	-	-	-	-	41	44°28N-52°30W	85	-	3.4	-	-	-
19/3/53	09.45	NNW4	3	749	91	10	XXII	42*	44°28N-52°30W	0	1.0	2.3	32.68	24.96	6'0
19/3/53	-	-	-	-	-	-	-	43	44°28N-52°30W	82	-	4.8	-	-	-
19/3/53	15.10	-	-	-	91	-	XXIII	44	44°28N-52°30W	0	0.5	2.1	32.60	24.96	6'1
19/3/53	-	-	-	-	-	-	-	45	44°28N-52°30W	85	-	3.0	-	-	-
19/3/53	17.50	-	-	-	90	-	XXIV	46	44°28N-52°30W	0	1.0	2.1	32.68	24.96	5'8
19/3/53	-	-	-	-	-	-	-	47	44°28N-52°30W	85	-	3.0	-	-	-
20/3/53	09.45	N2	3	756	89	10	XXV	48	44°25N-52°30W	0	3.0	2.1	33.33	25.46	5'3
20/3/53	-	-	-	-	-	-	-	49	44°25N-52°30W	85	-	6.6	-	-	-
20/3/53	15.10	-	-	-	93	-	XXVI	50	44°21N-52°30W	0	2.0	3.1	32.90	25.13	5'1
20/3/53	-	-	-	-	-	-	-	51	44°21N-52°30W	88	-	6.3	-	-	-
20/3/53	17.45	-	-	-	88	-	XXVII	52	44°21N-52°22W	0	0.5	2.2	33.01	25.21	5'0
20/3/53	-	-	-	-	-	-	-	53	44°21N-52°22W	85	-	5.5	-	-	-
21/3/53	13.50	NE5	5	759	138	6	XXVIII	54	45°23N-55°10W	0	-3.0	0.2	32.50	24.82	4'1
21/3/53	-	-	-	-	-	-	-	55	45°23N-55°10W	130	-	-0.2	-	-	-
21/3/53	16.20	-	-	-	131	-	XXIX	56	45°20N-55°05W	0	-1.0	0.8	32.50	24.82	4'1
21/3/53	-	-	-	-	-	-	-	57	45°20N-55°05W	125	-	1.1	-	-	-
21/3/53	21.30	-	-	-	163	-	XXX	58	45°20N-55°05W	0	-3.0	0.8	-	-	-
21/3/53	-	-	-	-	-	-	-	59	45°20N-55°05W	160	-	1.8	-	-	-
22/3/53	10.45	NNE2	2	761	140	0	XXXI	60	45°12N-55°20W	0	0.5	1.0	32.50	24.82	6'3
22/3/53	-	-	-	-	-	-	-	61*	45°12N-55°20W	135	-	0.6	-	-	-
22/3/53	12.45	-	-	-	165	-	XXXII	62	45°08N-55°20W	0	0.5	1.0	32.50	24.82	6'0
22/3/53	-	-	-	-	-	-	-	63	45°08N-55°20W	160	-	0.4	-	-	-
22/3/53	14.30	-	-	-	140	-	XXXIII	64	45°10N-56°22W	0	1.5	1.0	32.52	24.84	6'3
22/3/53	-	-	-	-	-	-	-	65	45°10N-56°22W	135	-	1.5	-	-	-
22/3/53	16.30	-	-	763	138	-	XXXIV	66	45°08N-55°20W	0	1.0	1.0	32.50	24.82	6'2
22/3/53	-	-	-	-	-	-	-	67	45°08N-55°20W	135	-	0.2	-	-	-
23/3/53	07.40	W4	3	753	140	10	XXXV	68	45°18N-55°05W	0	1.5	0.5	33.12	25.29	4'4
23/3/53	-	-	-	-	-	-	-	69	45°18N-55°05W	135	-	1.5	-	-	-

TABLE 8 (concluded)

Date	Hour	Wind	Sea	Air Pres.	Depth m.	Sky	Station	Oper.	Position	m.	Temperature C° Air	Temperature C° Water	Salinity	σ 17'5	Phosp. mgr/m3
24/3/53	12.10	NE3	3	771	170	6	XXXVI	70	45°04N-56°08W	0	-1.0	0.1	32.54	24.85	7'8
24/3/53	-	-	-	-	-	-	-	71	45°04N-56°08W	150	-	0.3	-	-	-
25/3/53	11.00	SE2	2	774	126	0	XXXVII	72	45°23N-56°19W	0	3.0	0.4	32.59	24.89	5'7
25/3/53	-	-	-	-	-	-	-	73	45°23N-56°19W	120	-	0.8	-	-	-
25/3/53	16.15	-	-	-	-	-	XXXVIII	74	45°18N-56°20W	0	0.0	0.4	32.90	25.13	5'5
25/3/53	-	-	-	-	-	-	-	75	45°18N-56°20W	197	-	1.8	-	-	-
26/3/53	09.45	E3	2	774	146	0	XXXIX	76	45°13N-56°17W	0	0.0	0.2	32.81	25.06	5'0
26/3/53	-	-	-	-	-	-	-	77	45°13N-56°17W	140	-	0.8	-	-	-
26/3/53	16.45	-	3	-	202	-	XL	78	45°09N-56°11W	0	1.0	0.2	32.54	24.85	5'1
26/3/53	-	-	-	-	-	-	-	79	45°09N-56°11W	190	-	0.8	-	-	-
27/3/53	07.35	E2	3	771	142	0	XLI	80	45°10N-56°10W	0	0.0	0.4	32.54	24.85	5'6
27/3/53	-	-	-	-	-	-	-	81	45°10N-56°10W	138	-	0.8	-	-	-
28/3/53	16.30	ESE4	3	761	188	10	XLII	82	45°08N-56°05W	0	2.3	1.7	-	-	-

*Remarks:-

Oper. 1 - muddy sand
Oper. 4 - snow squall
Oper. 8 - snow squall
Oper.18 - snow squall
9/3/53 - hurricane
10/3/53 - storm
Oper.21 - snow squall
Oper.42 - snow squall
Oper.61 - large stones

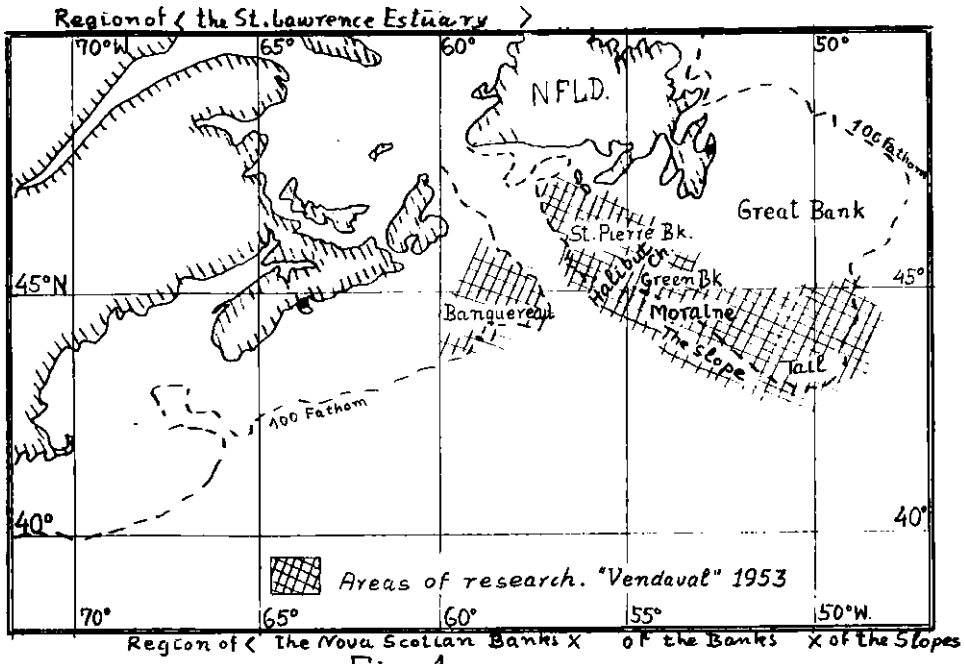

Fig. 1

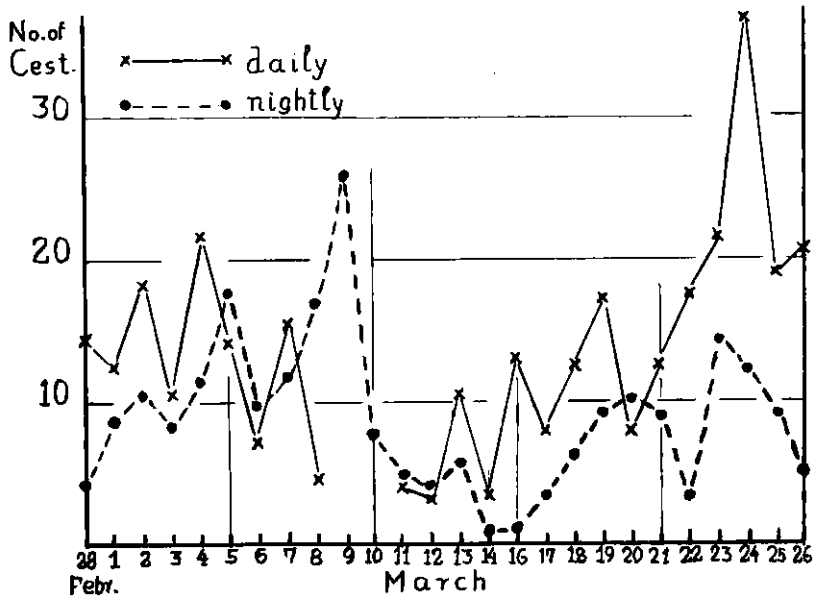

Fig. 2. Yield of fishery pr. trawl-hour, day and night.

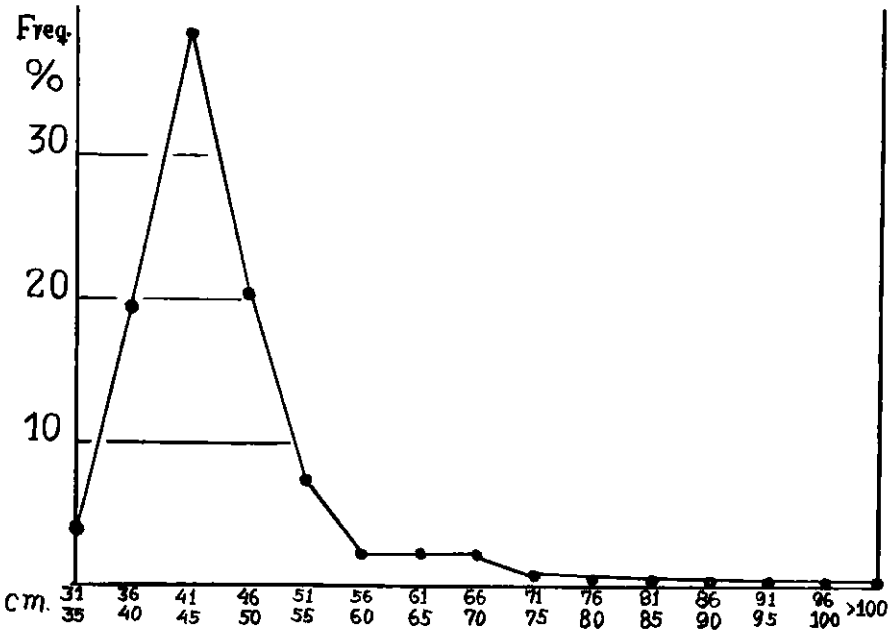

Fig.3. Cod. Length-distribution.

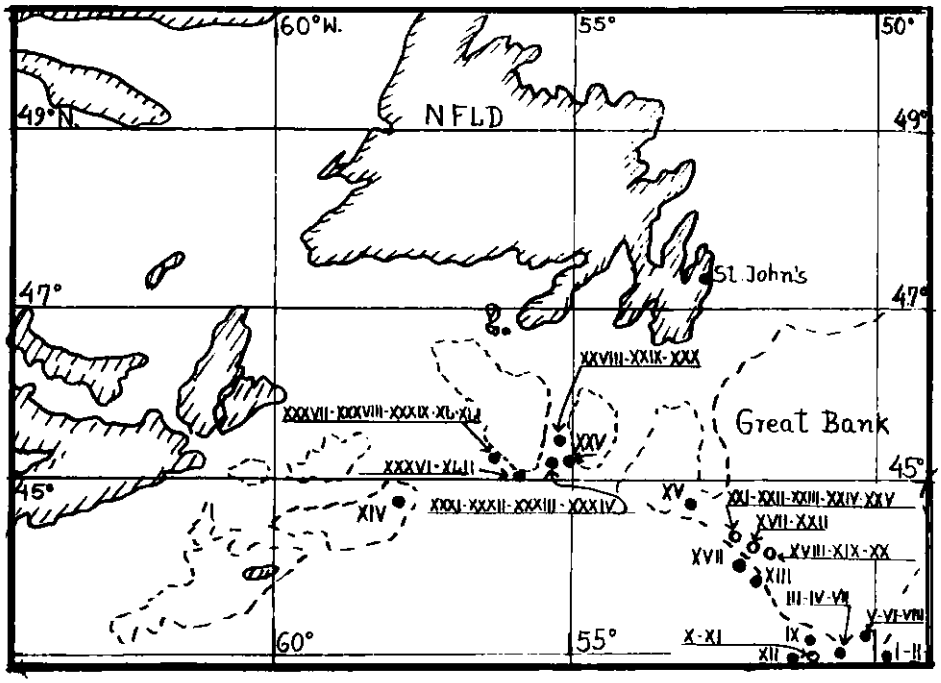

Fig. 4. Stations worked. o = stations where maximal temperatures were found.

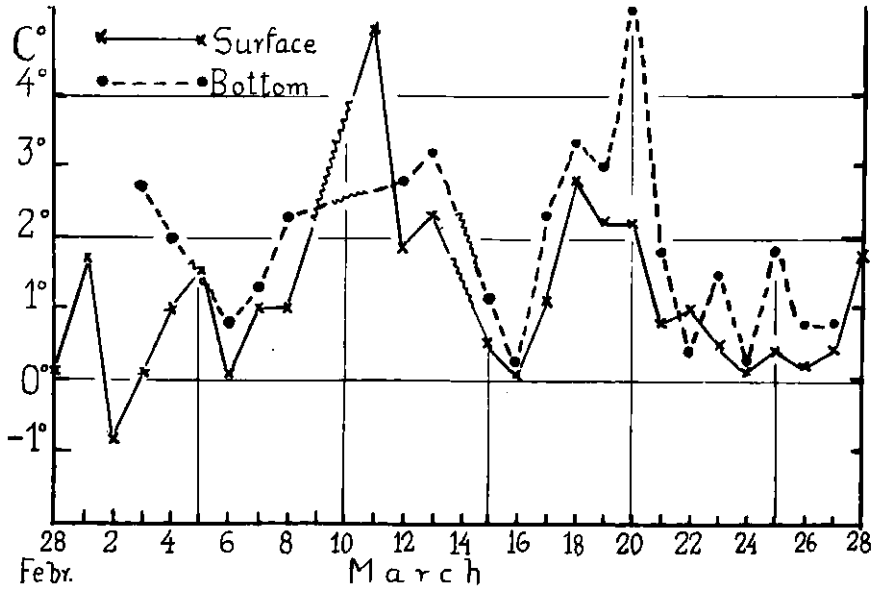

Fig. 5. Comparison of Surface and Bottom Temperatures, Febr.-March 1953.

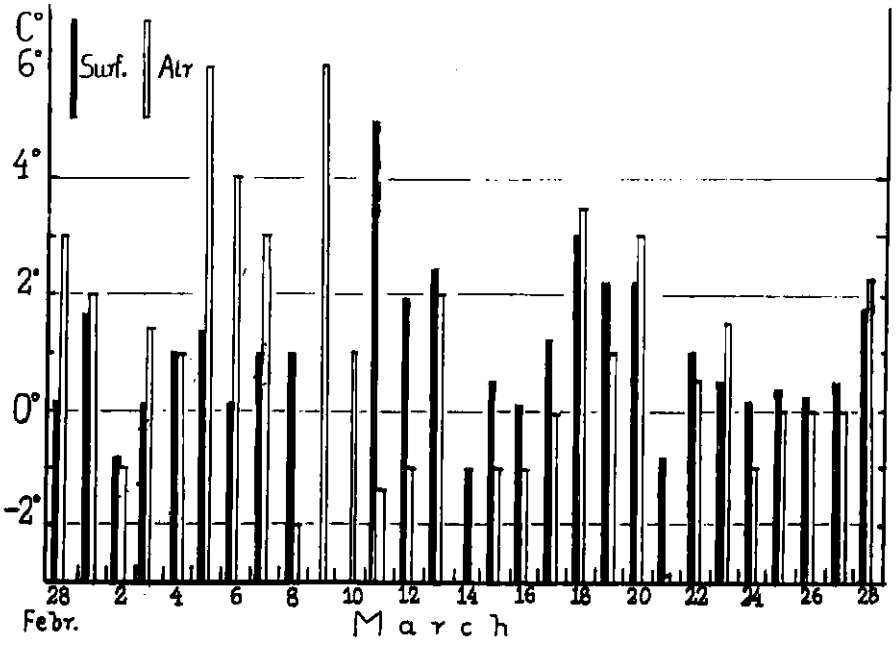

Fig. 6. Comparison of Temperatures of the Surface-Water and of the Atr. Febr.-March, 1953.

Appendix

Tables of measurements in cm. (taken by the authors) of the total length of the fresh round fish (1) and of the bacalada in the fresh state, i.e. headed, eviscerated, first 1/3 of backbone out (2) and when landed after salting (3). Measurements (1) and (2) are taken at the same dates, measurement (3) when landed in Spain. The fresh fish and the fresh bacaladas were measured on board 1-10 March 1953, the landed bacaladas in port on 12 Aug. 1953. The total length is measured from the point of the snout to the hind margin of the tail fin. The measurements of the bacalada are the maximal length (a) and the maximal breadth (b) as shown in the figure below:

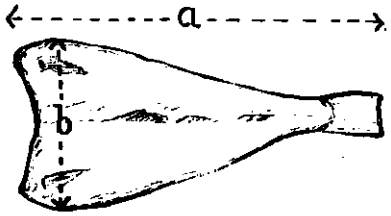

Table A - COD

Total length of fresh fish (1)	Dimensions of bacalada			
	fresh (2)		landed (3)	
	a	b	a	b
130	105	57	85	56
130	110	57	100	55
124	105	55	90	57
110	95	43	78	54
104	84	46	75	47
98	76	45	70	41
96	83	39	75	39
95	80	44	74	44
94	80	41	77	40
94	80	41	72	39
93	73	41	70	38
92	80	40	75	38
91	69	39	67	39
91	75	38	70	38
91	75	37	70	37
89	70	36	66	35
88	70	39	65	39
87	70	40	67	37
87	74	35	65	35
85	74	36	67	35
85	71	38	65	36
83	77	31	68	30

Table A - COD (continued)

Total length of fresh fish (1)	Dimensions of bacalada			
	fresh (2)		landed (3)	
	a	b	a	b
83	70	32	65	32
83	70	32	65	32
82	64	35	59	35
82	67	35	65	34
81	70	33	64	33
80	66	32	62	30
80	68	32	58	32
77	62	31	53	30
77	66	30	58	30
76	62	31	56	31
75	63	28	58	28
73	58	30	55	30
72	61	31	54	26
70	58	28	50	27
66	56	26	55	26
62	50	27	46	27
56	48	23	43	21
55	44	22	38	22
53	44	21	40	18
52	45	21	39	18
52	40	21	37	20
50	41	20	38	18
48	42	20	36	21
48	39	18	35	17
47	40	19	33	17
47	40	19	33	18
46	39	19	34	16
46	38	18	32	17
46	36	19	33	19
46	35	20	32	18
44	35	19	33	18
44	38	17	33	16
44	32	17	31	14
43	37	18	30	18
43	33	16	30	16
43	36	17	35	16
43	34	17	28	17
42	37	17	32	17
42	36	17	30	16
42	33	17	30	15
41	32	17	30	16
41	33	17	29	18
41	34	16	29	15
40	29	15	28	17
40	32	16	30	14
37	32	15	27	12
37	30	15	27	15

Table B - HADDOCK

Total length of fresh fish (1)	Dimensions of bacalada			
	fresh (2)		landed (3)	
	a	b	a	b
61	49	26	47	24
61	46	26	43	25
59	49	26	47	26
59	46	27	45	24
59	46	25	42	25
57	46	25	42	22
57	46	24	40	24
56	46	23	41	21
55	44	23	38	21
55	44	23	39	23
55	46	24	42	23
55	44	24	39	23
55	45	22	40	22
54	43	21	38	20
53	41	23	40	22
52	42	22	39	22
52	42	22	38	20
52	41	21	37	21
52	42	20	37	20
51	42	22	39	20
50	41	21	37	19
50	40	22	37	21
50	42	20	34	20
49	38	20	34	19
48	39	20	35	20
48	40	20	38	20
45	37	19	31	18
41	32	17	29	16
41	31	16	31	15
41	33	17	27	15
41	32	15	31	14
40	33	17	29	14
40	31	16	28	14
40	32	16	29	16
39	31	15	28	14
39	31	15	30	15
39	32	15	28	15
35	29	12	24	12
33	25	14	23	12
33	26	12	24	9

Table C - POLLOCK

Total length of fresh fish (1)	Dimensions of bacalada			
	fresh (2)		landed (3)	
	a	b	a	b
96 cm.	80 cm.	34 cm.	76 cm.	34 cm.
94	72	33	69	32
89			70	35
87			69	35
87	70	32	64	32
86			72	32
86			72	33
85	65	30	64	30
83	65	30	63	30
81			64	32
75	60	30	58	27
75	65	28	61	28
70	69	29	57	28
68	59	27	57	27
67			50	27
67	55	26	52	26
65	52	28	50	27
65	60	26	51	23
65	55	25	50	27
65	54	25	52	25
65	52	20	44	20
64	52	26	48	26
64	55	26	51	26
63			50	24
63	53	26	52	25
63	51	24	46	25
63	52	25	52	25
63	54	23	49	23
62	50	25	50	25
62	50	24	47	24
62	54	24	53	24
60	48	24	45	22
60	50	24	48	23
60	49	24	49	22
59	51	24	51	23
58	47	23	46	28
57	49	22	46	22
57	45	23	44	23
54	43	23	43	23
54	45	24	46	23
52	31	17	29	14

Table D - WHITE HAKE

Total length of fresh fish (1)	Dimensions of bacalada			
	fresh (2)		landed (3)	
	a	b	a	b
104 cm.	88 cm.	44 cm.	78 cm.	45 cm.
97	82	42	79	39
96	88	41	76	41
88	75	38	69	33
83	66	33	63	30
83	70	34	62	34
81	70	30	65	29
79	67	30	66	28
79	70	31	63	30
79	66	32	62	30
79	67	32	64	28
78	70	35	62	27
78	72	32	62	32
77	70	30	59	30
77	66	31	59	28
76	65	35	54	33
76	66	32	58	30
75	67	33	59	27
74	60	31	56	28
72	65	25	55	25
72	60	30	57	25
71	65	16	54	14
71	63	26	61	26
70	56	30	52	26
70	60	28	59	24
70	62	28	53	28
69	60	30	54	30
69	56	28	55	26
68	56	28	55	28
66	54	29	49	27
65	60	23	52	23
64	60	25	52	25
64	54	28	50	26
60	49	24	50	23
59	50	26	44	24
53	44	23	39	20
52	44	20	37	17
52	42	22	40	16