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International Council for the
Exploration of the Sea

C.M.1977/H:4
Pelagic Fish (Northern) Committee

REPORT OF THE ATLANTO-SCANDIAN HERRING WORKING GROUP

Bergen, Norway, 18-22 April 1977

This report has not yet been approved by the International Council for the Exploration of the Sea; it has therefore at present the status of an internal document and does not represent advice given on behalf of the Council. The proviso that it shall not be cited without prior reference to the Council should be strictly observed.

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1. Introduction and Participation

1.1. Terms of reference

At its Statutory Meeting in Copenhagen 1976, the International Council for the Exploration of the Sea (ICES) decided that "a meeting of the Atlanto-Scandian Herring Working Group should be held in Bergen from 18-20 January to reassess the current state of the Atlanto-Scandian herring stock, with a view to advising NEAFC on future management action for this stock".

In November 1976, it was decided to postpone the meeting, and the Working Group met in Bergen during the period 18-22 April 1977.

In addition to the original terms of reference as stated above, the Working Group was also asked to compile sections of Norwegian spring-spawning herring, Icelandic spring and summer spawners, as well as sections on Barents Sea and Icelandic capelin stocks in relation to new extended national fisheries jurisdiction regimes.

1.2. Participants

Mr J. Hamre	Norway
Mr J. Jakobsson (Chairman)	Iceland
Mr S.H. Jákupsstovu	Norway
Mr I. Røttingen	Norway
Mr Ø. Ulltang	Norway

The absence of participants from other countries than Iceland and Norway was observed with regret.

2. Historical Review

- 2.1. The previous meeting of the Working Group on Atlanto-Scandian Herring was held in 1975. The Working Group considered stock abundance and exploitation of the Norwegian spring-spawning herring based on various data sources for the period back to 1950. The main results may be summarized as follows.
- 2.2. In the mid-fifties, the adult stock was of the order of 10-15 million tons. In the period 1955-1962, the adult stock declined sharply to about 3 million tons, a temporary increase in 1963-1965 to about 5 million tons and from 1966 onwards a drastic decline until the stock was depleted in 1970. No evidence of any improvement in the state of the stock was observed in the early 1970s, except for a small component consisting of the 1969 year class, which matured in 1973.
- 2.3. There are two periods of high catches of adult herring, 1954-57 and 1964-67. These periods coincide with the recruitment of strong year classes, especially those of 1950 and 1959.
- 2.4. The decline in abundance during the period 1955-62 was mainly due to relatively weak year classes recruiting to the spawning stock. The building-up of the stock in 1962-65 was mainly due to recruitment of the 1959 and 1960 year classes. The sharp decline from 1966 onwards was caused by lack of recruitment to the spawning stock and increased exploitation rate.
- 2.5. Recruitment to the adult stock is not indicative of the corresponding 0-group year class strength. Cohort analysis including catches from the small and fat herring fishery (Dragesund and Ulltang, 1975) shows that year classes recorded as very weak

in the adult stock have been considerably strong as 0-group fish. The small and fat herring fishery constituted a heavy exploitation on the immature herring on year classes of average strength or below even in the 1950s. In the period after 1962, all year classes were of average strength or below, and they were more or less fished out completely before they reached maturity.

- 2.6. Since 1960, major changes took place in the distribution and migration of the adult stock. Spawning grounds off western Norway south of Stadt were abandoned and the main spawning was centered farther north, in some years as far north as Lofoten. From 1965 to 1969, the feeding area during summer changed from the north and northeast of Iceland to the area west of Bear Island and Spitsbergen. In recent years, no offshore concentrations of herring have been located, the adult stock having spent most of the year inshore the Norwegian coast and only migrating out of the fjords for spawning in winter and early spring.
- 2.7. The growth rate of herring has increased in recent years. The mean length of herring of the 1969 year class as 5 year olds corresponds to the mean length of 7-8 year olds in the fifties (Figure 9.1). The age at first time spawning is moreover reduced by at least one year.
- 2.8. The Working Group concluded that in view of the extremely low stock level, no fishing either on adult or juvenile herring of this stock should be allowed until there is evidence of a build-up of the adult stock to an acceptable level.

3. Catch Statistics and Age Composition

In the last report, catch statistics are given for the Norwegian spring-spawning stock for the period 1950-71 for the adult component and for 1950-74 for the small and fat herring fisheries. Since there has been no winter or summer fishing for adult herring since 1971, only a summary of these fisheries (not divided by nations) is given in Table 3.1. The table has been updated for 1975 when the catch was only 3 100 tons. In 1976, there was a fishing ban enforced and no recorded catches. The age distribution of the spawning stock is given in Table 3.2.

4. Echo Registration of Herring 1970-77

Since the late 1960s, no oceanic distribution of herring has been recorded. In 1970-72, practically no spawning herring was found on the spawning ground. Some registration of immature herring of the 1969 year class was made in inshore waters from Møre to Helgeland in 1970-71, and off the coast of Troms in the autumn 1972.

In 1973 spawning herring was again recorded off the coast of Møre and Lofoten. The registrations were rather weak, but they indicated a slight renewal of the adult stock, samples mainly consisted of the 1969 year class (Table 3.2.).

The herring migrated into inshore waters after spawning and were recorded during summer in the inner part of Vestfjorden and in the fjords of Møre. The component from Vestfjorden probably migrated southward during autumn 1973 and spawned off Vikna in 1974. In 1975 and 1976, most of the adult herring were found in the fjords from Møre to Helgeland, and migrated into offshore waters during winter for spawning. In the period 1973-76, the registrations of herring on the spawning grounds did not indicate any significant increase in the stock.

In winter 1977, the amount of spawning herring recorded increased considerably. Schools and scattering layers of spawners were located off Møre and Trøndelag in late February and early March.

In late March, schools and scattering layers of spent herring were recorded by the research vessel "G.O. Sars" on the Trøna Bank. The area of distribution was about 3 600 square miles. This is the first time since 1970 that adult herring has been located so far off the coast.

Immature herring of the year classes 1973 to 1976 have been recorded in some of the fjords from Møre to Finnmark. Components of the 1973 year class were distributed in the fjords of Troms and Finnmark, whereas the later year classes have all been distributed further to the south. The areas referred to above are indicated in Figure 4.

5. Larval Surveys 1968-1977

From 1968 to 1972, herring larvae were collected with Clarke-Bumpus plankton samplers with a tube aperture of 13 cm. The mesh size of the nylon nets was 0.5 mm. Two samplers, both equipped with flowmeters, were towed simultaneously at different depths and raised in 5 m steps. The sampling depths were 25-5 m and 50-30 m.

From 1973-76 a modified version of the Gulf III sampler has been used for the herring larvae sampling. The mesh size here was also 0.5 mm. The towing speed has been about 5 knots, and water masses down to 60 m depth have been sampled. The flowmeters have been calibrated, and each year the number of larvae has been converted to the number of larvae pr. m². There has been about the same survey effort each year.

The distribution of herring larvae for the years 1968-76 is shown in Figures 5.1 - 5.9, together with the length intervals and mean length for the larvae.

In the autumn of 1975 and 1976, local fishermen on the Møre coast reported spawning of herring during early autumn. In subsequent larval surveys, a few larvae were collected at various localities at the coast from Møre to Troms.

6. Acoustic Abundance of 0-Group Herring

In October to December 1974 to 1976, abundance surveys of 0-group herring were carried out in coastal waters of western and northern Norway, using an echo integrator system. This technique has been described by several authors, e.g., Nakken and Dommasnes (1975).

The abundance of 0-group herring for 1974-76 are given in Table 6.1. The 0-group strength of the 1974 year class is probably underestimated, because not all areas were surveyed that year. More than 50% of the 1975 year class was recorded in the Trondheimsfjord. In the autumn of 1976, dense concentrations of I-group herring were found in that area, and the herring had a considerably slower growth rate than observed in other areas. This may result in delayed recruitment of this year class to the adult stock. In 1976, 0-group herring was recorded in the Barents Sea (Anon. 1976). This component is not included in the estimate given in Table 6.1.

7. Tagging

7.1. The tagging project

In the spring 1975 and 1976, 64 834 herring have been internally tagged and released at various localities along the north Norwegian coast. The tagged herring have been released from purse seine catches using the same technique as applied in

previous tagging experiments. The tagged fish were measured in length, and converted to age by age-length keys. Details on the release are given in Table 7.1.

7.2. Recoveries

No commercial fishing for herring in the area north of 62° north has been allowed since the end of 1975. Some recoveries have, however, been reported from local fishermen who are allowed to fish herring for their own consumption. Recoveries have also been obtained from reduction plants, which have reduced herring (and offals from herring fillets production) caught in the North Sea. Eight of these have been reported from Denmark and three from the United Kingdom. These sporadic recoveries are not related to corresponding catch data, and can therefore only be used as an indication of migration. Tagging locality and likely area of recapture are shown in Figure 7.1.

Internal tags have previously been retained in reduction plants. In view of the present state of the stock, no herring may be used for reduction in the years to come. A new tag indicator retaining internally tagged fish has therefore been developed.

In 1977, the Institute of Marine Research, Bergen, was allowed to fish 5 000 hl (465 tons) of herring during the spawning season in order to sample the spawning stock for tagged herring. The recoveries obtained have given information on the biological state of the fish carrying the tag, distribution and migration of the herring and some indication on the abundance of the spawning stock. The fishing was carried out by a chartered fishing boat equipped with purse seine and pelagic trawls.

370 tons of herring were caught and 17 tagged herring were recovered. Details on release-recapture localities are given in Figures 7.2 and 7.3; the recoveries and corresponding catch in weight and number by locality and age groups are shown in Tables 7.2a and 7.2b.

7.3. Results

7.3.1. The condition of the recovered tagged herring

The herring carrying the tags have been examined with respect to age, length/weight relationship, sex and maturity stage. Table 7.3 shows a comparison of the weight of tagged and untagged herring of the same sex, length and maturity stage. The Table shows that the individual weight of the tagged herring is significantly smaller than in the sample of individuals drawn from the untagged population. The marking operation thus affects the condition of the tagged fish in a long period after release. This reduced growth rate is also reflected in the length distribution of the recovered tagged fish (Table 7.4a). This reduced growth must therefore have delayed the maturing of the tagged herring compared to the untagged population.

The 17 recoveries in Table 7.2 are all from the 1973 year class or older fish. The catch of the 1974 year class amounts to 344 000 individuals, the number of releases being 14 622 (Table 7.1). The absence of recoveries from the 1974 year class is most likely caused by the reduced growth of the tagged fish, i.e. that a tagged herring may not be expected to spawn as a 3-year-old fish.

The same phenomenon may apply to the slow-growing 4-year-old herring in the north. This may explain the reason why no recoveries are obtained from the releases in Troms and Finnmark.

Selection by size also occurs in the recoveries from the releases further south. Table 7.4 shows the number of releases and corresponding recoveries by cm-groups from five localities, excluding the 1974 year class. It is seen that no recoveries are obtained from herring less than 21 cm when released. It is also observed that the rate of recoveries pr. 1 000 releases is higher in the length groups above 24 cm than in the range 21-24 cm.

7.3.2. Migration

The migration of the tagged herring is illustrated in Figures 7.1 - 7.3. The figures show that the herring have moved southward during the last 2 years. The herring from the Helgeland - Lofoten area have moved to the spawning grounds off the northern part of Møre and Trøndelag. The herring distributed in the Møre - Trøndelag area have also moved southward, and a part of this stock have even migrated into the North Sea. The relatively high rate of recoveries in the catch taken off Ullsteinfjord and Grasøyane indicates, however, that this southern component has been rather small (Table 7.2a).

Tagged herring released in Troms and Finnmark have not been recovered. This northern component consists of the most slow-growing herring, and these are expected to spawn as recruit spawners in the Lofoten area in April-May. According to echo registration in the winter of 1976/7, this component is expected to be rather small. It is therefore concluded that the bulk of the adult stock has spawned on the grounds between Grip and Nordøyane in early March 1977, a smaller component has spawned on the coast of Møre in the second half of February (spawning herring have also been recorded south of Stadt), and a third component consisting of the most slow-growing herring of the 1973 year class may migrate to the Lofoten area for spawning later in the season.

7.3.3. The state of the spawning stock

The Working Group agreed that the results of the tagging experiments as yet were too preliminary to be used for stock abundance calculations. However, taking into account the reduced growth and the delayed maturity of the tagged herring, the data indicate an abundance level of the spawning stock in 1977 in an order of 200 000 tons.

8. Spawning Stock 1973-77 and Prognoses for 1978 and 1979

The spawning stock in number by age for 1977 was estimated from an assumed spawning stock in weight of 200 000 tons, and the age composition and weight at age data. The spawning stock in number by age for 1973-76 was estimated from back-calculations of the 1969 year class and the age composition of the spawning stock in the various years. Spawning stock in weight was calculated from the estimated stock in number by age and weight at age data for each year. In the back-calculation, the total mortality Z was assumed to be 0.2, i.e. slightly higher than the natural mortality of 0.16 used in previous reports.

The spawning stock for 1978 and 1979 was calculated from the stock in 1977 and estimates of the 1975 and 1976 year class from acoustic 0-group surveys. In this calculation, $M = 0.16$ and $F = 0$ were used. Recruitment to the spawning stock was set as 50% for the 3-year-old herring and 100% for the older.

The resulting spawning stock sizes in number and weight for 1973-79 are shown in the text table on the next page.

Spawning stock in number and weight

Year	N x 10 ⁻⁶							Spawning stock in weight	% increase from 1973
	Age								
	3	4	5	6	7	8	9		
1973	18	289	9	14	6	3	5	93	
1974	6	21	237	3	2	1	1	71	- 23.6
1975	44	4	6	194	1	1	1	81	- 12.9
1976	237	57	1	3	159	1	-	124	33.3
1977	173	413	23	-	-	130	-	200	115.1
1978	934	295	352	20	-	-	110	432	364.4
1979	1 380	1 594	251	299	16	-	94	895	862.1

9. Recruitment Potential

In Table 9.1, estimates of 0-group strength are given for the year classes 1950-1969 and 1973-76. The numbers of 4-year-old herring of the year classes 1950-69 and the number of 3-year-old herring of the year classes 1973-76 are also given. The estimates for the year classes 1950-69 are the VPA values given by Dragesund and Ulltang (1975) with some small adjustment for the 1967-69 year classes. The figures for the 1973-76 year classes are based on the stock size table given in Section 8.

Although the number of 0-group herring of the later year classes are low compared to earlier periods, Table 9.1 shows that the recruitment rate to the adult stock is strongly improving. The increased growth rate of the 1969 year class is illustrated in Figure 9.1. Later year classes also have a similar growth rate. This has resulted in earlier maturing. Therefore, the relation between the recruitment to the adult stock during the period 1950-70 and the present recruitment is best illustrated by comparing the number of 4 year olds in the earlier period and the number of 3 year olds at present. It is seen that the 1975 and 1976 year classes probably will recruit to the spawning stock in about the same number as the 1952, 1953 and 1961 year classes did, and those year classes were of average strength, or above, as 0-group. Thus, the very high recruitment potential of this stock, which in earlier periods was suppressed by the heavy fishing on young herring, may lead to a rapid rebuilding of the stock, if the young herring are not exploited.

10. Conclusions

- 10.1. The spawning stock of the Norwegian spring spawners was almost depleted in 1970-1. During this period, practically no spawning herring were found on the spawning grounds, the larval production was nearly zero and the corresponding year classes are absent in the present spawning stock.
- 10.2. After 1972, there has been a renewal of the spawning stock. This was due to the fact that a component of the 1969 year class survived the small and fat herring fishery and matured in 1973 as 4-year-old fish, i.e. one year earlier than normal.
- 10.3. As shown in the table in Section 8, the abundance of the 1973 year class as 4-year-old fish is about 20% higher than that of the parent stock in 1973. During the period 1973-77, the total biomass of the spawning stock has more than doubled. These are relative estimates and therefore independent of the absolute stock abundance.

- 10.4. The data on present stock abundance from the tagging and 0-group surveys are preliminary. Taking into account, however, all available information, the Working Group agreed that the abundance of the spawning stock is in the order of 200 000 tons.
- 10.5. The prognoses on stock size in Section 8 shows that in spite of relatively low 0-group abundance, there will be a rapid increase in the stock size if there is no exploitation of the stock.
- 10.6. Although the spawning stock size has increased in 1976-77, it should be stressed that it is still at an extremely low level compared with former periods, as shown in Figure 8.1.

In Figure 8.1. the spawning stock size for the whole period 1950-77 is plotted. The figures from 1950-71 are taken from Dragesund and Ulltang (1975).

11. REFERENCES

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- ANON., 1976. Preliminary report of the international 0-group fish survey of the Barents Sea and adjacent waters in August-September 1976. ICES, C.M.1976/H:43, pp.1-5 (mimeo).
- DRAGESUND, O. and ULLTANG, Ø., 1975. Stock size fluctuations and rate of exploitation of the Norwegian spring-spawning herring, 1950-74. ICES, C.M.1975/H:47, pp.1-26 (mimeo).
- NAKKEN, O. and DOMMASNES, A., 1975. The application of an echo integration system in investigations on the stock strength of the Barents Sea capelin (Mallotus villosus, Müller) 1971-74. ICES, C.M.1975/H:25, pp.1-13 (mimeo).

Table 3.1. Catches (in thousand tons) of Norwegian spring-spawning herring during the period 1950-76.

Year	Winter herring	Summer and autumn herring	Total adult herring	Small and fat herring	Grand total
1950	771.3	54.8	826.1	106.9	933.0
1951	889.3	104.9	994.2	284.2	1 278.4
1952	829.4	89.8	919.2	335.6	1 254.8
1953	678.6	171.3	849.9	240.7	1 090.6
1954	1 119.1	187.3	1 306.4	338.1	1 644.5
1955	1 004.4	213.1	1 217.5	142.3	1 359.8
1956	1 192.8	267.8	1 460.6	198.8	1 659.4
1957	856.5	291.8	1 148.3	171.2	1 319.5
1958	429.1	355.9	785.0	201.6	986.6
1959	510.2	372.9	883.1	228.0	1 111.1
1960	401.0	420.1	821.1	280.7	1 101.8
1961	146.3	351.6	497.9	332.2	830.1
1962	133.5	417.7	551.2	297.4	848.6
1963	132.8	538.0	670.8	313.7	984.5
1964	420.2	697.7	1 117.9	163.9	1 281.8
1965	391.2	934.6	1 325.8	221.9	1 547.7
1966	631.8	1 091.7	1 723.5	231.5	1 955.0
1967	458.8	672.7	1 131.5	545.7	1 677.2
1968	44.8	228.3	273.1	439.1	712.2
1969	20.5	3.6	24.1	43.7	67.8
1970	20.9	-	20.9	41.4	62.3
1971	6.9	-	6.9	14.2	21.1
1972	-	-	-	13.2	13.2
1973	-	-	-	6.8	6.8
1974	-	-	-	6.3 ¹⁾	6.3 ¹⁾
1975	-	-	-	3.1 ¹⁾	3.1 ¹⁾
1976	-	-	-	-	-

1) The catch in 1975 consists of adult and juvenile herring caught in Norwegian inshore waters during autumn.

Table 3.2. Atlanto-Scandian herring. Age composition of the spawning stock in 1973-77.

Year \ Age	3	4	5	6	7	8	≥9
1973	5.1	84.4	2.5	4.1	1.7	0.7	1.5
1974	2.1	7.8	87.8	1.0	0.9	0.2	0.2
1975	17.5	1.8	2.2	77.5	0.2	0.3	0.5
1976	51.8	12.4	0.1	0.6	34.7	0.4	0
1977	23.4	55.9	3.1	0	0	17.6	0

Table 6.1. Abundance ($N \times 10^{-6}$) of 0-group herring in 1974-76.

Year	Area			Total
	Møre, Trøndelag	Nordland	Troms, Finnmark	
1974	50	249	31	330
1975	1 933	692	55	2 680
1976	440	2 610	750	3 800

Table 7.1. Number of herring tagged in 1975 and 1976, divided into year classes.

Year	Year class			Total
	1972 and older	1973	1974	
1975	5 788	27 106	5 049	37 943
1976	1 032	16 286	9 573	26 891
Total	6 820	43 392	14 622	64 834

Table 7.2.a Total catch in weight and number by area and age groups, and corresponding tag recoveries.

	C tonnes	C _N in numbers x 10 ⁻³				Σ C _N	R ₁₉₇₅	R ₁₉₇₆
		1974	1973	1972	1969			
Islendingen	12.2	16	34		5	55	1	
Nordøyane	82.7	45	195	13	61	314	3	1
Sula	144.2	78	296	28	140	542	3	1
Grip	104.5	193	236		33	462	2	1
Total	343.6	332	761	41	239	1 373	9	3

Table 7.2.b Total catch in weight and number by area and age groups, and corresponding tag recoveries.

	C tonnes	C _N in numbers x 10 ⁻³				Σ C _N	R ₁₉₇₅	R ₁₉₇₆
		1974	1973	1972	1969			
Ulsteinfjord	20.0	12	57	4	6	78	4	0
Grasøyane	8.8	5	25	2	3	35	1	0

Table 7.3. Weight comparison between tagged and untagged herring of the same length, sex and maturity stage.

Length cm	Tagged			Untagged
	Weight g	Sex	Maturity stage	\bar{W}
30.0	180	1	7	197
30.5	190	1	5	213
30.5	180	1	5	213
31.0	200	2	6	218
31.0	200	1	6	230
31.0	220	2	5	225
31.0	230	1	5	220
32.0	220	2	7	228
32.0	225	2	4	263
32.0	215	1	7	210
32.0	230	1	5	255
32.0	260	1	5	255
32.5	230	2	7	250
33.0	305	1	5	270
33.5	270	1	5	313
33.5	285	1	4	310
Mean weight	227.5			241.8

Table 7.4a Number released by length of 2-year-old fish and older in 1975 and the corresponding length at the release for the recaptured fish.

Gavelfjord - Haltefjord

Length cm	No. released	Σ No.	Recaptures
17			
18	40	18 055	
19	300	18 015	
20	1 222	17 715	
21	2 323	16 493	2
22	2 505	14 170	1
23	2 503	11 665	
24	2 503	9 160	1
25	6 659	6 659	5

Table 7.4b

Altafjord - Jøkelfjord

Length cm	No. released	Σ No.	Recaptures
16	159	7 984	
17	718	7 825	
18	1 357	7 107	
19	1 677	5 750	
20	1 837	4 073	
21	1 757	2 236	
22	399	479	
23	80	80	
24	0		
25	0		

Table 9.1. Stock size in numbers ($N \times 10^{-6}$) of 0-group herring of the year classes 1950-1969 and 1973-1976 and as 4-year-olds for the year classes 1950-1969 and as 3-year-olds for the year classes 1973-1976.

Year class	Stock size as 0-group	Stock size as 4-year-olds (Year classes 1950-1969) and 3-year-olds (Year classes 1973-1976)
1950	97 375	41 687
1951	26 081	6 043
1952	27 910	2 852
1953	20 973	2 637
1954	16 878	490
1955	9 188	450
1956	11 098	130
1957	9 725	103
1958	13 728	176
1959	74 965	16 297
1960	47 478	5 552
1961	18 327	1 747
1962	7 242	91
1963	26 264	5 185
1964	17 305	1 987
1965	3 560	4
1966	17 334	27
1967	1 262	21
1968	2 595	11
1969	1 971	289
1973	919	(504)
1974	630	(346)
1975	(3 273)	(1 868)
1976	(4 641)	(2 760)

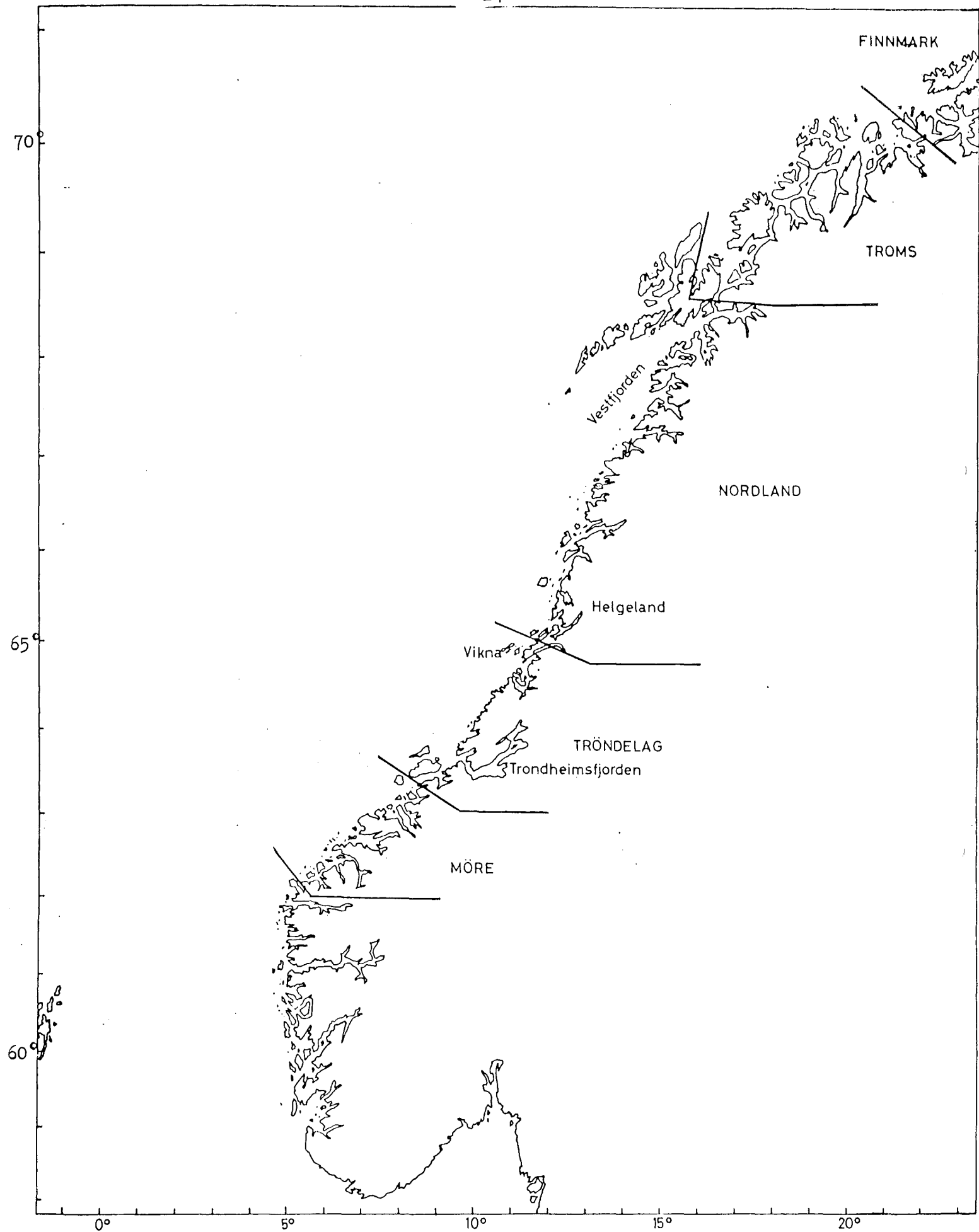


Figure 4. Norwegian west coast areas.

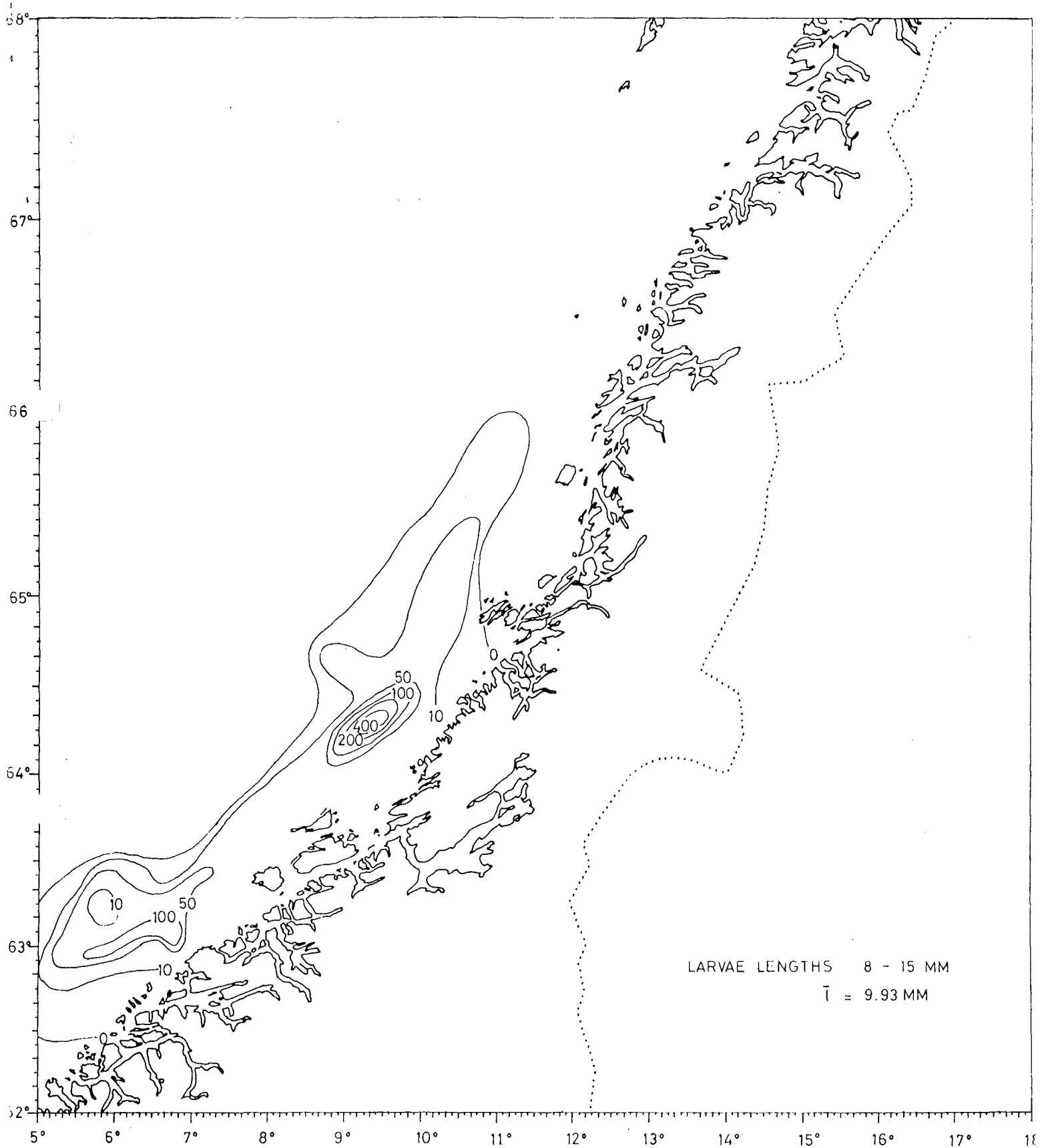


Figure 5.1 Distribution of herring larvae in 1968

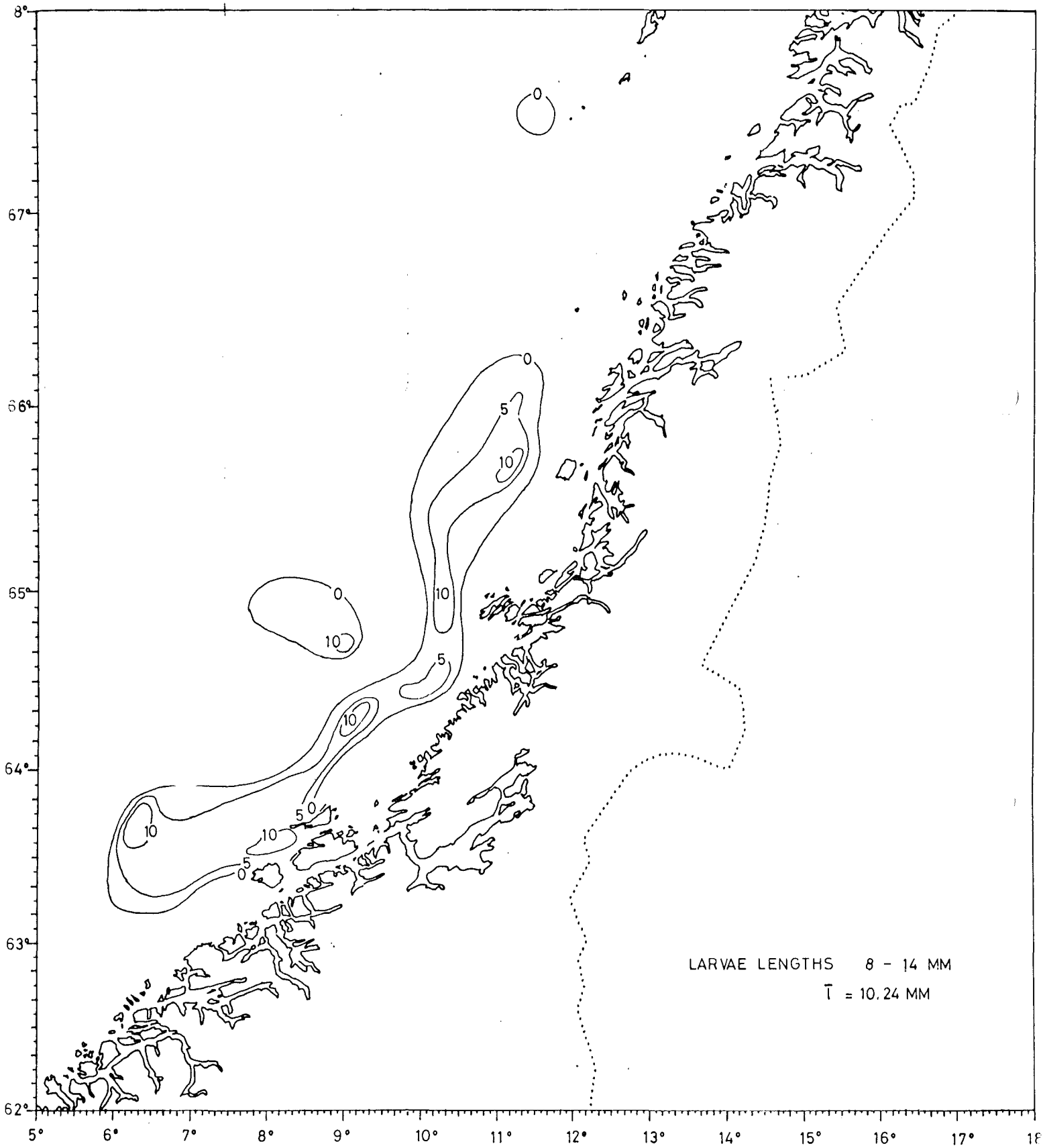


Figure 5.2

Distribution of herring of larvae in 1969

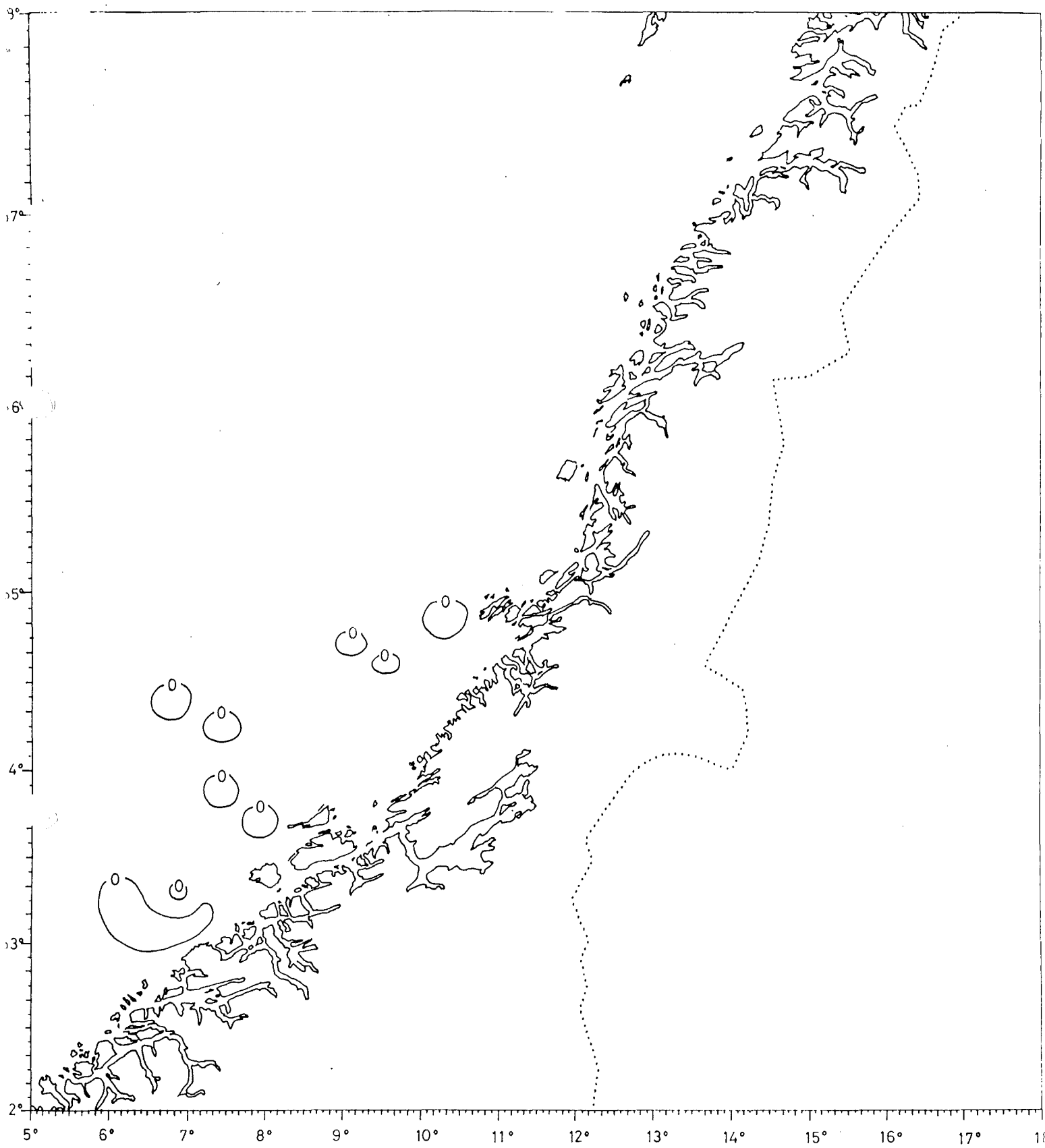


Figure 5.3 Distribution of herring larvae in 1970

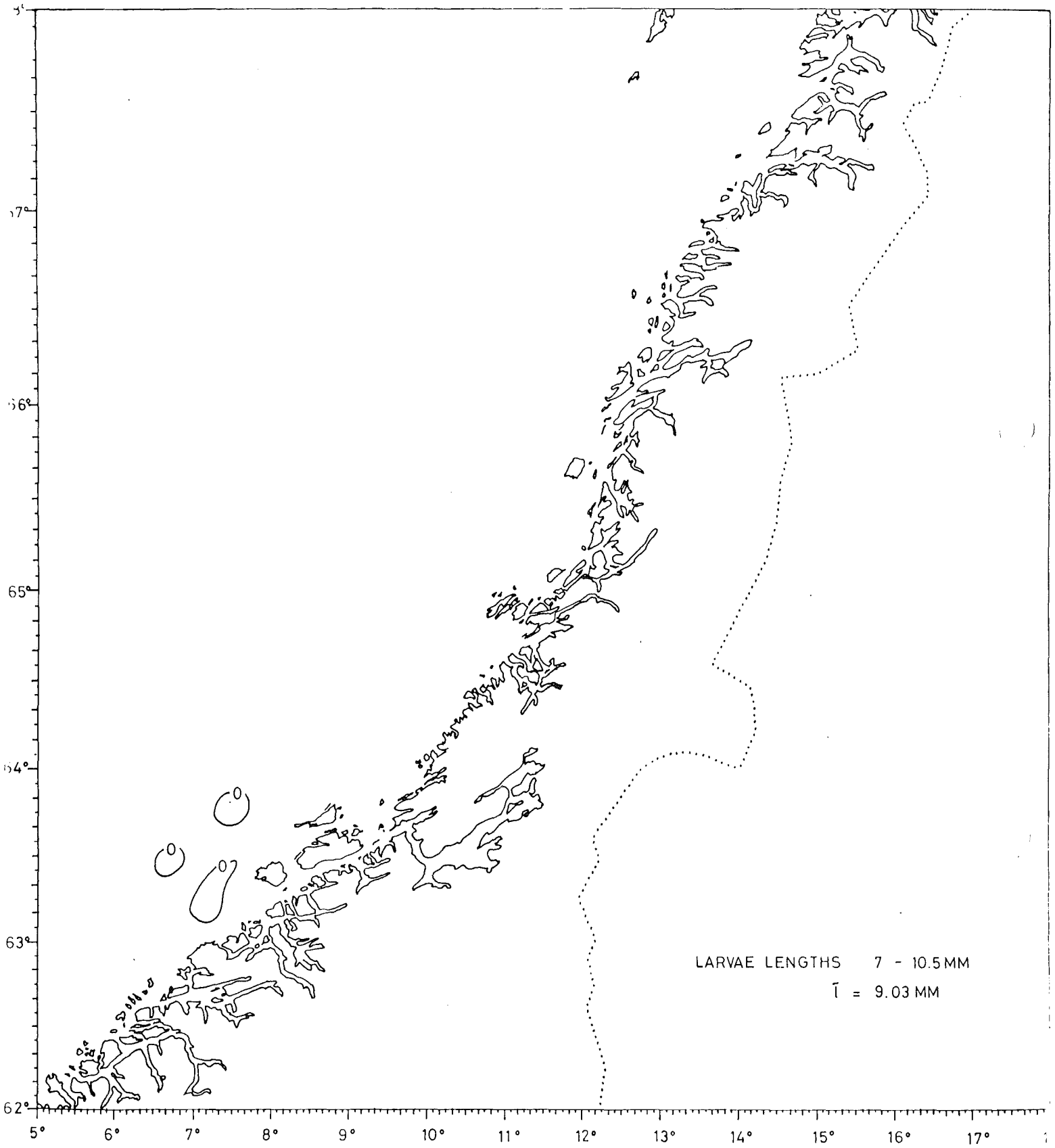


Figure 5.4 Distribution of herring larvae in 1971

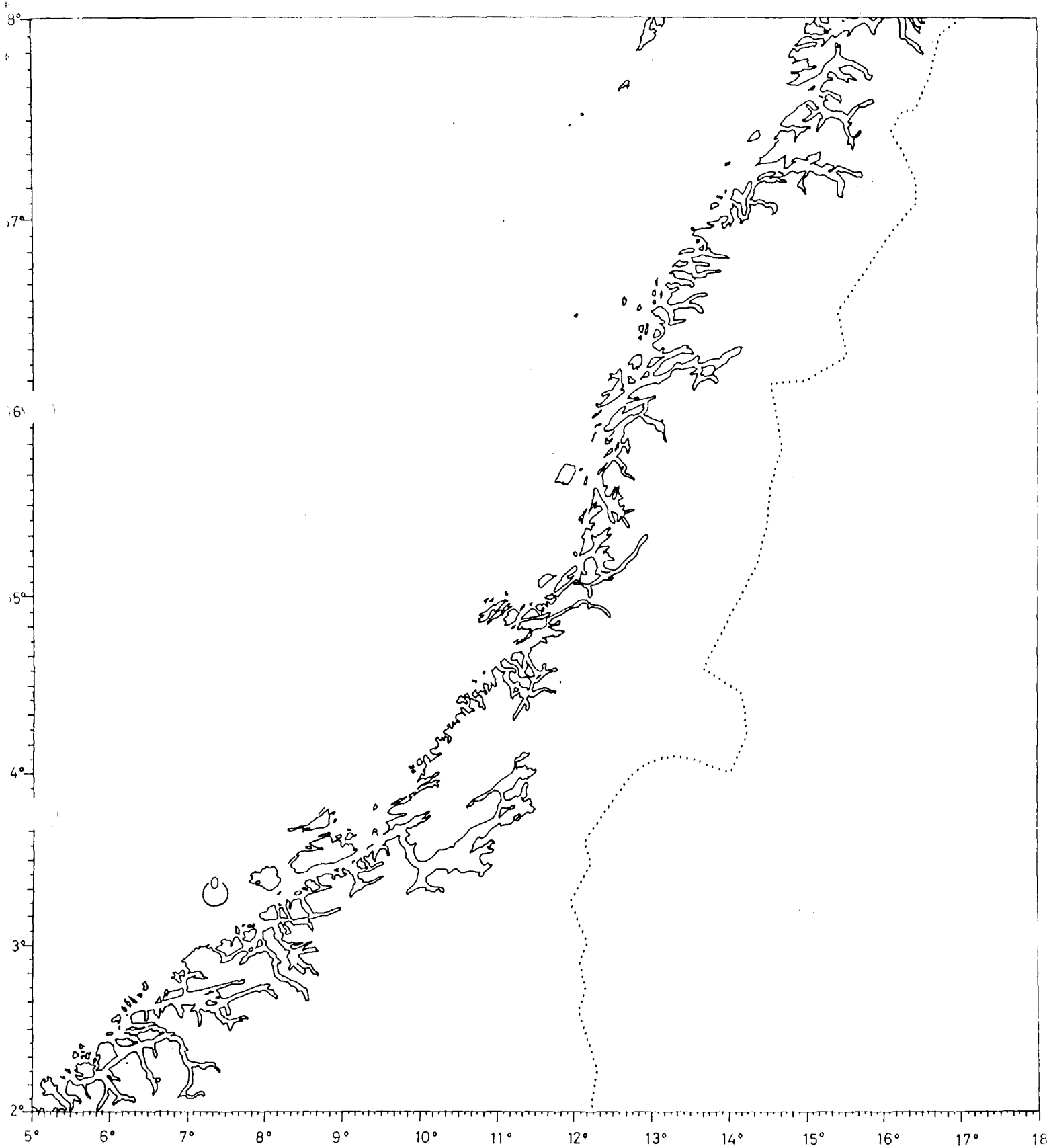


Figure 5.5 Distribution of herring larvae in 1972

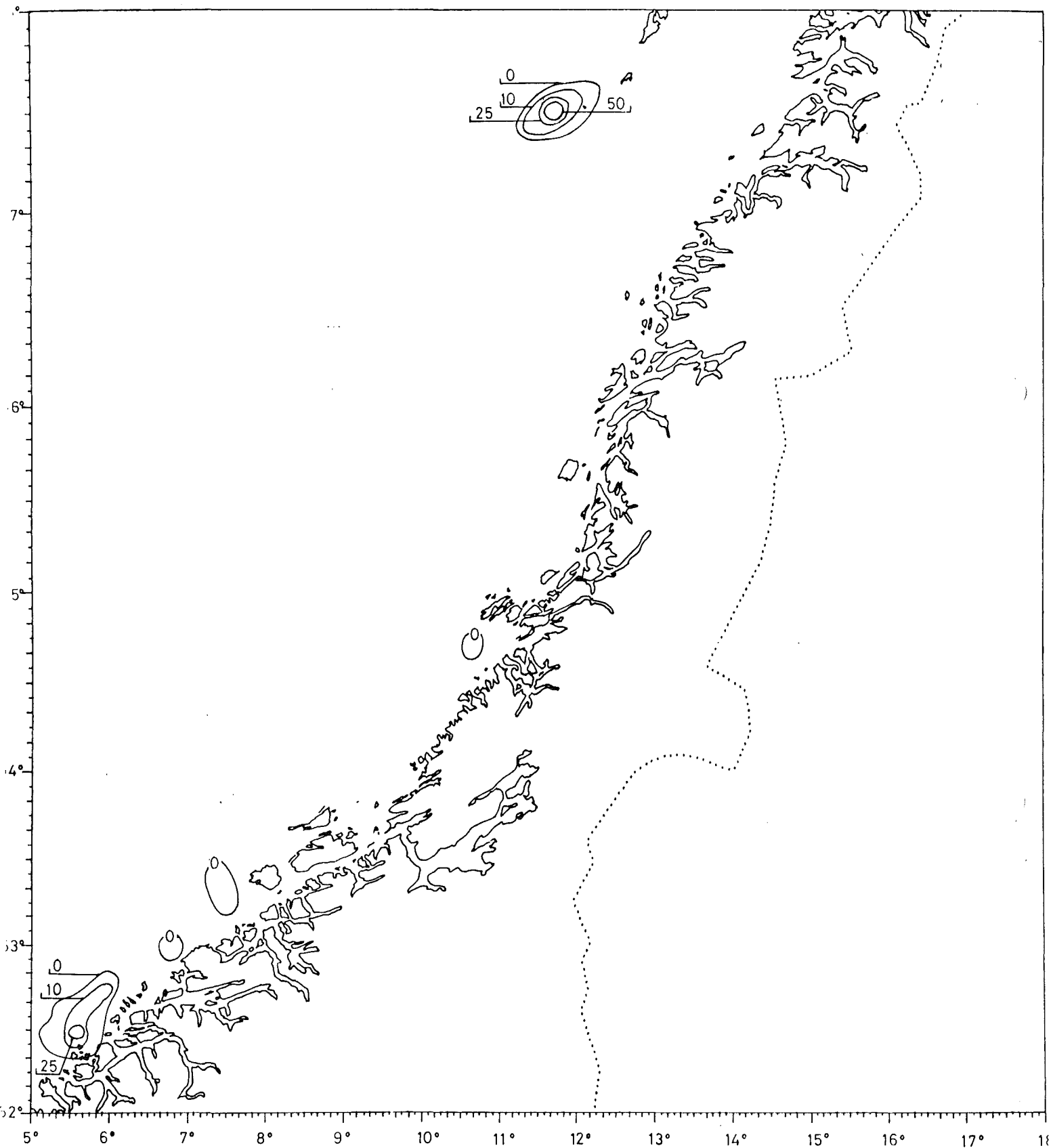


Figure 5.6 Distribution of herring larvae in 1973

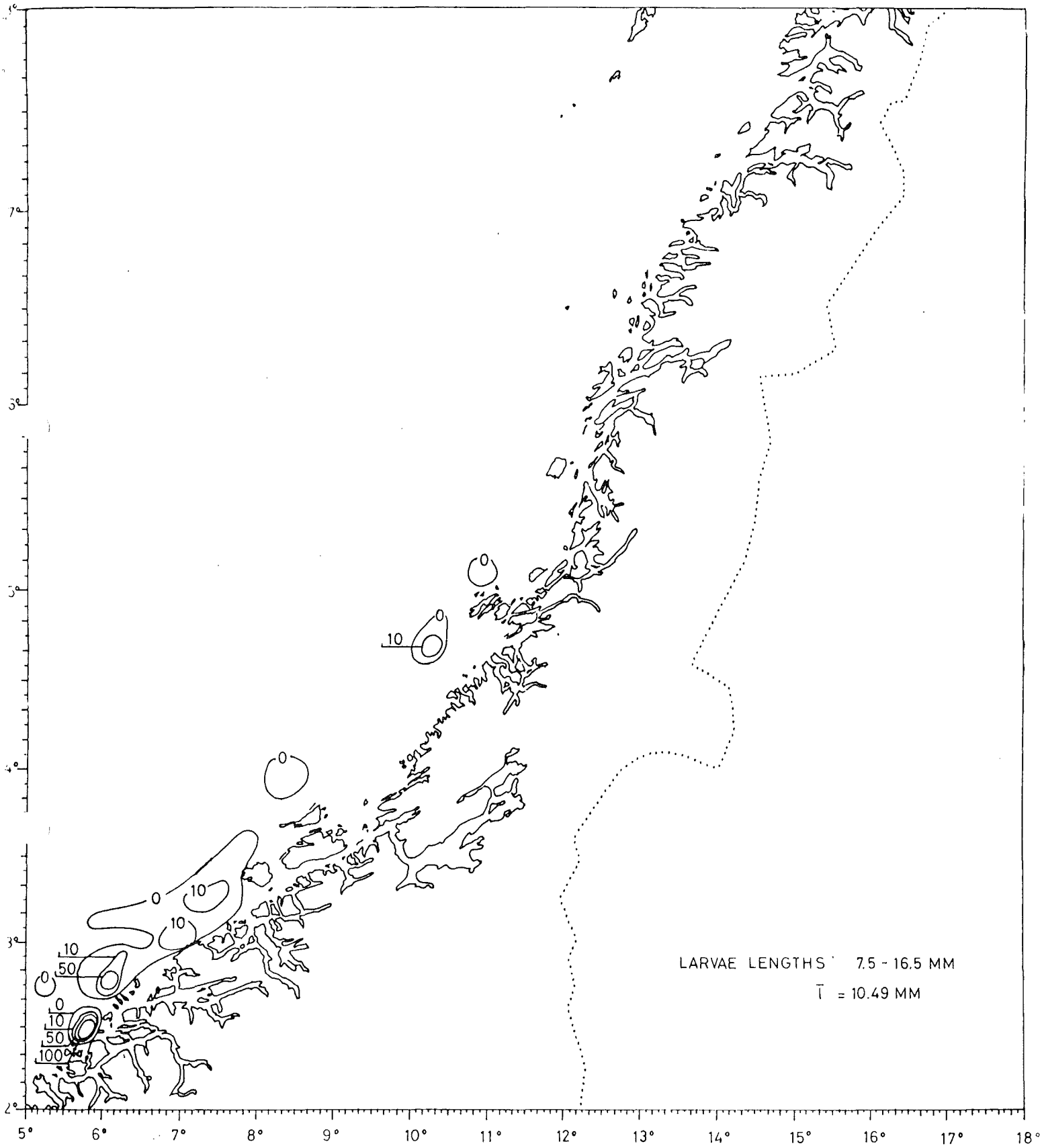


Figure 5.7 Distribution of herring larvae in 1974

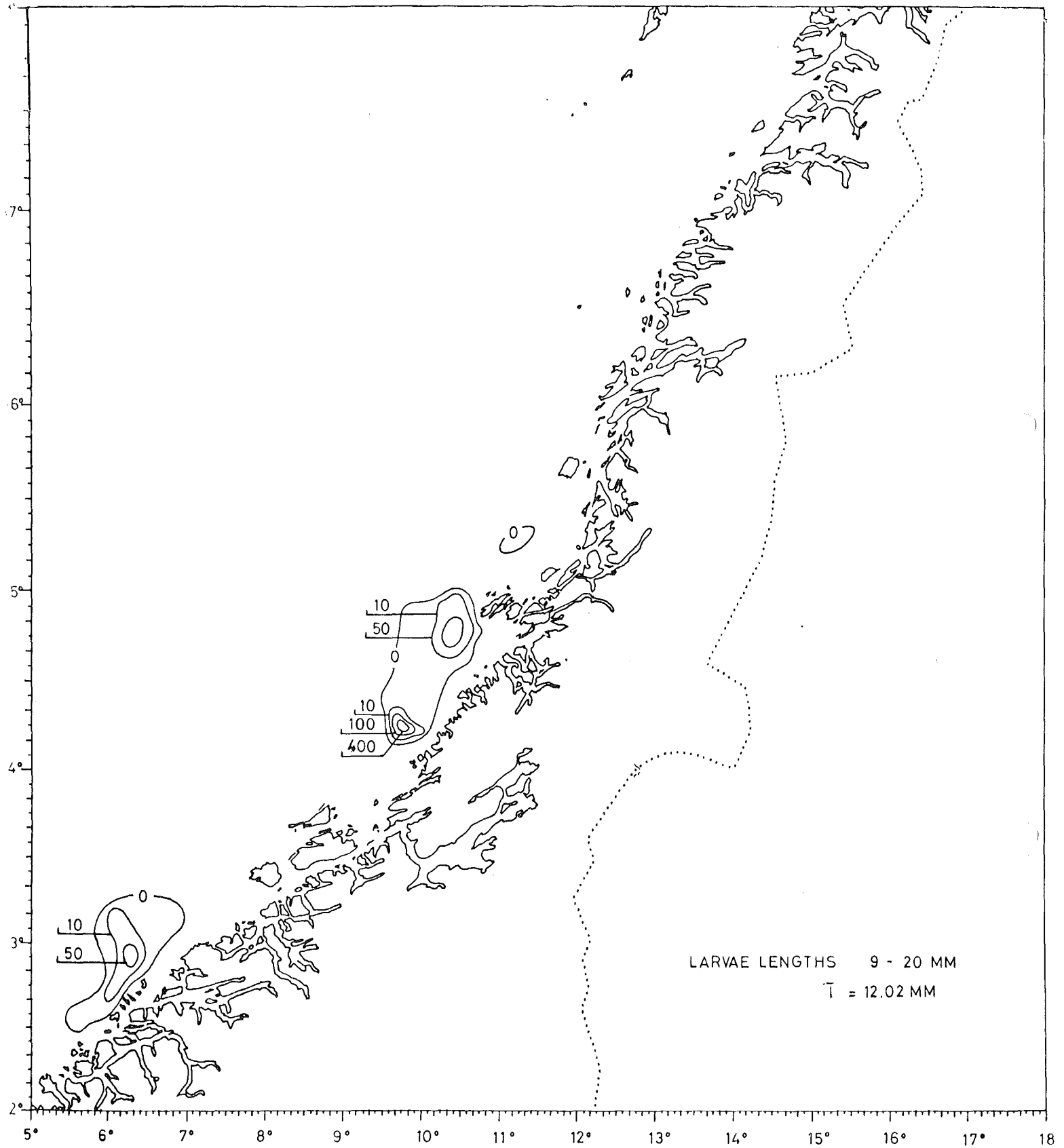


Figure 5.8. Distribution of herring larvae in 1975.

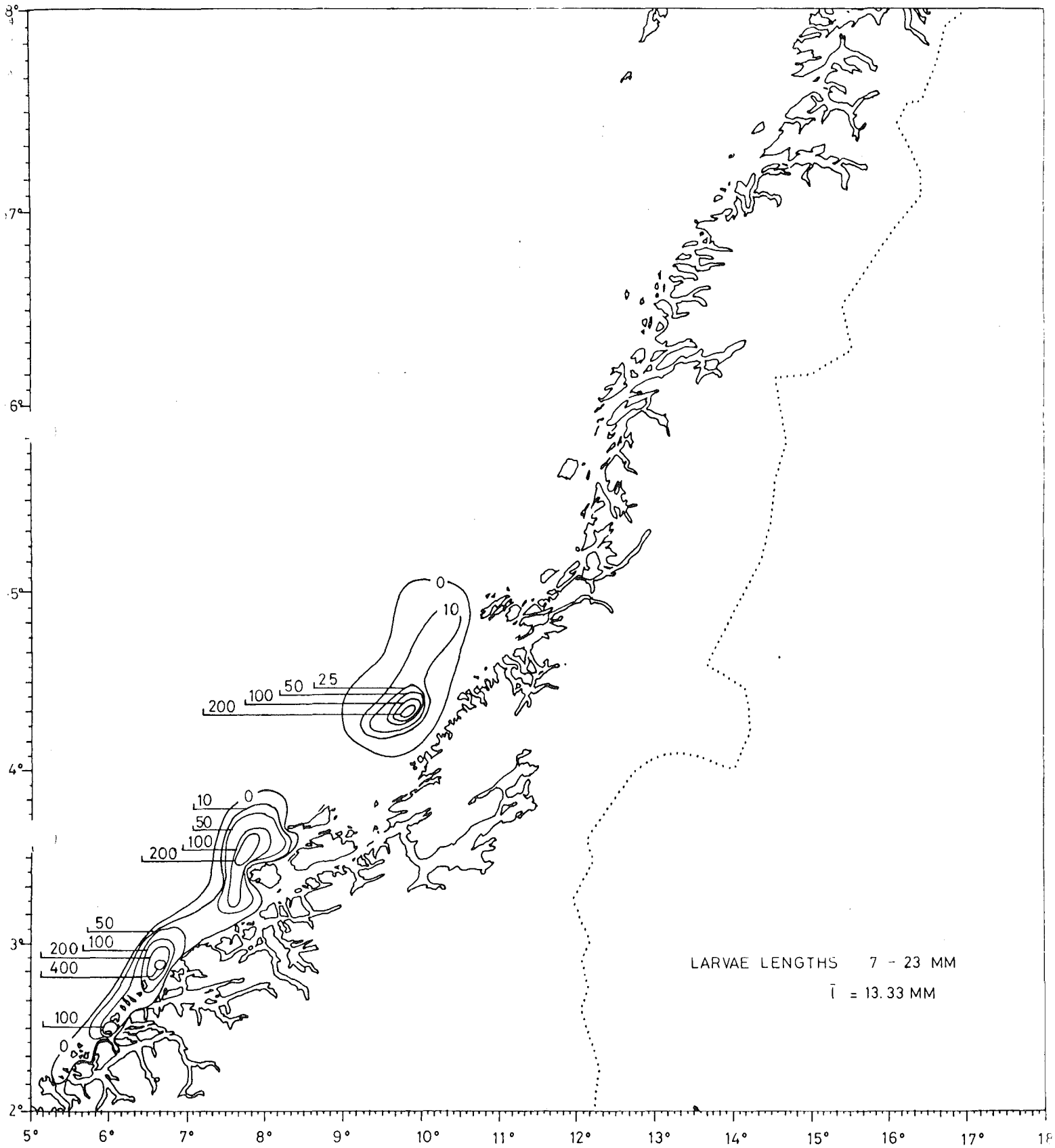


Figure 5.9 Distribution of herring larvae in 1976

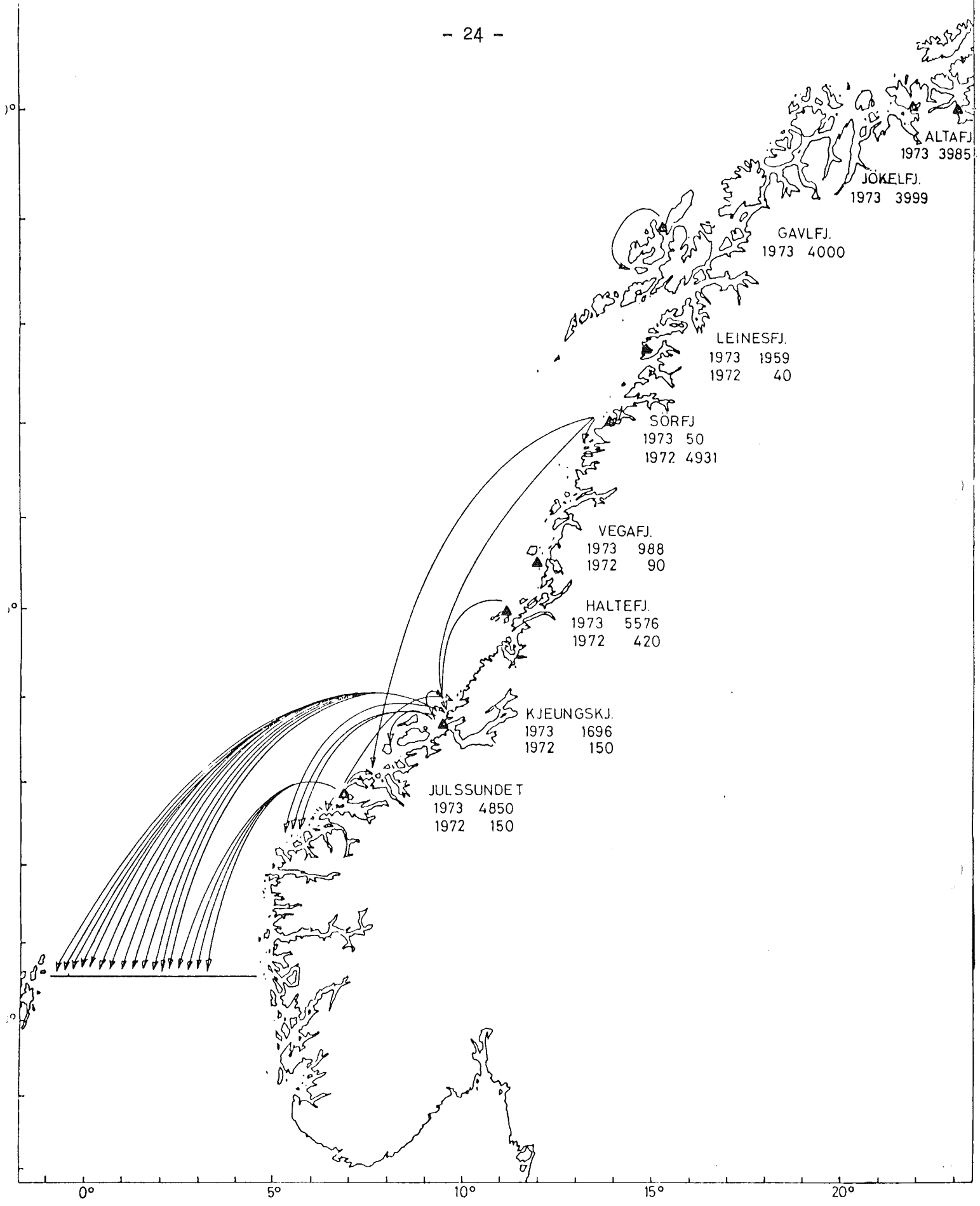


Figure 7.1. Tagging localities in 1975, and recoveries from the fishery 1975-1977. Number of releases by year classes are shown in the Figure.

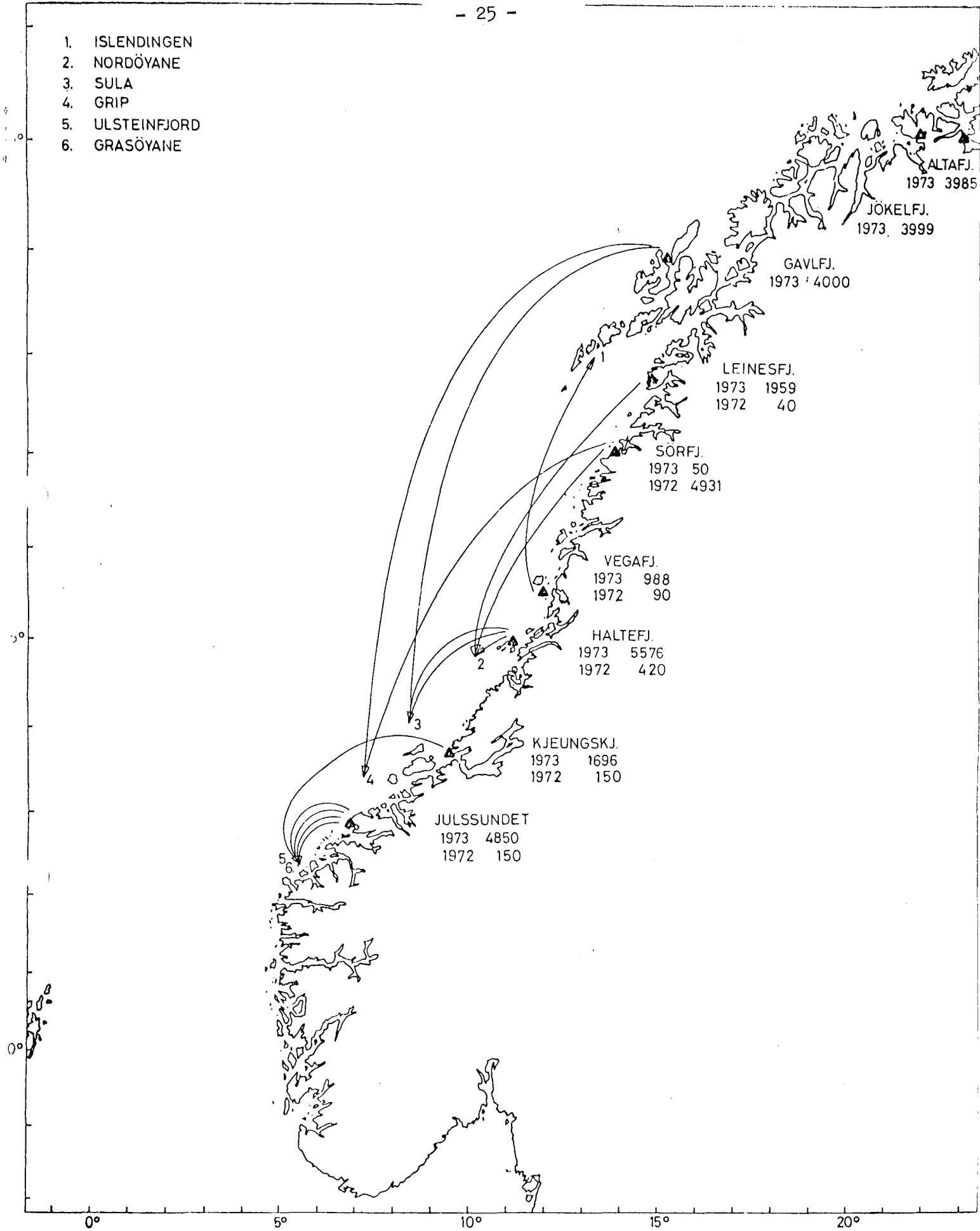


Figure 7.2 Tagging localities in 1975, and recoveries during the experimental fishing in 1977. Number of releases by year classes are shown in the Figure.

- 2. NORDÖYANE
- 3. SULA
- 4. GRIP

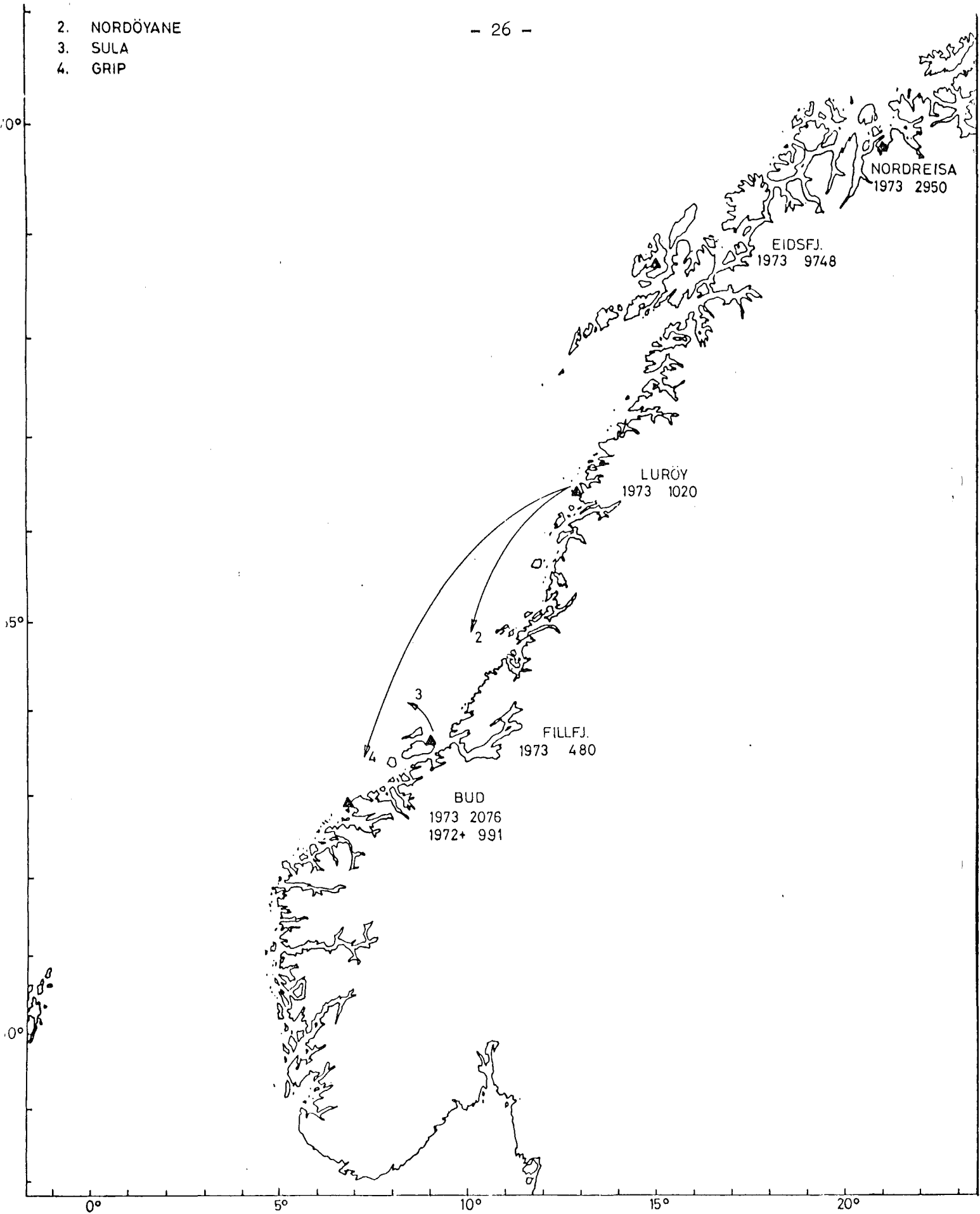
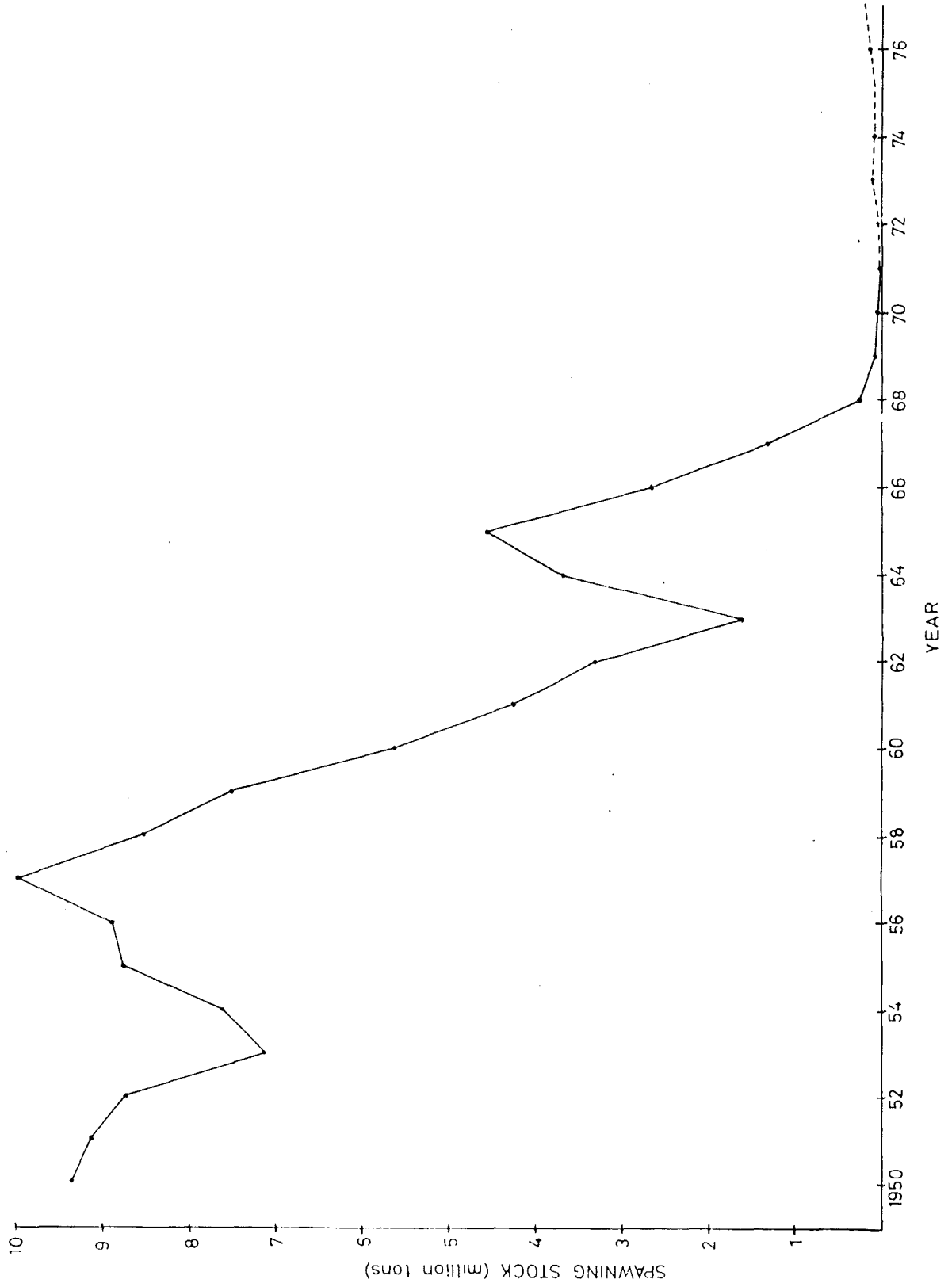


Figure 7.3 Tagging localities in 1976, and recoveries during the experimental fishing in 1977. Number of releases by year classes are shown in the Figure.

Figure 8.1. Spawning stock size.



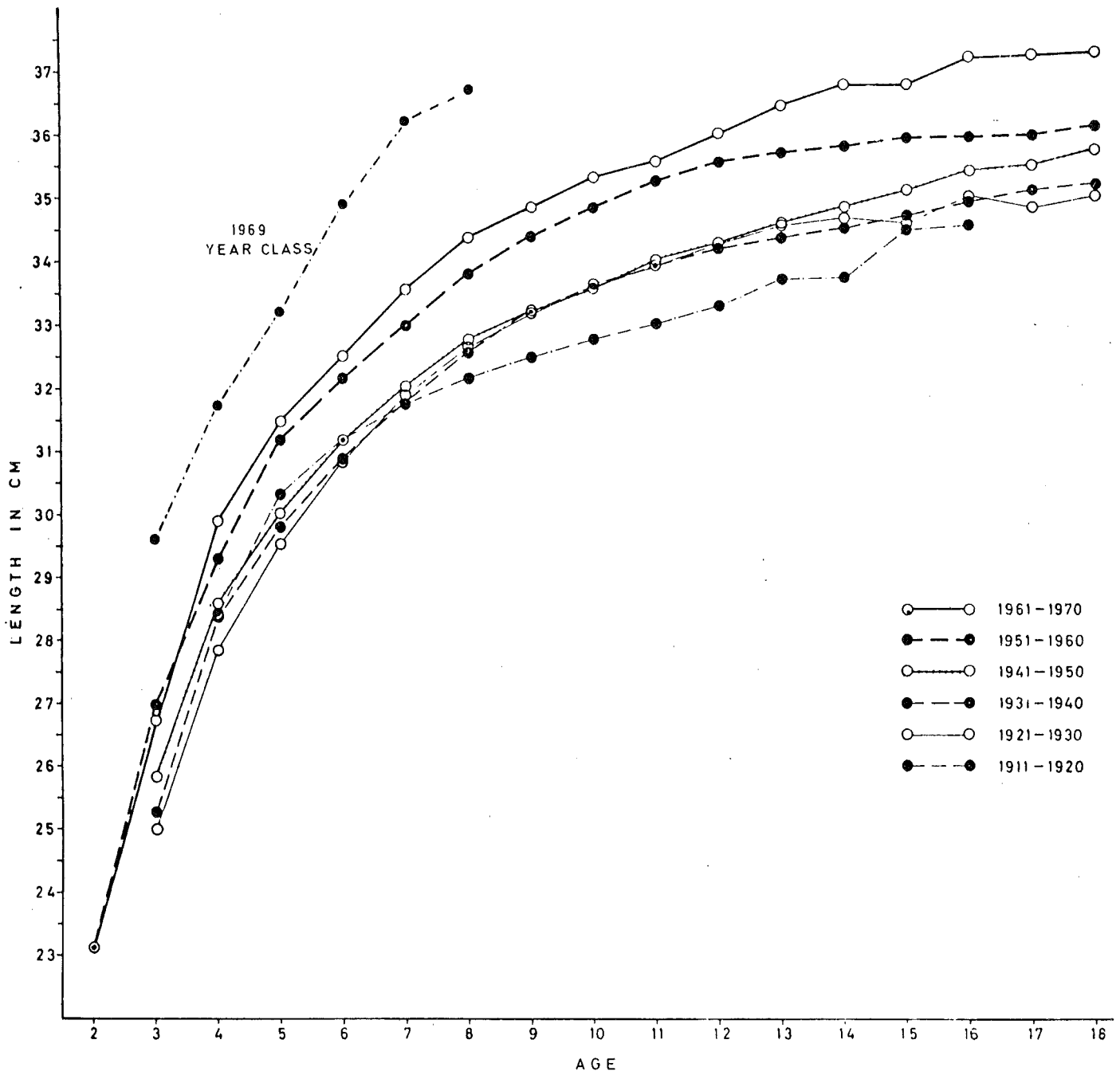


Figure 9.1

Mean length at age of the 1969 year class as compared to mean length at age for Atlanto-Scandian herring in earlier periods (Østvedt, per.comm.).