Northwest Atlantic Fisheries Organization

Serial No. N1174

NAFO SCR Doc. 86/57

SCIENTIFIC COUNCIL MEETING - JUNE 1986

Distribution of Silver Hake and Other Numerous Fish Species on the Scotian Shelf Slopes in 1985 from the Data of Soviet Observers

by

V. A. Rikhter, V. F. Turok, and I. K. Sigaev

Atlantic Research Institute of Marine Fisheries and Oceanography (AtlantNIRO)
5 Dmitry Donskoy Street, Kaliningrad, 236000, USSR

Abstract

An analysis was made of distribution of silver hake and other numerous fish species in the area open for foreign fishery in May-August 1985. Significant differences in distribution and abundance of some species as compared with the previous years have been revealed. Extremely dense concentrations of silver hake over large area were observed for the first time in August. Haddock, saithe, Urophycis spp. and mackerel were distributed almost as wide as silver hake. The by-catch of the three latter objects increased considerably while cod, argentine and redfish were rarely encountered in the catches in negligible number.

Analysis of some oceanographic factors permits to suppose that the latter was the major reason of the above-mentioned peculiarities of distribution.

Introduction

In 1985, following the NAFO Scientific Council recommendations, Soviet observers continued sampling of silver hake for length-age analysis from commercial catches. In addition, species composition and distribution of other species encountered in the catches was studied. In the present paper distribution of silver hake and some other species catches per trawling hour is considered in comparison with similar data for the previous years, and following the STACFIS recommendation (June 1985) detailed information on sampling in 1985 is given by fishing grounds and periods.

Materials and Methods

In 1985 sampling was made by three Soviet observers from May to August inclusive. Standard methods (Rikhter et al., 1980; Waldron, 1978, 1979) were used for sampling and analysis of distribution. In figures (in denominator) and in table 3 (in brackets) the number of sets with the catches of corresponding species is shown. Like in 1984, the distribution was analysed only by month due to relatively stable fishing conditions. Analysis of distribution of hakes of genus Urophycis was made without discriminating between species. Altogether, the observers measured 109 337 sp. of silver hake, and collected 1020 pairs of otoliths for age determinations. The intensity of sampling in 1985 on different grounds and in different periods of fishing is presented in Table 1, in which the number of samples taken in the regions with the extent of 10° by longitude, namely 59°01'-59°10', 59°11'-59°20'W etc. is given. As is evident from these data the intensity of sampling appeared to be the largest in the third ten-day periods of May, June and July. In addition, three regions where the largest amount of samples was taken, may be selected as follows:
1) 59°31'-60°40'; 2) 61°01'-61°10' and 3) 62°21'-63°00'.
Finally, the data cited in the table show that sampling in July-August shifted westwardly..

Results and Discussion

Silver hake (Merluccius bilinearis)

From the distribution of catches, in May 1985 silver hake concentrated in the lesser area (fig. 1) than in 1984 (Rikhter, Turok, 1985). The fishing was conducted mainly at 150-200 m depths (table 2) in the region between 59°00' and 61°30'W. The density of aggregations was very high, although it was lower than in 1984 (table 3). Record density was observed in May 1982. In June, the region where the fishing for silver hake was conducted, expanded markedly (fig. 2) covering almost the entire area southward of small- mesh-gear-line (SMGL). The fishing was mainly made at 115-160 m depths (table 2). The density of aggregations increased against May (table 3), being inferior only to the 1982 value in

the reference period (1981-1985). In July the fishing markedly shifted westwardly (fig. 3) which was certainly due to local migrations of silver hake influenced by oceanographic factors. The catches per trawling hour somewhat increased compared to June and appeared to be the largest over the entire reference period. In August the area of aggregations expanded once again (fig. 4). The observers' data permit to choose three fishing region:

1. 59°40' - 60°20'
2. 61°00' - 61°30'
3. 62°20' - 63°10'.

It was not difficult to note that silver hake was observed almost throughout the entire area open for foreign fishery. The density of aggregations in the above-mentioned regions appeared to be extremely high (table 3). These peculiarities were not previously observed in August at least since 1977. In most cases, during this month the silver hake abundance on the shelf slopes markedly decreased as a result of spawning migration of the fish northward of SMGL (Rikhter et al., 1980, 1981, 1982, 1983, 1984). Changing in the mentioned scheme occurred in 1984 when dense silver hake aggregation on the shelf slopes still persisted in August although the area of aggregation was considerably lesser compared to previous months (Rikhter, Turok, 1985). It is worth noting that from average monthly stages of maturity, sexual maturation rate was very high in May-June 1985 (table 4). However during the entire fishing season silver hake in great number persisted on the shelf slopes where according to the observers' data spawning took place in July-August. From the above-stated it may be supposed that oceanographic factors and high abundance of silver hake influenced greatly the peculiarities of distribution of the fish in 1985.

Haddock (Melanogrammus aeglefinus)

During the entire fishing season this species was distributed almost as wide as silver hake (fig. 5-8) which was one of the peculiar features of the 1985 season. However, according to the observers' data the by-catch did not exceed the allowed level of 1% on the whole, although it appeared to be somewhat higher than in the previous years (table 3).

Saithe (Pollachius virens)

During the previous years saithe was absent in the catches or occurred occasionally and usually in small amount. In May-June 1985 this species was relatively abundant on the shelf slopes (fig. 9-10). Next two months the by-catch of saithe sharply decreased (fig. 11-12, table 3).

Urophycis spp.

While in the previous years Urophycis spp. were encountered even individually far less than in each trawl catch, in 1985 they were distributed almost as wide as silver hake (figs. 13-16) and the by-catch size was approximately similar to that of haddock (table 3).

Mackerel (Scomber scombrus)

During the 1985 fishing season this species was found almost as frequently as silver hake (figs. 17-20), and ranked the first by the by-catch size (table 3). In the previous years mackerel was encountered in the catches occasionally and usually in small numbers which could probably be considered as normal because mackerel is a transit fish on the shelf slopes. Unusual situation observed in 1985 also became apparent in the present case.

Analysis of some oceanographic factors given below makes it possible, to some extent,to explain peculiarities of distribution of massive fish species southward of SMGL observed in 1985.

Differences in temperature conditions in 1984 and 1985 on the Grand Bank and Scotian Shelf

In order to reveal environmental factors which could influence rather unusual distribution of commercial fish species in 1985 in the area of the Soviet fishery on the Scotian Shelf slope, the data on the water temperature were compared for the recent two years. These included monthly means of ocean surface temperature in the selected points on the Grand Bank and Scotian Shelf and autumn distribution of temperature on Halifax section. Just these data were chosen for analysis which is stipulated by almost

complete absence of Soviet deepwater oceanographic observations in the areas mentioned.

Monthly mean values of the water temperature were taken from the charts of surface temperature of the northern Atlantic issued by the USSR Gidrometcentre. These charts show distribution of temperature both in isotherms and as values in the corners and centres of 5-degree squares. Our values correspond to the centre and southwest corner of the Grand Bank square extended between 45-50°N and 45-50°W and to the centre and northeast corner of the square on the Scotian Shelf extended between 40-45°N and 60-65°W. Monthly means of the temperature in these points are presented in table 5.

Halifax section is sometimes made during the Soviet-Canadian autumn surveys on abundance of silver hake fry. Fig. 21 shows the distribution of temperature on this section in November 1984 and 1985.

Although the values of surface temperatures and not of deep-water observations are mainly used, they still permit to suggest that temperature conditions in the water column differ on the shelf slope.

To do this, the well-known thesis that the waters of cold Labrador Current dominating in the areas of Labrador and Grand Bank are transported by this current and its branches to the Scotian Shelf and form to a great extent the temperature regime of its water column, will be followed. Surface temperature on the shelf may also undergo significant changes depending on advection of Labrador waters. Therefore, if stable decrease (increase) in the water temperature is observed in the Grand Bank area, a decrease (increase) in the temperature should really be expected after a while on the Scotian Shelf. It is evident from table 5 that sea surface temperature (SST) decreased in the selected points of the square of Grand Bank compared to 1984. However, this decrease was recorded constantly from February to October at the point of square centre, and in February and March and then from May to December at the southwest point. It is worth of noting that the centre of the square is located near the eastern Grand Bank slope, and south-

west corner is in the shallow waters of the Bank. As is evident from the points of the square of the Scotian shelf, a similar decrease in the temperature has been observed in this area covering both the offshore part (the point of the centre near the slope) and the shelf (northeast corner). At the first point a decrease was recorded from March to August and in December, and from February to September and in November-December at the second point. Thus, during the winter, spring and summer periods SST on the Scotian Shelf was lower in 1985 than in 1984. The decrease in SST is indicative of the more intense and long advection of cold waters into the shelf from the Grand Bank and Gulf of St. Lawrence which could be extended over the greater shelf area, compared to 1984, up to the slope region where the fishing is conducted. This could be one of the main reasons for the formation and retention of dense aggregations of silver hake within the region alloted for fishing and non-distribution of the species northward of SMGL. The same reason could result in the increase in the by-catch of mackerel for which cold waters on the slope could be to some extent a barrier to the penetration into the shelf, as well as in the by-catch of saithe and Urophycis sp. for which the intensification of cold waters advection promoted the appearance of these species in the fishing area.

Comparison of vertical distribution of temperature on the Halifax section in November 1984 and 1985 (fig. 21) confirms the increase of intermediate cold layer in 1985 and indicates the great decrease of the temperature in its core. It may be suggested that these differences were the strongest in spring and summer.

Conclusions

During the 1985 fishing season extremely dense and stable silver hake aggregations persisted on the shelf slopes. The area of aggregations was large even in August. Distribution of other fish species was also unusual. Hadddock, saithe, Urophycis spp. and mackerel southward of SMGL were distributed almost as wide as silver hake. While in the recent years the latter three species were scarcely encountered in a trawl and usually in small number, in 1985 their

by-catch appeared to be relatively large although it did not reach the allowed level of 10%. Mackerel ranked the first by the by-catch size is especially distinguished among others. At the same time, cod, argentine and redfish were virtually completely absent in the fishing area.

The 1985 fishing season was characterized by a number of peculiar features which were not observed in the previous years. It can be suggested that oceanographic factors were decisive there.

References

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Table 1 Distribution of length samples of silver hake Collected by USSR observers in 1985 by fishing regions and periods

Positions (West longitude)	Months and decades										Total
	May		June			July			August		
	II	III	I	II	III	I	II	III	I	II	
1	2	3	4	5	6	7	8	9	10	11	12
59°00'											
10											
20				4	1						5
30			1	5	2						8
40	4	2	8	7	2						23
50	5	10	11	8	3						37
60°00'	8	12	2	9	3				1	1	36
10	10	14	7	5	2					1	39
20	12	1	10	3	8				4	3	41
30	5		4	7	8						25
40	3	1	5	3	10						21
50	2	2		1	1						6
61°00'	2				4						6
10	5	16	3		4				1		29
20		14	1		2				3		20
30		2			3				2		7
40					1						1
50		1				3	1				5
62°00'						4	1				5
10							2	2			4
20						8	2	2			12
30					5	7	2	16	2		32
40					11	13	30	48	10	4	116
50					3	10	8	11	4		36
63°00'								1	17	6	24
63°10'							2		3		5
20							4				4
Total	56	75	52	52	73	45	52	80	47	15	547

Table 2 Fished depths by month in 1981-1985

Year	May		June		July		August	
	Main depths fished, m	Max. depths, m	Main depths fished, m	Max. depths, m	Main depths fished, m	Max. depths, m	Main depths fished, m	Max. depths, m
1981	100-130	250	100-170	250	90-140	180	-	-
1982	130-200	350	140-250	370	100-165	220	-	-
1983	150-280	320	120-210	340	-	-	-	-
1984	180-220	280	120-160	240	110-120	130	160-180	220
1985	150-200	330	115-160	300	115-140	230	115-125	310

Table 3 Catches per trawling hour (kg) by species, month and year (brackets show no. of sets)

Species	Months	Year				
		1981	1982	1983	1984	1985
1	2	3	4	5	6	7
Silver hake	May	2368 (33)	8654 (34)	2771 (160)	5738 (90)	3094 (131)
	June	1121 (69)	5471 (103)	2778 (105)	2783 (57)	3635 (195)
	July	1909 (68)	1724 (99)	-	3298 (125)	3994 (208)
	August	-	-	-	4931 (26)	7320 (81)
Haddock	May	3 (10)	22 (23)	17 (81)	6 (37)	28 (123)
	June	20 (46)	-	40 (90)	17 (53)	54 (190)
	July	8 (37)	10 (74)	-	-	37 (204)
	August	-	-	-	-	59 (80)
Cod	May	2 (4)	-	46 (65)	3 (15)	-
	June	30 (31)	-	1013 (87)	-	-
	July	64 (67)	14 (94)	-	-	-
	August	-	-	-	-	-
Redfish	May	106 (3)	-	34 (118)	7 (51)	-
	June	1 (2)	96 (41)	49 (53)	-	-
	July	-	-	-	-	-
	August	-	-	-	-	-
Saithe	May	-	-	-	-	38 (105)
	June	-	-	-	-	22 (123)
	July	-	-	-	-	4 (142)
	August	-	-	-	-	2 (58)
Urophycis sp.	May	-	-	-	-	39 (125)
	June	-	-	-	-	25 (188)
	July	-	-	-	-	32 (206)
	August	-	-	-	-	45 (78)
Mackerel	May	-	-	-	-	101 (126)
	June	-	-	-	-	53 (180)
	July	-	-	-	-	104 (191)
	August	-	-	-	-	149 (75)

Table 4 Mean gonad maturity stages of mature part of silver hake stock in May-June 1977-1985

Year	May		June	
	Males	Females	Males	Females
1977	-	-	3.7	4.0
1978	3.8	3.4	4.2	3.9
1979	3.9	3.9	4.0	4.0
1980	3.4	3.5	4.0	4.0
1981	3.4	3.3	3.8	3.5
1982	3.7	3.1	3.9	3.1
1983	4.1	3.9	4.5	4.2
1984	3.2	3.0	3.0	3.1
1985	3.8	3.1	4.4	3.7

Table 5 Monthly means of sea surface temperature in 5-degree-squares* on Grand Bank and Scotian Shelf in 1984 and 1985

Month	Grand Bank				Scotian Shelf			
	Square centre		Southwest corner		Square centre		South-east corner	
	1984	1985	1984	1985	1984	1985	1984	1985
I	-0.5	0.5	1.3	2.7	6.5	7.8	2.6	3.1
II	-0.3	ice	3.4	1.6	5.6	5.8	1.7	1.0
III	0.0	ice	0.7	0.2	7.2	5.4	1.1	0.7
IV	3.8	1.0	1.5	2.0	11.3	6.1	2.4	1.1
V	3.6	2.1	4.7	2.2	12.0	9.1	9.2	3.0
VI	5.5	4.0	8.1	6.9	13.2	12.6	8.9	6.9
VII	9.4	7.0	11.9	11.5	18.3	17.1	14.7	12.3
VIII	14.7	11.0	17.2	14.7	21.7	18.8	19.4	15.8
IX	12.3	11.1	15.3	13.9	19.4	19.2	16.0	14.2
X	8.9	6.6	11.7	10.7	16.8	17.1	11.7	12.2
XI	4.3	4.3	6.4	6.0	13.1	13.0	8.5	7.9
XII	1.9	2.5	4.8	3.1	9.9	8.5	5.7	5.0

* Positions of squares are given in the text

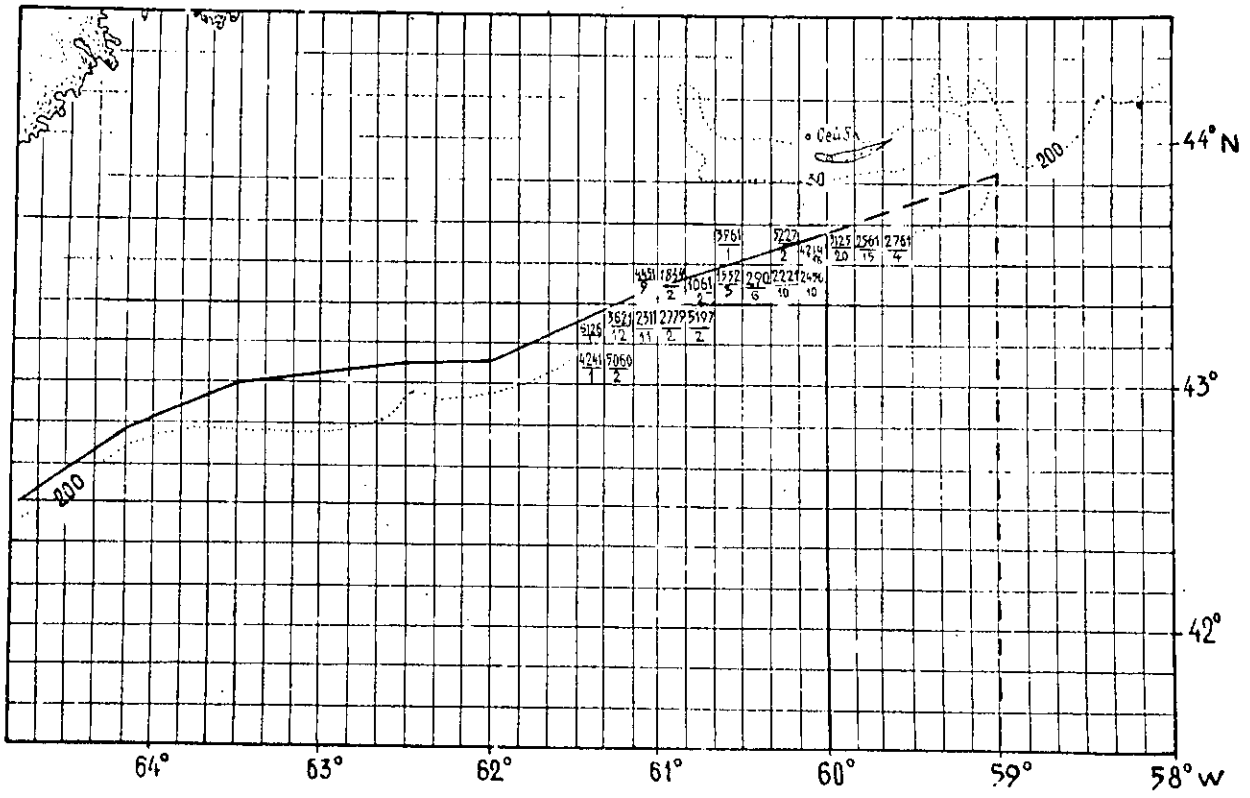

Fig. 1. Silver hake catches per trawling hour (kg) in May 1985.

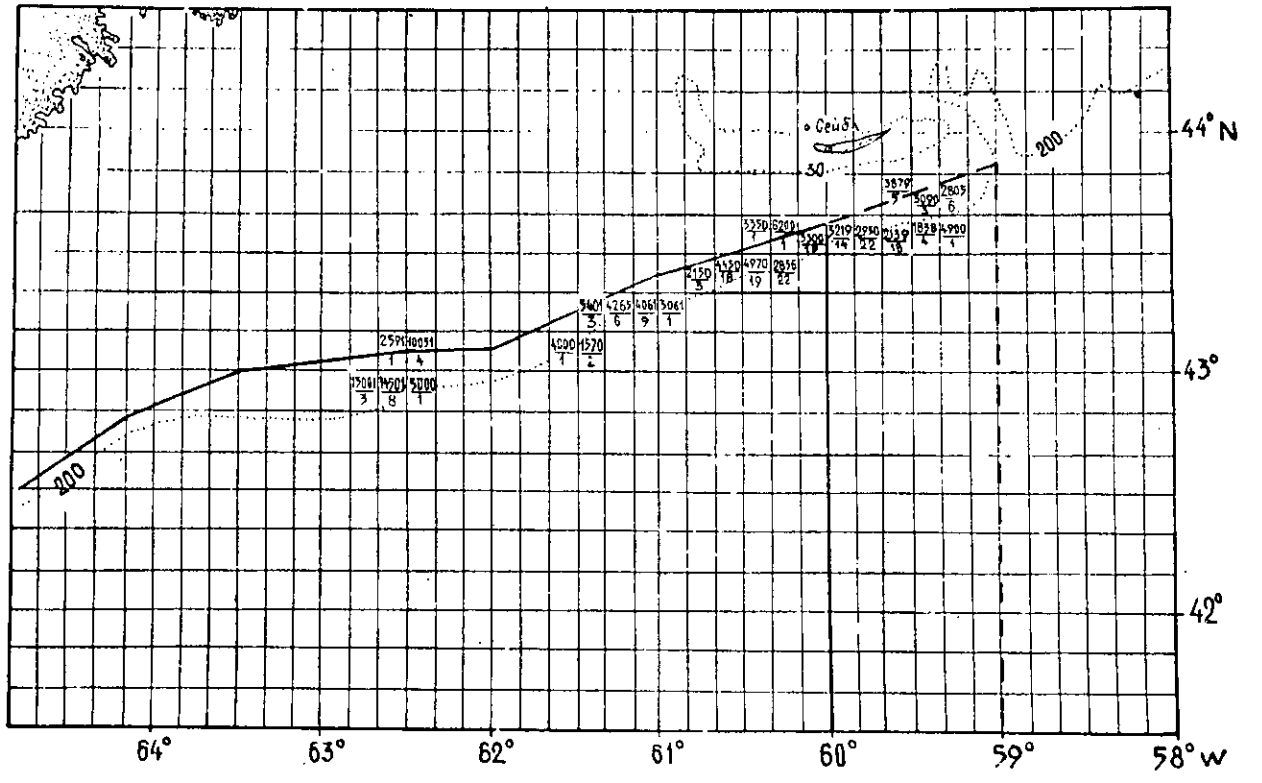

Fig. 2. Silver hake catches per trawling hour (kg) in June 1985.

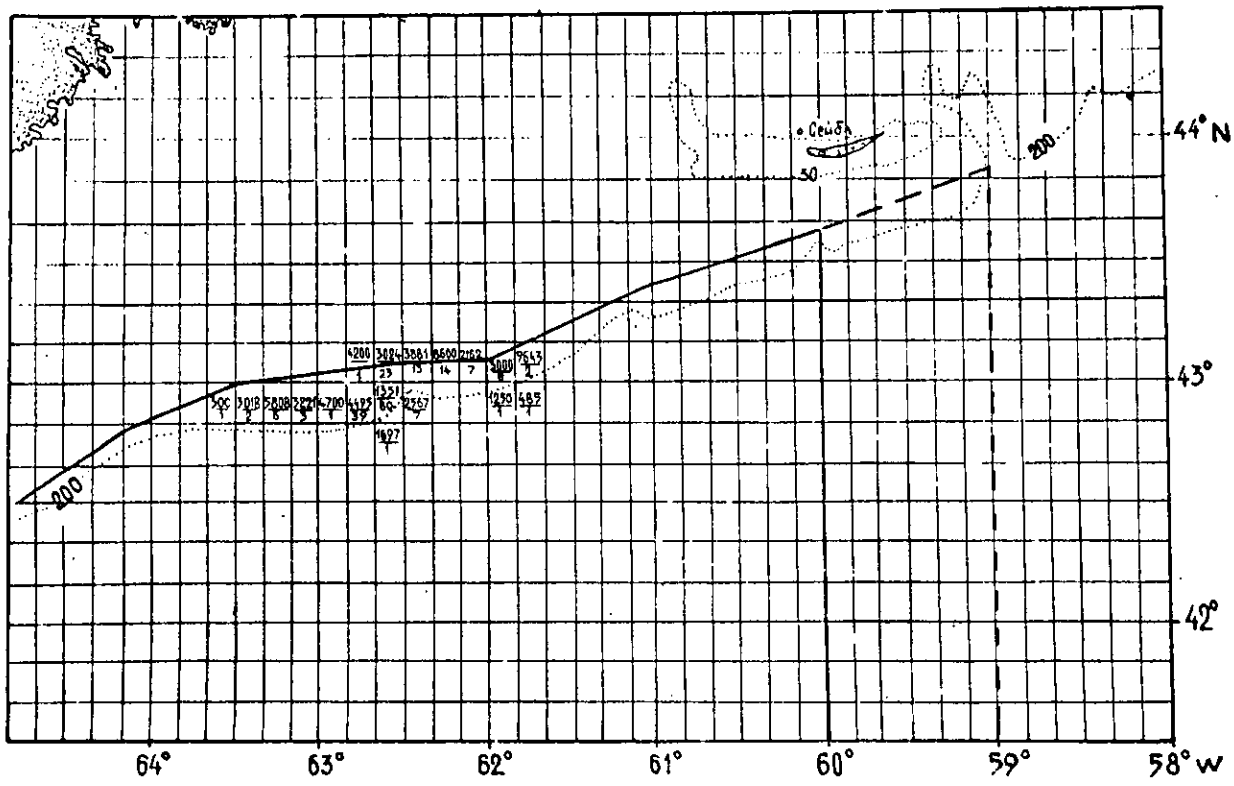

Fig. 3. Silver hake catches per trawling hour (kg) in July 1985.

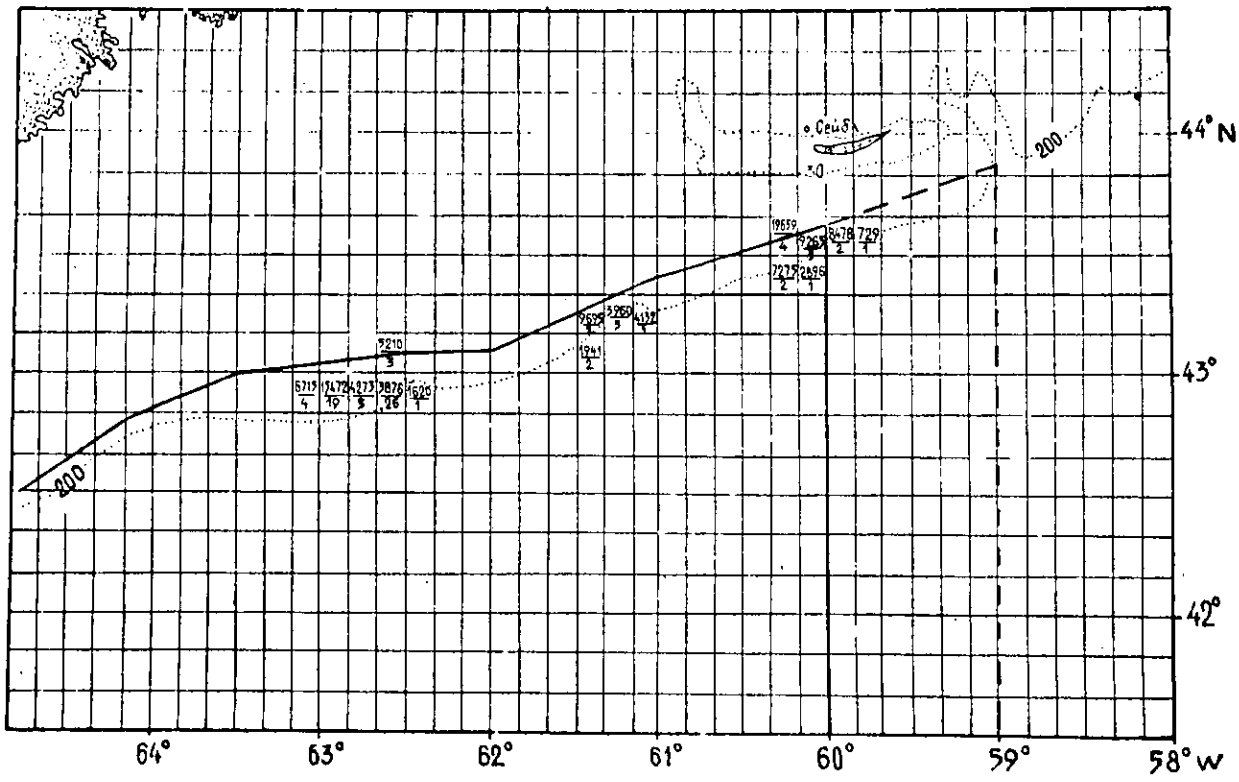

Fig. 4. Silver hake catches per trawling hour (kg) in August 1985.

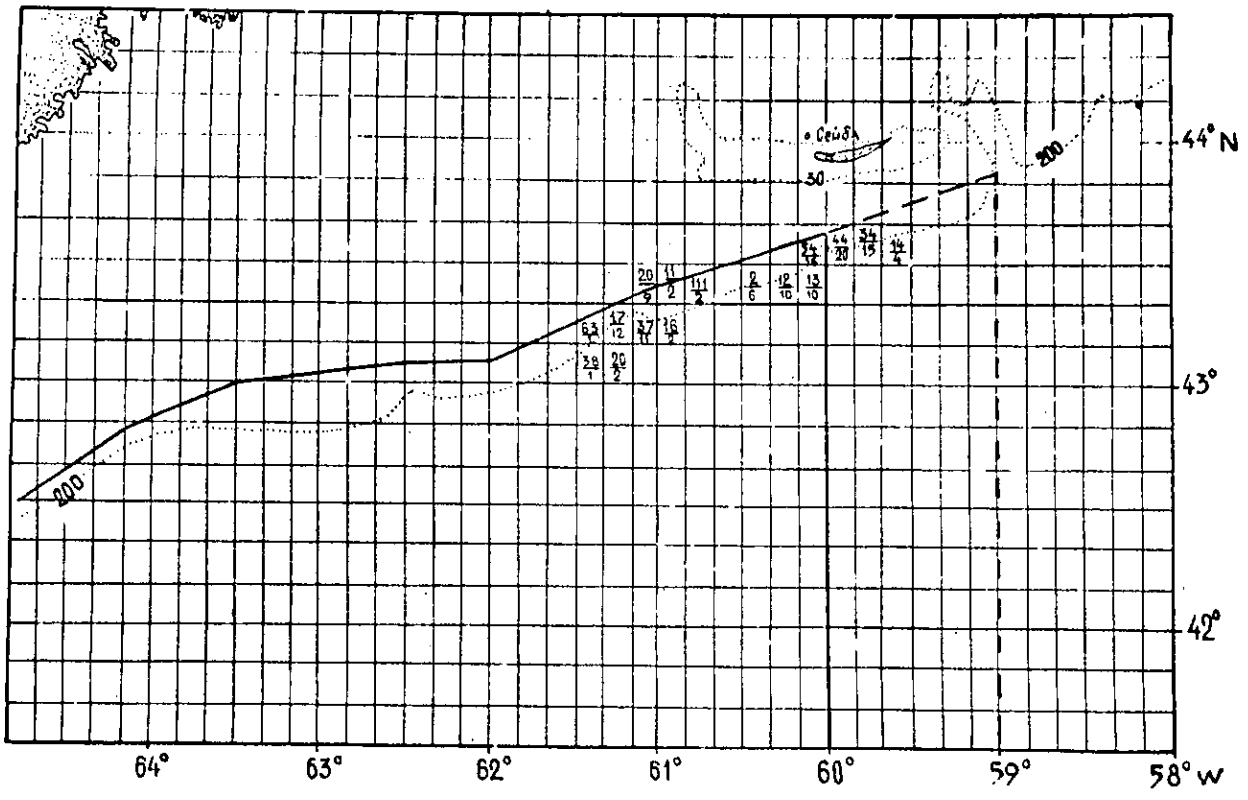

Fig. 5. Haddock catches per trawling hour (kg) in May 1985.

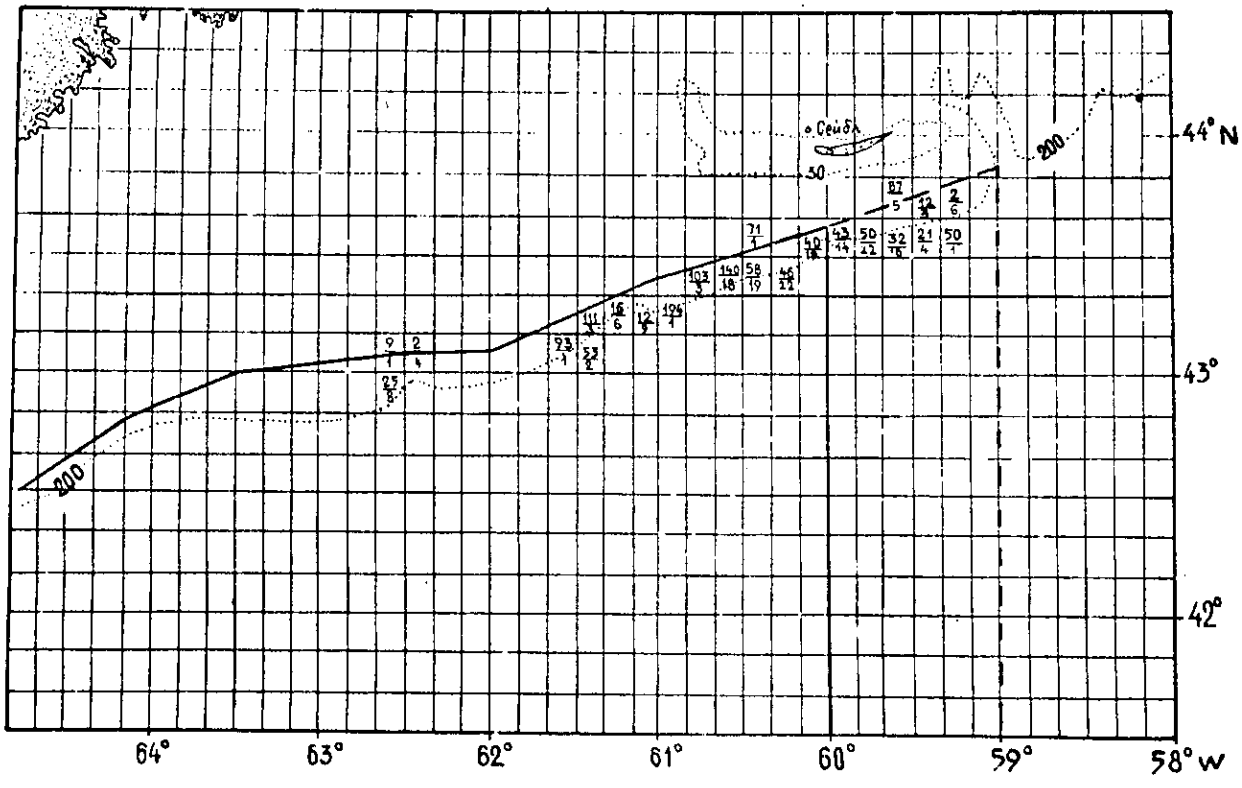

Fig. 6. Haddock catches per trawling hour (kg) in June 1985.

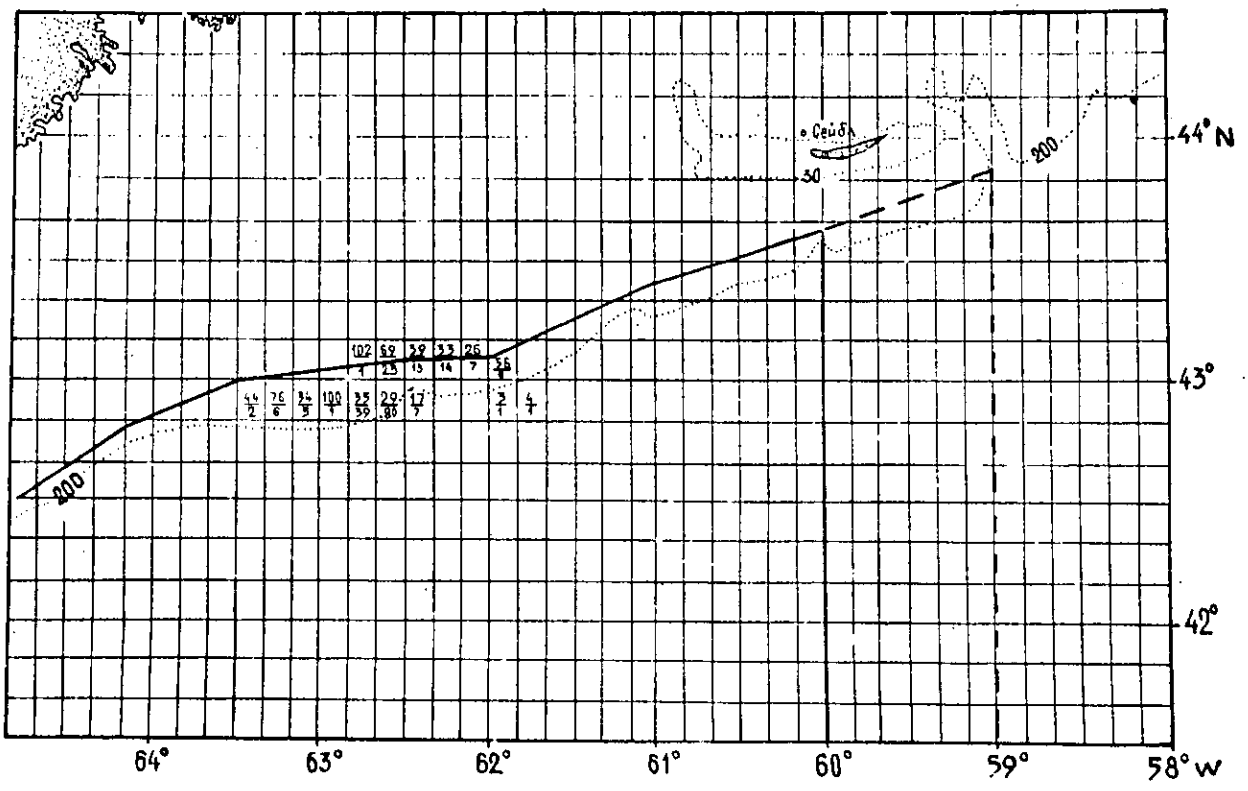

Fig. 7. Haddock catches per trawling hour (kg) in July 1985.

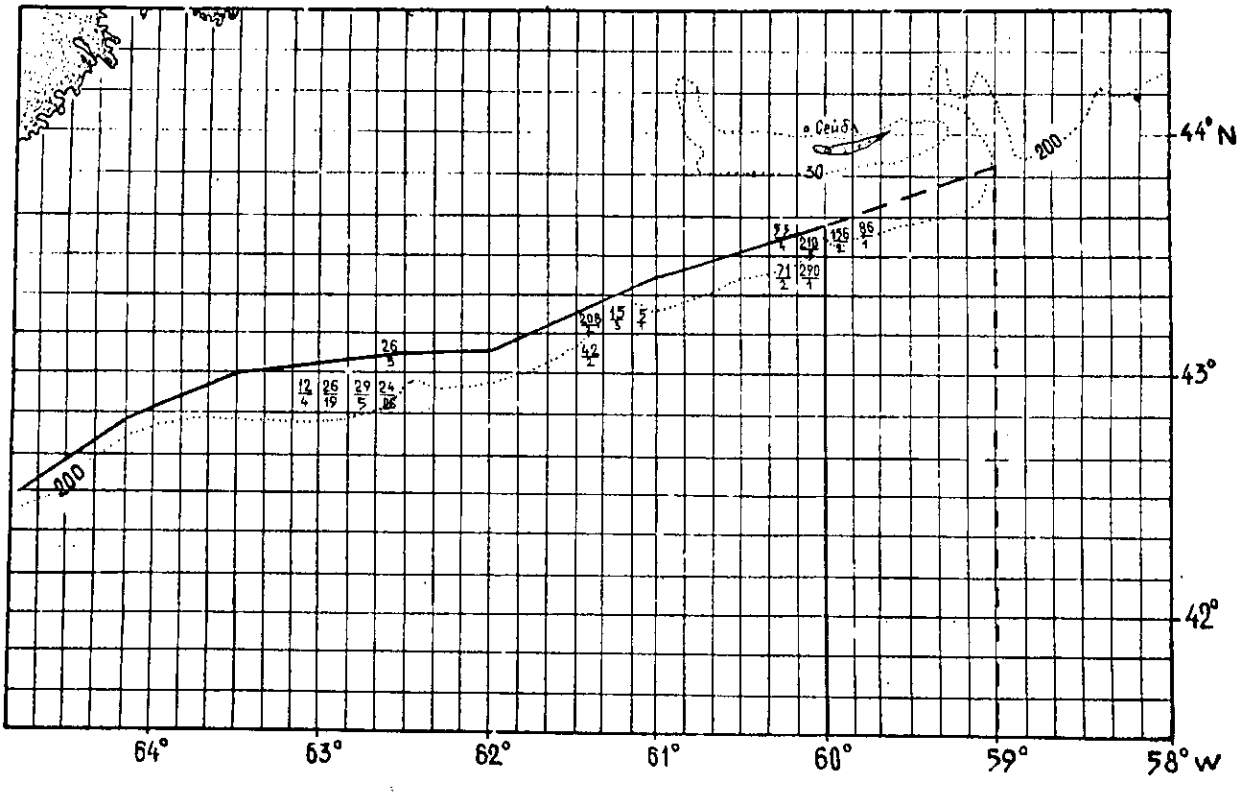

Fig. 8. Haddock catches per trawling hour (kg) in August 1985.

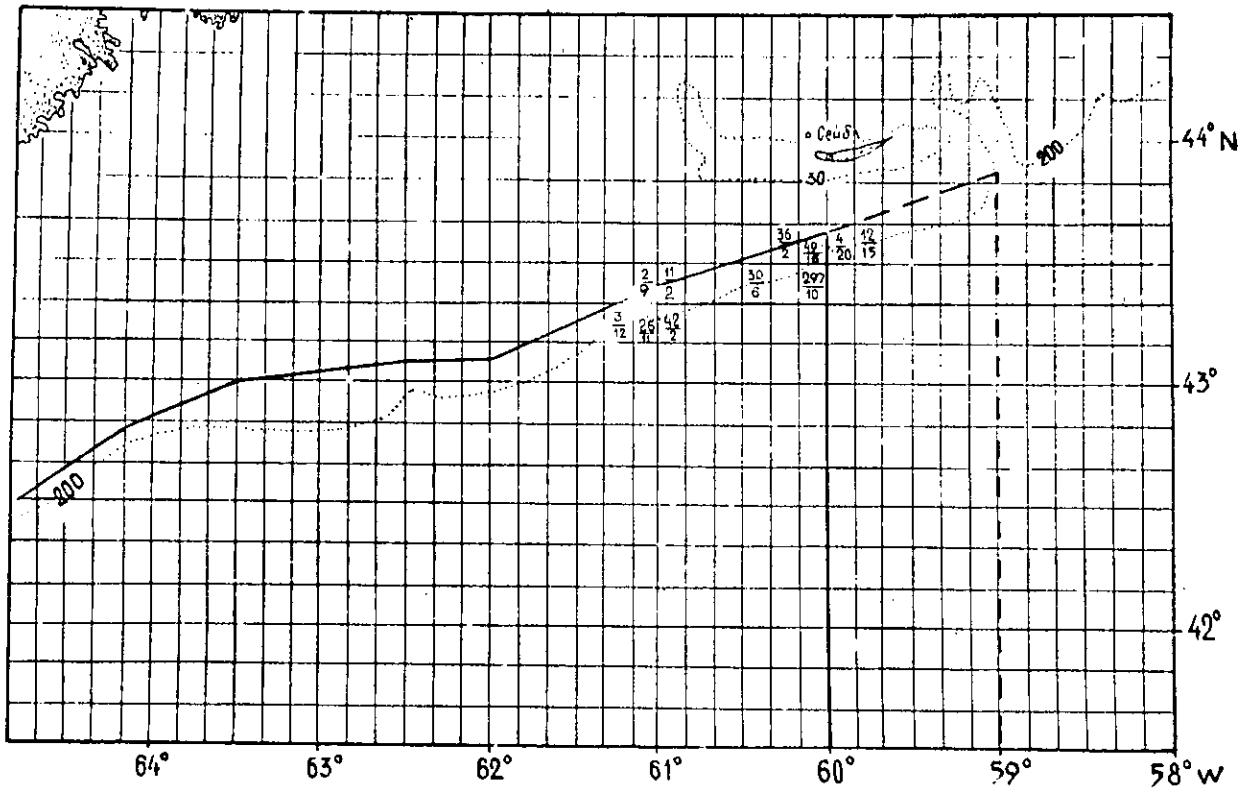

Fig. 9. Saithe catches per trawling hour (kg) in May 1985.

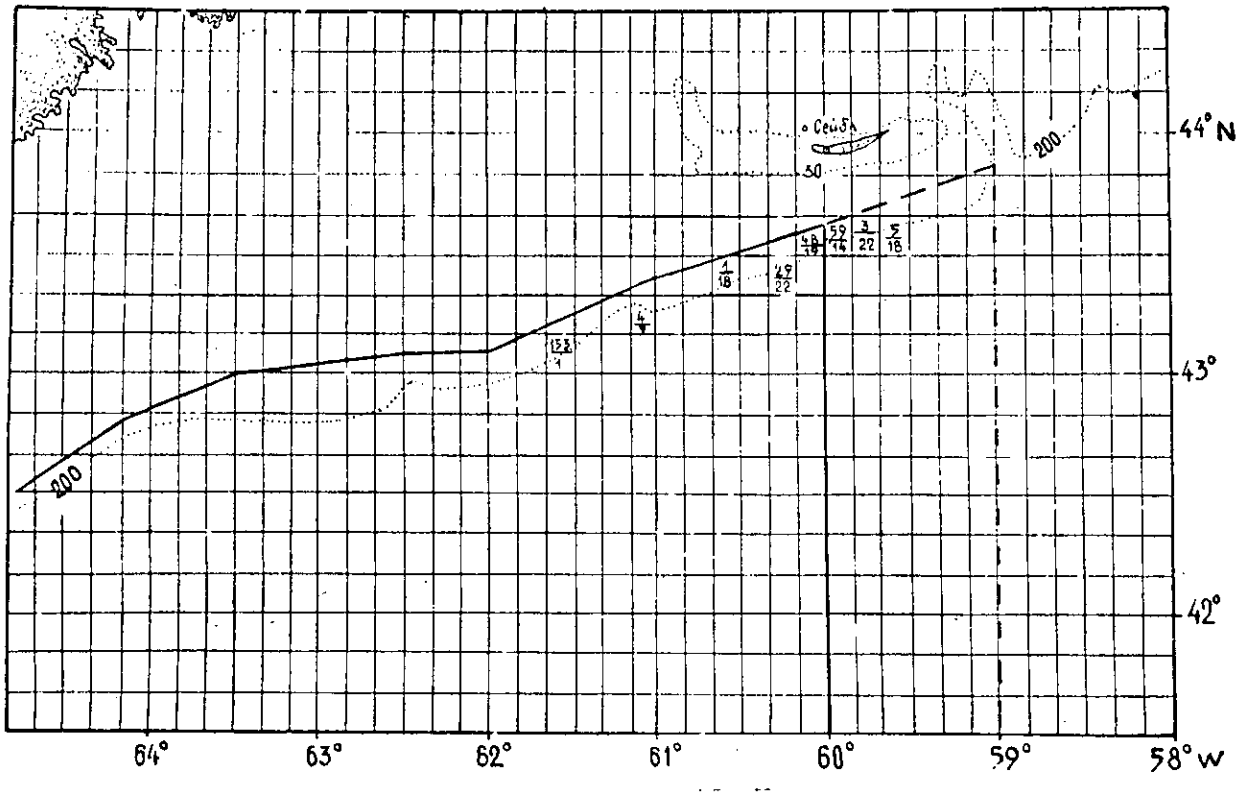

Fig. 10. Saithe catches per trawling hour (kg) in June 1985.

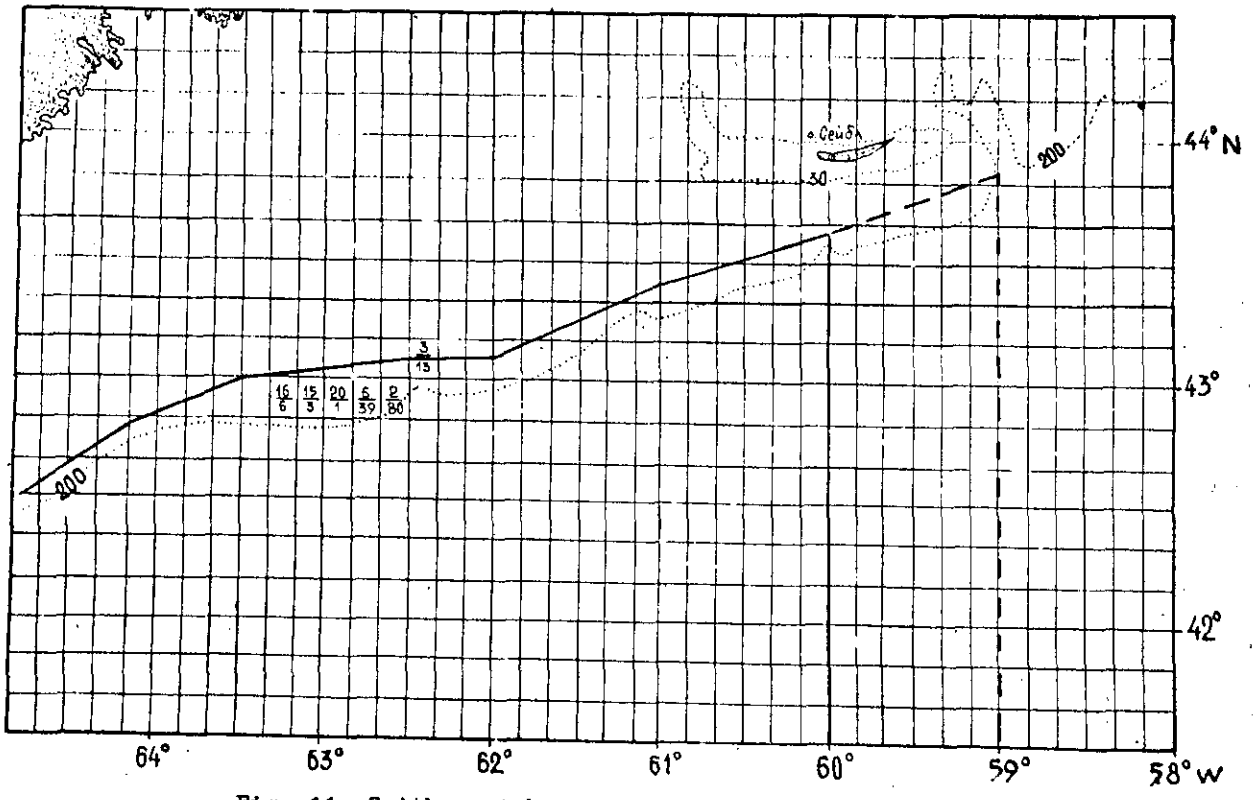

Fig. 11. Saithe catches per trawling hour (kg) in July 1985.

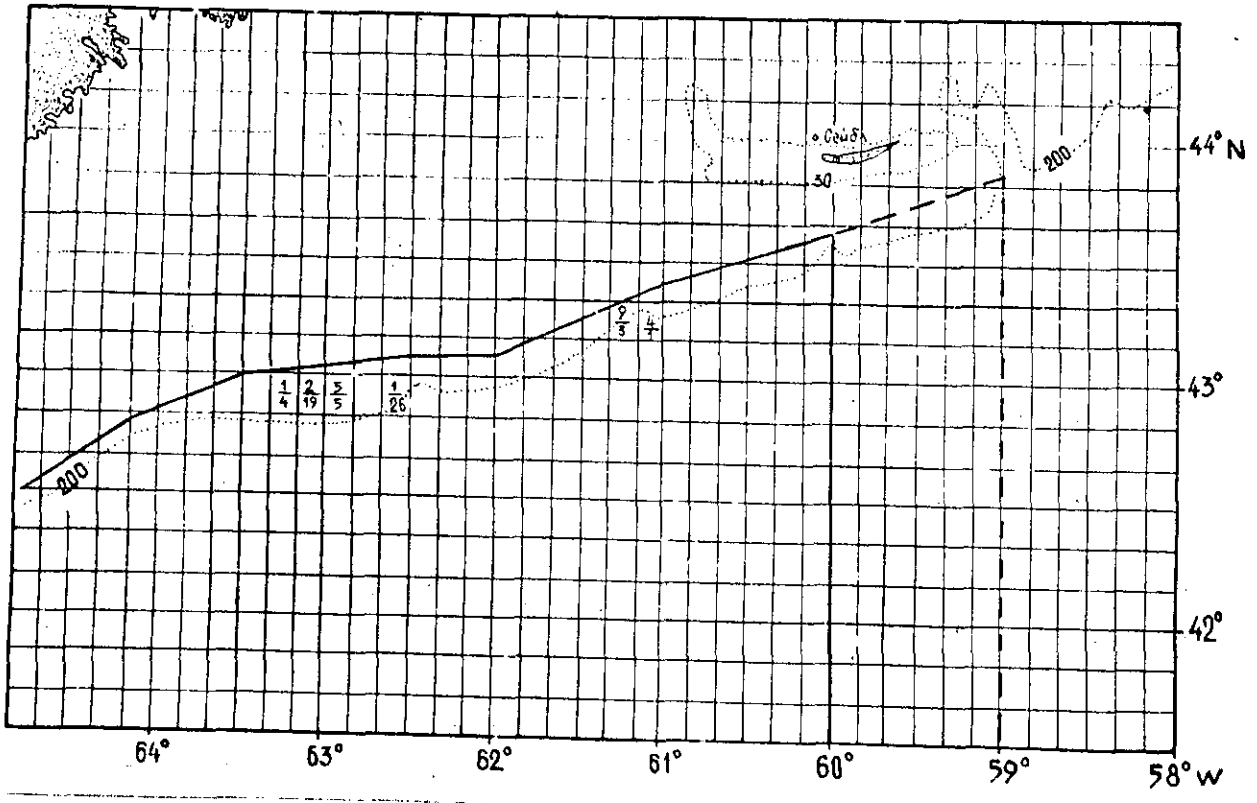

Fig. 12. Saithe catches per trawling hour (kg) in August 1985.

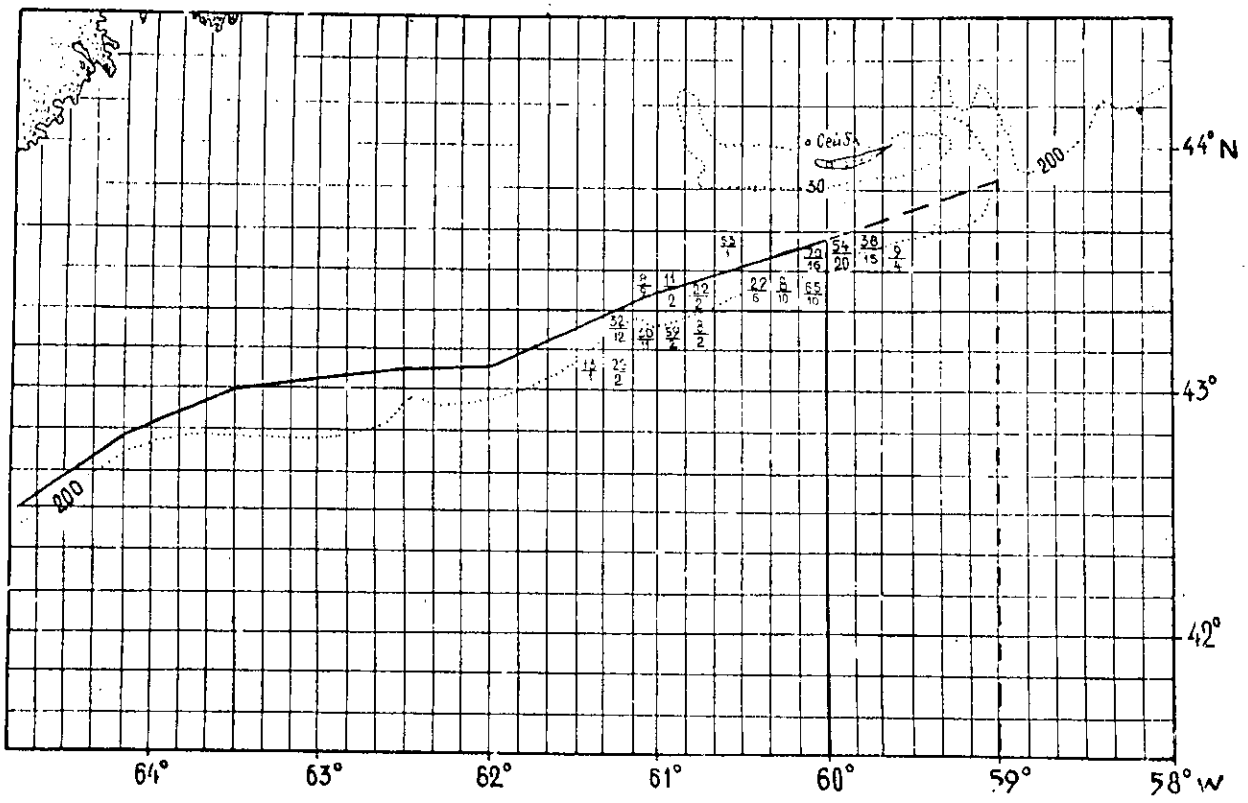

Fig. 13. Urophycis sp. catches per trawling hour (kg) in May 1985.

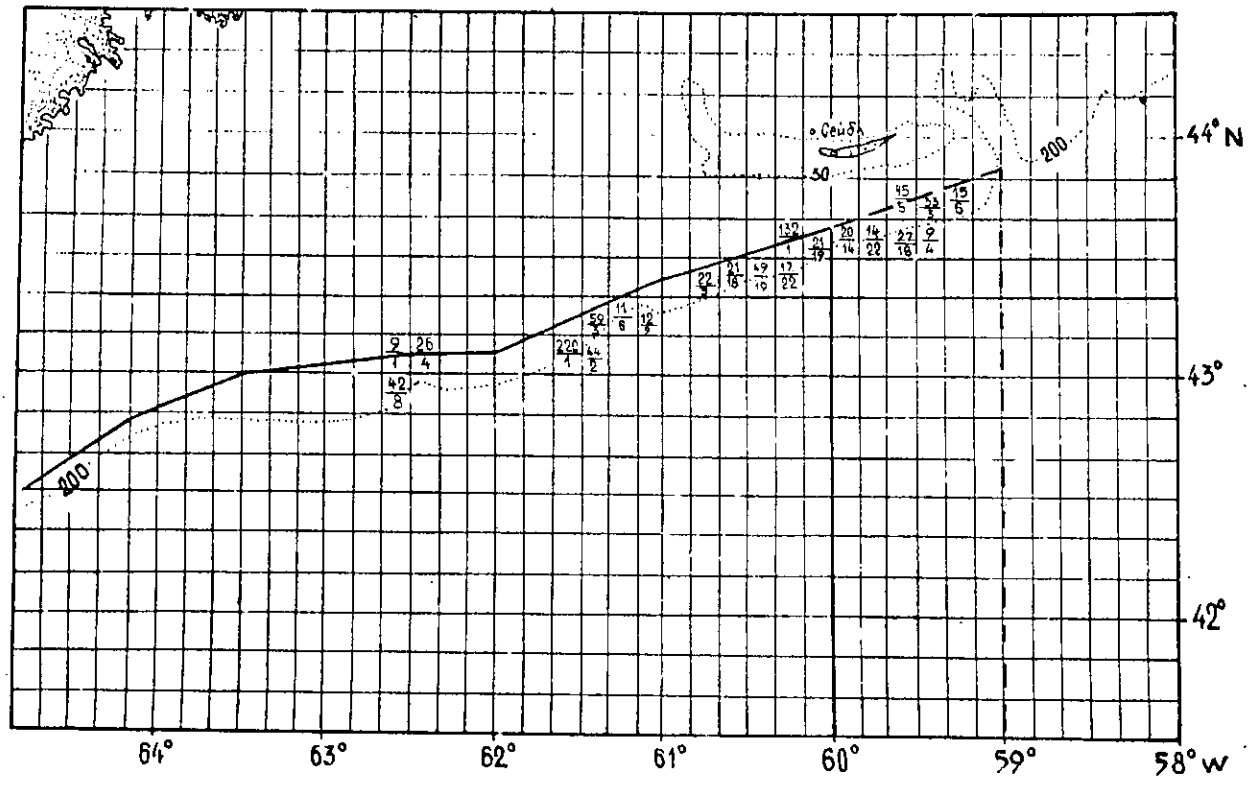

Fig. 14. Urophycis sp. catches per trawling hour (kg) in June 1985.

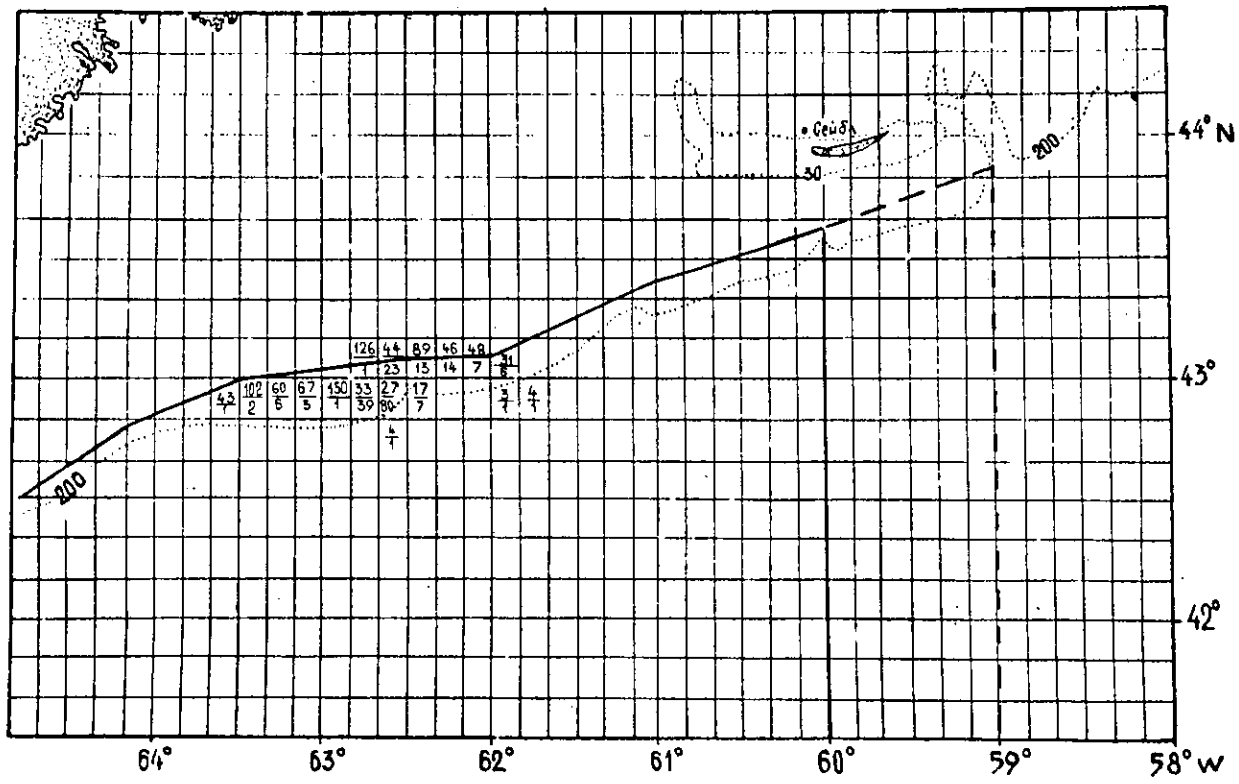

Fig. 15. Urophycis sp. catches per trawling hour (kg) in July 1985.

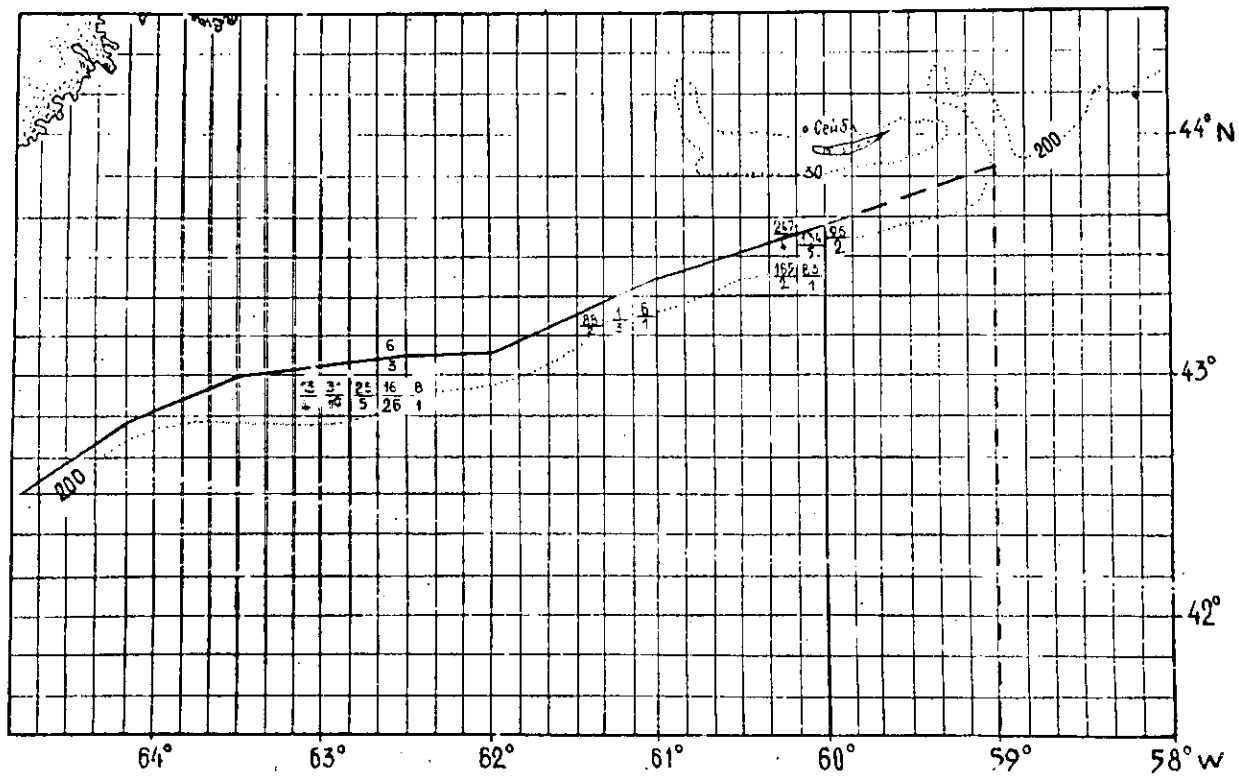

Fig. 16. Urophycis sp. catches per trawling hour (kg) in August 1985.

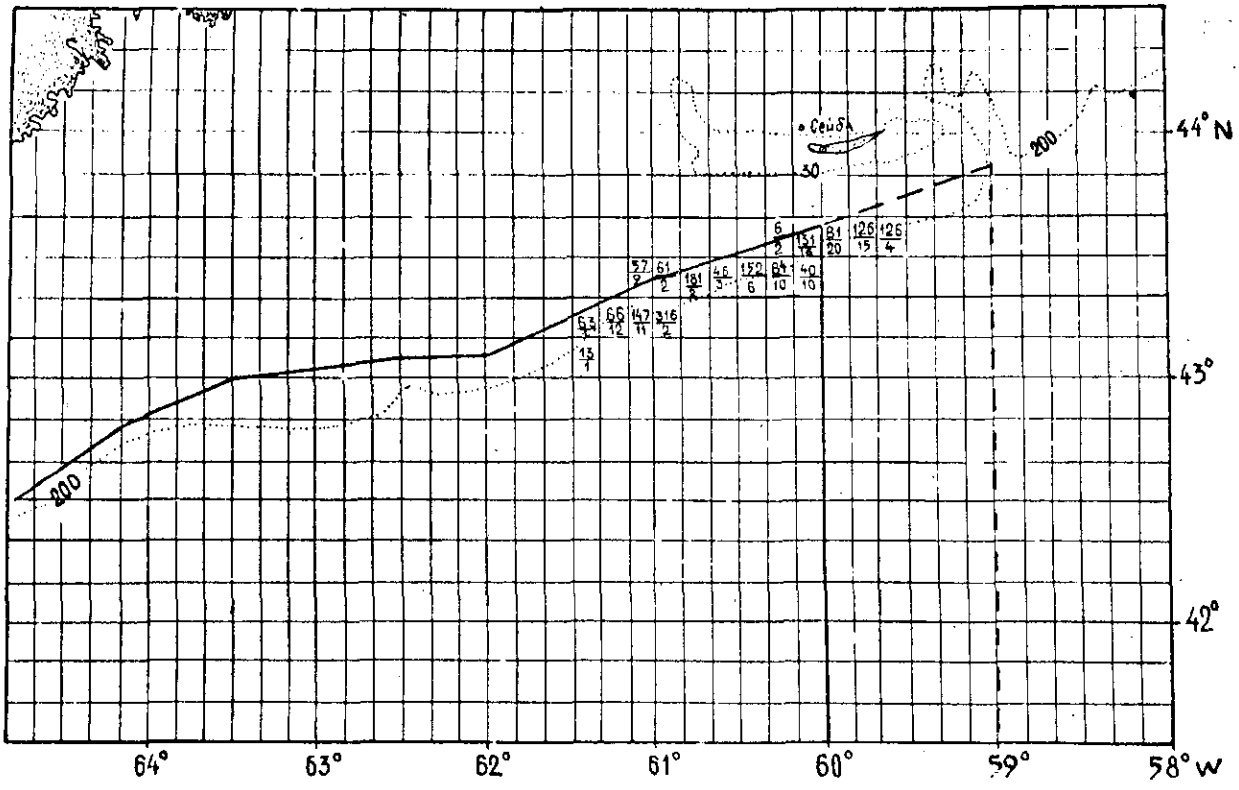

Fig. 17. Mackerel catches per trawling hour (kg) in May 1985.

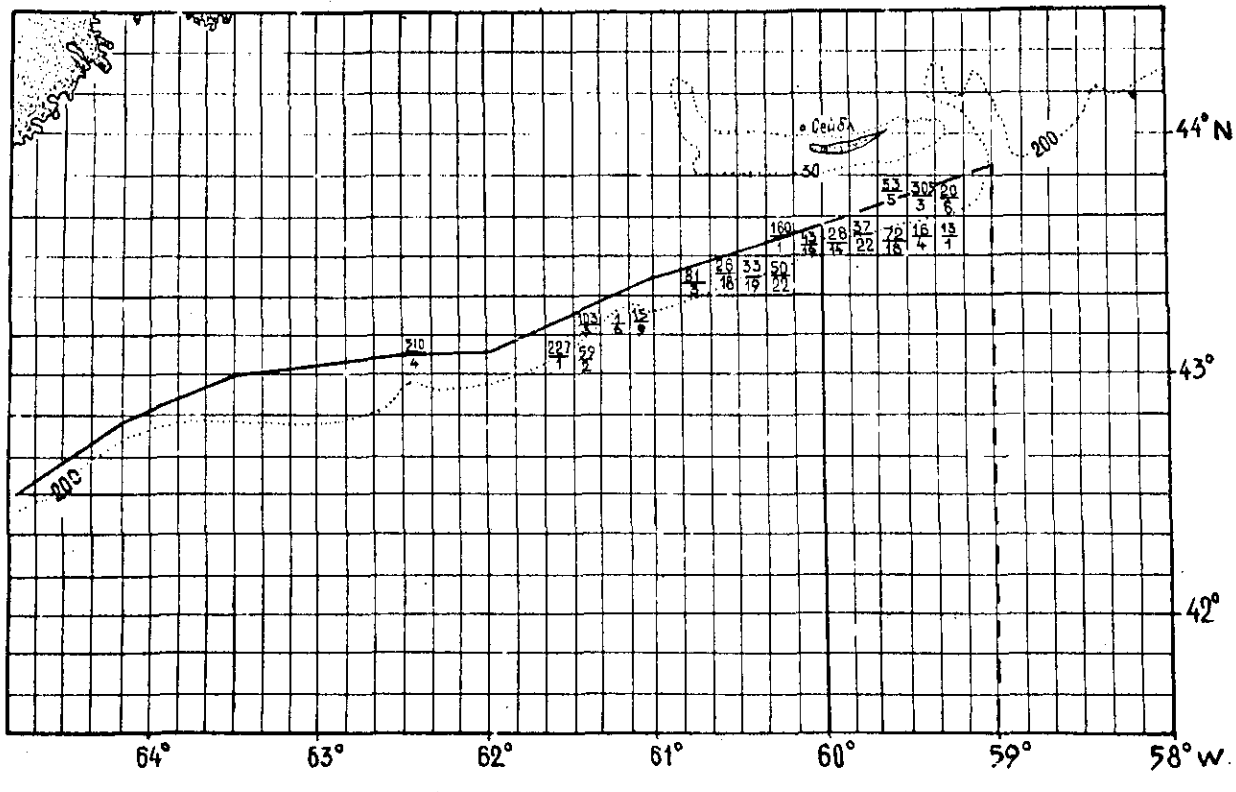

Fig. 18. Mackerel catches per trawling hour (kg) in June 1985.

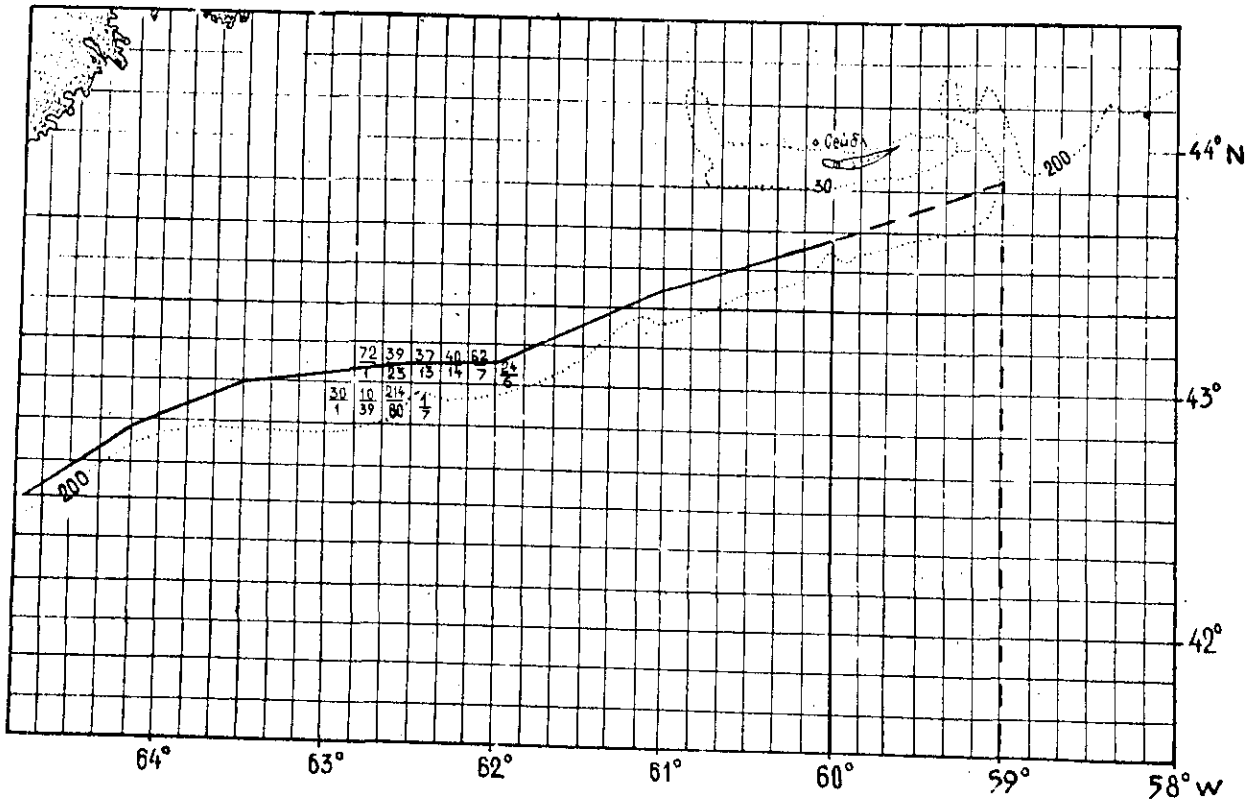

Fig. 19. Mackerel catches per trawling hour (kg) in July 1985.

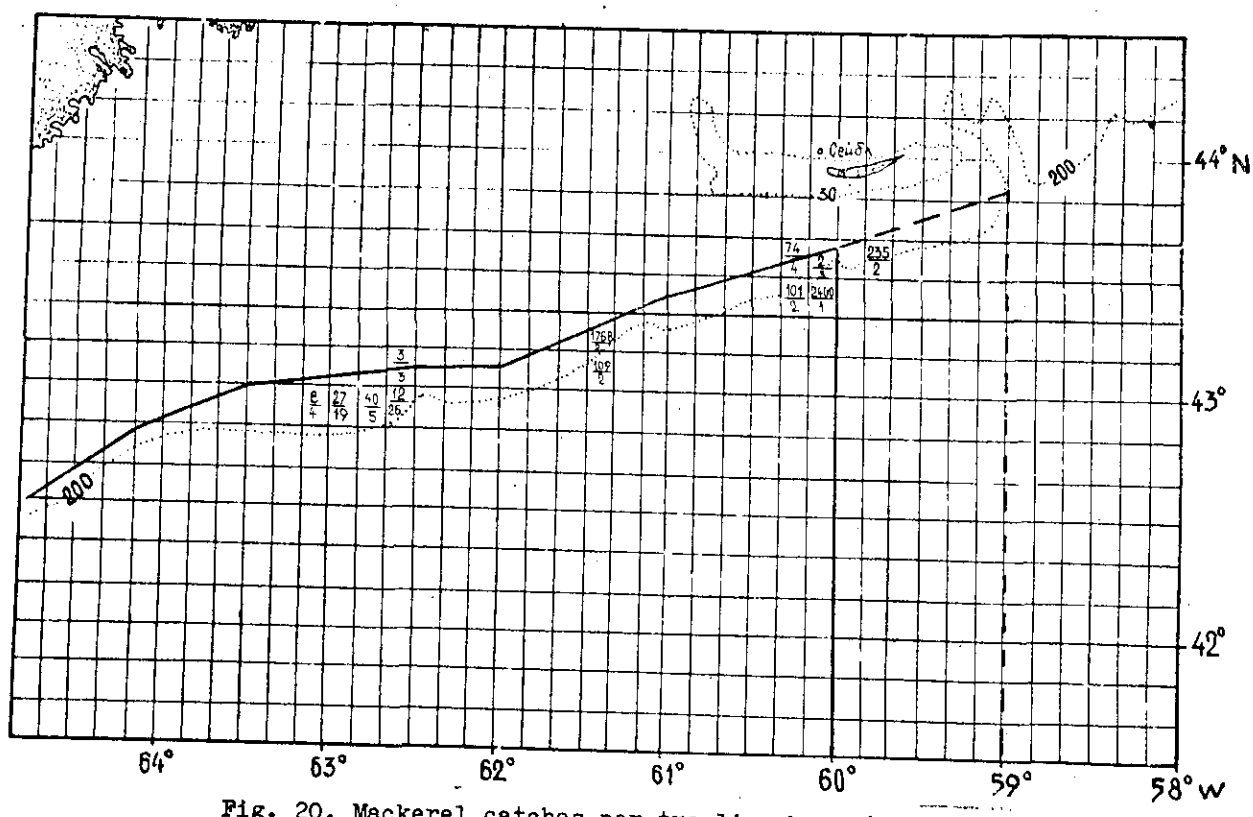

Fig. 20. Mackerel catches per trawling hour (kg) in August 1985.

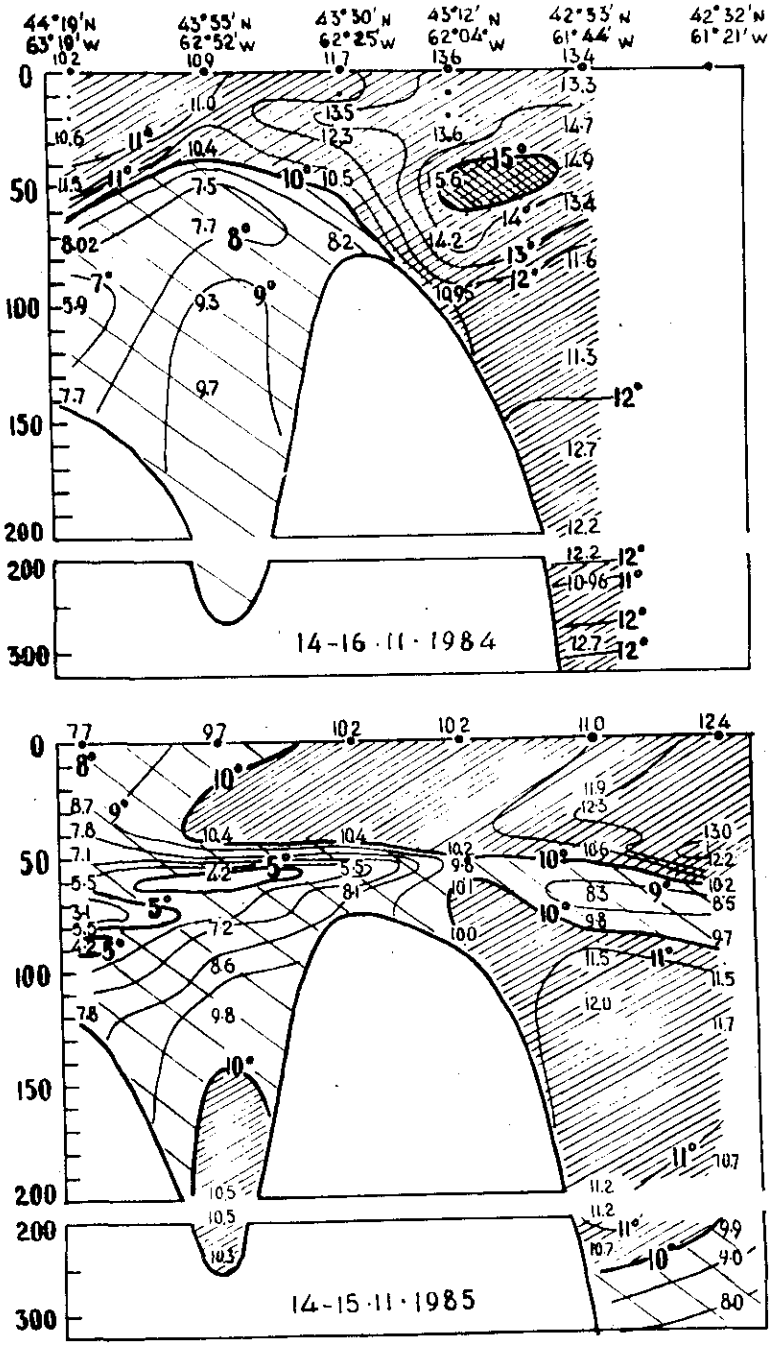

Fig. 21. Water temperature distribution on the Halifax section in November 1984 and 1985.