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PRELIMINARY RESULTS OF THE NORWEGIAN COALFISH TAGGINGS 1954-58.

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Abstract

From 1954 to 1958 more than 7 800 tagged coalfish were released, mainly in North Norway, of which about 2 600 recoveries have been reported. During the summer months the coalfish seem to be fairly stationary within limited feeding areas, and the large mature fish appear to be visiting the same district year after year. In the young immature fish there is a marked trend of gradual movement towards north and east. The regular spawning migrations previously reported on, are clearly demonstrated. In Finnmark migrations start from October to December. By January the main bulk have reached the Malangen and Lofoten banks where immature fish are left behind. On the spawning grounds tagged fish are recaptured in January, February and March. The eventual return migrations are not clearly demonstrated as only few mature fish are recaptured in April, May and June. Since 1957 a number of recoveries has been reported from Iceland and Faroe Islands as dealt with in a special report to this meeting. The material has not yet been fully analysed for the purpose of estimating mortalities etc.

Brief reports on the Norwegian coalfish taggings were given at this meeting in 1955 and 1956 (Olsen 1955 and 1956). The results obtained by that time indicated a regular spawning migration in late fall and winter of sexually mature coalfish from the feeding areas in North Norway to the spawning grounds off the west coast of Norway and in the Northern North Sea. The material also indicated a remarkable tendency of the coalfish to visit the very same feeding locality two and three years in succession.

Since 1956 the coalfish taggings in North Norway have been continued, and the material presently at hand fully confirms our previous concept of the spawning migrations. In the summer of 1957 and each year since Norwegian tagged coalfish have been recaptured in Icelandic and Faroe Island waters. A special report on these trans-oceanic migrations has been prepared (ICES, C.M. 1959, Gadoid Fish Committee No. 12). Here we shall give a full account of the taggings conducted from 1954 to 1958, and a preliminary analysis of the results, mainly with regard to migrations, as the work on using tagging data for estimations of mortalities etc. has not yet been completed.

Material and Methods.

The release data for the different experiments and the number of recaptures reported prior to June 15. 1959, are listed in Table I, and the tagging localities are shown in Fig. 1.

Only Lea hydrostatic tags were used, and except for some few experiments with small coalfish (see Table I), these were of the "large" type and attached in front of the first dorsal fin, with double monofilament nylon of 0.45 or 0.50 mm diameter as described by Dannevig (1953).

Purse-seine caught fish were kept in a small seine, and the fish to be tagged were taken onboard one by one with a dip-net, measured, tagged and released over the other side of the vessel in less than one minute.

From trawl catches, the fish which seemed to be alive were placed in a tank, and the few which would then swim normally around were tagged and released over the side. Trawl caught coalfish are usually injured and therefore unsuitable for tagging experiments, but from short hauls it seems to be possible to find enough suitable fish to make the method practically feasible.

In some of the initial experiments with small fish the smaller type of Lea's tag was used. The tag was attached with thinner nylon, stainless steel wire or a barbed hook made of stainless steel. The hook was designed by Mr. Lea who suggested this method for tagging small fish which are expected to grow much larger before recapture. However the method was abandoned as it gave no recaptures after a period of two months from liberation.

In an attempt to increase the visibility of the tag, every second fish released during the summer of 1956 had a bright yellow plastic flag attached to the tag. Similar experiments conducted in the cod taggings at Lofoten and in the Barents Sea, have been reported on by Hylen (1958). Table II below gives an account of the tri-monthly numbers of recaptures from the coalfish experiments.

Table II. The tri-monthly numbers of recaptures of coalfish tagged in 1956 with flagged and unflagged tags.

Type of tag	Months in freedom											Total
	0 -3	4 -6	7 -9	10 -12	13 -15	16 -18	19 -21	22 -24	25 -27	28 -30	31 -33	
With flag	117	28	18	28	28	17	8	4	12	7	2	269
No flag	100	22	21	18	39	8	5	6	10	4	2	235
Sum	217	50	39	46	67	25	13	10	22	11	4	504
Percentage with flag	54	56	46	61	42	68	62	40	55	64	50	53

It would appear that the addition of the yellow plastic flag resulted in a very slight increase in number of returned tags, but not to the extent that the method is a solution of the problem to make the tag conspicious enough always to be discovered before the fish reach the processing plant, or at any later stage in the processing and distribution chain. The method was therefore discontinued

Seasonal distribution and movements of coalfish in Norwegian coastal and offshore areas.

Much valuable information about the distribution of a species can be gathered from the study of the fisheries and statistics of landings. The Norwegian statistics of coalfish landings are lacking in details, and thus leave much to be desired for this purpose. However, paired with market sampling and partly based on German catch statistics the following general scheme has been established:

The main bulk of the Norwegian catch are medium (4 to 7 years), and to a lesser extent large fish, caught from May to October with purse seine in inshore and coastal waters from Lofoten to Varanger. In May, June and July mainly three and four year old fish are caught with purse seine in large quantities off Møre and Trøndelag. During the winter, from November to February, medium and large coalfish are caught with gill nets and otter trawl on the coastal banks off Malangen, Vesterålen and Lofoten, and from January to March the mature stock is exploited with the same gears on the spawning grounds off the West Coast of Norway and in the Northern North Sea.

German otter trawlers participate to a large extent in the winter fishery, and the German landings in the winter months exceed by far the Norwegian ones for the same period.

From this it would appear that medium and large coalfish accumulate during the feeding season in North Norwegian waters, and the mature fish migrate to spawn in the winter on the West Coast and Northern North Sea. The tagging experiments have given much information about the details of the seasonal distribution and movements.

The feeding season, May to November.

Small fish in their third and fourth year of life have been tagged near Bergen, at Griptaren and in Finnmark. The recaptures in the two first years after tagging were practically all made on or very near the locality of tagging. Thus at this age the coalfish seem to be very stationary. However, the small fish are hardly exploited at all in the winter, and no direct evidence of their habitat for several months of the year is available.

Most of the fish tagged in Finnmark in July and August were four years old or more, and large numbers have been recovered during the first three months after liberation. With very few exceptions these recoveries were made on or very

close to the tagging localities. There is a tendency of movements into the fjords in September and October, but hardly any migrations in any direction along the coast is apparent until the westbound migrations start in late October and November.

It would thus appear that the medium and large coalfish which in the first part of the summer inhabit a local coastal district will remain there for the rest of the feeding season.

In Figs. 2, 3 and 4 are plotted the recaptures made from May to November in successive years of coalfish tagged in 1954, 1955, 1956 and 1957 in three different localities at the Finnmark coast. Only recaptures at the Finnmark coast are shown, as the number of those made during the summer outside this area is negligible.

The fish tagged at Tubåen were mainly four and five years old. In the first summer after that of tagging the majority of the recaptures was made at or near Tubåen, as 58 recoveries were reported within a distance of 30 nautical miles from the tagging locality against 27 at a longer distance. For the second summer after liberation the respective figures are seven and nine, and one and three for the third summer. In these experiments the majority of the recoveries made outside an area within 30 nautical miles from the tagging locality was reported from Central- and East-Finnmark.

On Oksefjord in Central-Finnmark the fish were of medium and large size. Most of the recoveries in successive summers from these experiments were made in the area between North Cape and Nordkyn; thus during the first summer after that of the tagging 52 out of 69 were made within a distance of 30 nautical miles from the tagging locality; 12 out of 21 the second summer; five out of five the third summer, and two out of three the fourth summer after that of tagging. The recaptures made at greater distances than 30 miles from the tagging locality are fairly evenly divided between East and West-Finnmark.

The fish tagged at Tanasnaget were medium and large, but somewhat smaller than those tagged on Oksefjord, and many were probably to spawn for the first time the winter after tagging. During the successive summers also from these experiments the majority of the recoveries was made on or in the vicinity of the tagging locality. The first summer after that of the tagging 27 out of 53 were recaptured within an area of 30 nautical miles from Tanasnaget, the second summer 11 out of 16, and the third summer three out of a total of four. The recaptures at distances over 30 miles from the tagging locality were made both east and west of Tanasnaget, but with the majority in Central-Finnmark between North Cape and Nordkyn.

In the various other tagging experiments at the Finnmark coast the same general feature is evident: the coalfish tagged during the feeding season are to a large extent recaptured at or near the tagging locality during the following summers, and this feature is more pronounced the larger and older the fish were at the time of tagging.

Market sampling has shown that the coalfish which feed at the Finnmark coast are not randomly distributed with regard to size. The western districts are dominated by three to five years old fish, and the larger and older fish are caught in greatest quantities east of North Cape. The results of the tagging experiments show that the shift towards the central and eastern districts as the fish grow older is a gradual one. Thus over 50 per cent of the fish present in one particular year in the western districts will in the next season return to the same area.

The practical significance of this stationariness is obvious. A new strong or week year-class will first affect the catches in West Finnmark, and result in a godd or poor fishery for one or two years before the effect is noticed in the districts farther east.

We do not know exactly to what extent the young fish leave the Finnmark coast in the winter months, but as we are to see later, the great majority of the mature fish migratesin the winter to spawn off the west coast of Norway and in the Northern North Sea. Their facility of returning to the very same feeding locality year after year is therefore astounding, and the material presently at hand gives no indication of explanation for this phenomenon.

The winter season, December to April.

In Figs. 5, 6, 7, 8 and 9 are plotted recaptures in the winter months (December to April) made in the various seasons from 1954/55 to 1958/59. These figures refer to the tagging experiments at the Finnmark coast, and only those recaptures where accurate localities are given have been included.

In the first two seasons only a few recoveries were reported from the Finnmark coast and mainly in December and January, but from 1956/57 onward large numbers were taken in March and April. This seems to be partly due to the larger number of immature coalfish tagged in the later years, as most recaptures in March and April at the Finnmark coast are of 50 to 60 cm fish.

In December and January the recaptures are concentrated on the Lofoten and Malangen Banks, and many tagged fish are also recaptured in February, March and April in these areas. Immature fish are recaptured as far south as Røst (67°30' N), but when the mature fish proceed south of this latitude the smaller immature fish are left behind.

Large mature fish are recaptured mainly in February and March, and in the last two seasons also in January, on the spawning grounds off the SW-coast of Norway and in the Northern North Sea. The largest number of recoveries is reported from the Svinøy area (about 63° N).

We may conveniently divide the general distribution area of the Norwegian stock of coalfish in three subareas, i. e. :

1) the Finnmark coast and the Barents Sea;

2) the coastal banks off Troms and Nordland; and

3) the SW-coast of Norway and the North Sea.

The histograms of Fig. 10 demonstrate the monthly numbers of recaptures in these three subareas, of fish tagged at the Finnmark coast and recaptured more than four months after liberation.

Provided the distribution of fishing effort in space and time is predominated by the accessibility of the fish, the following general scheme is suggested:

In late fall the coalfish of commercial size at the Finnmark coast start a migration towards west and south. They reach the Malangen and Lofoten Banks in the early part of winter, and the mature fish proceed to the spawning grounds off the SW-coast of Norway and in the Northern North Sea where they are caught in January, February and March. The distance from the Lofoten Banks to Svinøy seems to be covered in not less than one month's time. The return migrations are not clearly indicated from these tagging experiments, but most likely the fish recaptured in March and April on the Lofoten and Malangen Banks are on their northward track.

It would appear that the time when the coalfish occur in the various areas may vary from year to year, and this is particularly noticed in the Svinøy area and the Northern North Sea. In the seasons of 1954/55 and 1955/56 most recaptures in these areas were made in March. The following years a gradual change took place towards the situation in 1958/59 when the largest number of recaptures was made in January. As suggested in the report about the migrations to Icelandic and Faroe Island waters (C.M. 1959, Gadoid Fish Committee No. 12), the recent transoceanic migrations of coalfish may be linked to the delayed and more northerly distributed spawning of the herring in recent years; and this observation of an advanced migration of the coalfish to the SW-coast is a further support of the theory.

The taggings at the SW-coast.

A fair number of fish has been tagged at the SW-coast of Norway, particularly in May and early June at Griptaren off Møre (cfr. Table I and Fig. 1). In Fig. 11 are plotted the recaptures from these experiments at distances over 30 nautical miles from the tagging localities.

The general trend of the smaller fish is a northward migration along the Norwegian coast. Some of those tagged as two to four years old at Griptaren have been recaptured as mature coalfish in the Svinøy area and in the North Sea; and mature fish tagged in the Svinøy area have been recaptured as far north as on the Malangen Bank.

It would thus appear that the young coalfish, which grow up at the SW-coast, as they grow older, gradually move northwards; and recruit the stock

of medium and large sized fish, which during the feeding season is mainly distributed in the northern areas.

It is further seen that the mature fish do migrate from the Svinøy area to the coastal waters off North Norway. However, from Fig. 10 it appears that some few fish tagged at the Finnmark coast are recaptured during the summer months in the southern areas. Consequently, all coalfish do not always return to the northern areas after spawning, and as already suggested by Schmidt (1957) irregularities in the return migrations may occur.

To enlighten this problem more effort should be spent in tagging mature fish on the spawning grounds; but so far the technical difficulties encountered in tagging coalfish caught at greater depths have prevented large scale experiments to be carried out.

So far we have only considered the tagging data for the purpose of studying the migrations of the coalfish, and only preliminary attempts have been made to use this material for estimating mortality parameters. Because of the complexity of the migratory patterns and of the fisheries this task is a very delicate one; and the progress made in this field does not justify any presentation of results at the present moment.

References:

Hylen, A., 1958. Marking experiments on the Arctic cod. ICES, C. M. 1958, Gadoid Fish Committee No. 74. (Mimeographed).

Olsen, Steinar, 1955. Marking Experiments. Ann. Biol. (Copenhagen), Vol. XI (1954) 1956, p. p. 104 - 105.

Olsen, Steinar, 1956. The Norwegian coalfish investigations; growth of immature fish and tagging experiments. ICES, C. M. 1956, Gadoid Fish Committee. (Mimeographed).

Schmidt, U., 1957. Die dutschen Köhleranlandungen 1946/47 - 1956/57 aus norwegischen Gewässern und ihre Abhängigkeit vom Fischbestand. (Manuscript).

Table I. Records of tagging experiments and numbers of recaptures 1954 to June 15. 1959.

O.T. - otter trawl, P.S. - purse-seine, G.N. - gill net, H.L. - hand line, L. - large Lea tags, S. - small Lea tags, F. - with yellow plastic flag, N. - .45 or .50 mm double monofilament nylon, n. - .25 or .35 double monofilament nylon, W. - stainless steel wire, H. - Lea's steel hook.

RELEASE DATA								RECAPTURED							
Exp. No.	Date	Locality/Position	Gear	No.	Tag	Attachement	Size range	1954	1955	1956	1957	1958	1959	Not specif.	Total
01/54	10/3 1954	Fugløy Bank 70°28'N-17°23'E	O.T.	4	L.	N.	59-64								0
02/54	6/4 1954	Off Anda 69°16'N-14°59'E	O.T.	5	L.	N.	66-75			1					1
03/54	7/4 1954	Røst Bank 68°27'N-11°47'E	O.T.	2	L.	N.	55.68								0
04/54	9/6 1954	At Askøy 60°24'3N-5°14'5E	P.S.	24	S.	n.W.H.	40-48	2		3					5
05/54	7/8 1954	At Havøysund 71°00'N-24°44'E	H.L.	25	S.	n.H.	26-50	2							2
06/54	10/8 1954	At Havøysund 71°00'N-24°44'E	H.L.	42	S.	n.H.	26-53	1							1
07/54	13/8 1954	At Havøysund 71°00'N-24°44'E	H.L.	31	S.	n.H.	25-49		1						1
08/54	17/8 1954	Oksefjord 71°05'N-27°25'E	P.S.	528	L.	N.	50-101	79	72	35	17	8	3		214
09/54	23/10 1954	Varangerfjord 70°04'N-30°27'E	O.T.	2	L.	N.	73		1	1					2
10/54	27/10 1954	Syltefjord 70°38'N-30°41'E	O.T.	3	L.	N.	57-74		1						1
11/54	28/10 1954	Tanasnaget 70°59'N-29°04'E	O.T.	4	L.	N.	59-65		1						1
12/54	13/11 1954	Off Andenes 69°21'N-15°38'E	G.N.	2	L.	N.	80.94								0
13/54	17/11 1954	Off Andenes 69°21'N-15°38'E	G.N.	8	L.	N.	77-91								0
14/55	23/2 1955	Aktivneset 62°24'N-04°17'E	O.T.	8	L.	N.	72-91		1						1

Table I (continued)

RELEASE DATA								RECAPTURED							
Exp. No.	Date	Locality/Position	Gear	No.	Tag	Attachement	Size range	1954	1955	1956	1957	1958	1959	Not specif.	Total
15/55	13/5 1955	Griptaren 63°17'N-07°20'E	P.S.	92	L.	N.	40-56		20	1	3				24
16/55	23/5 1955	Griptaren 63°17'N-07°20'E	P.S.	190	L.	N.	40-61		46	6	4	4			60
17/55	26/5 1955	Griptaren 63°17'N-07°20'E	P.S.	208	L.	N.	34-57		60	4	4	5	1		74
18/55	23/7 1955	Tubåen 71°01'N-23°22'E	P.S.	301	L.	N.	49-78		53	35	13	11	1		113
19/55	26/7 1955	Tubåen 70°59'N-23°24'E	P.S.	200	L.	N.	42-72		16	16	7	2			41
20/55	3/8 1955	At Kiberg 70°15'N-31°01'E	P.S.	313	L.	N.	53-89		28	38	19	10	2	1	98
21/55	4/8 1955	At Kiberg 70°15'N-31°01'E	P.S.	126	L.	N.	46-81		1	14	6	2	1		24
22/55	15/8 1955	Tanasnaget 70°58'N-29°10'E	P.S.	436	L.	N.	49-91		43	63	30	11	2		149
23/55	17/8 1955	Laksefjord 70°48'N-26°45'E	P.S.	350	L.	N.	44-96		50	55	20	13			138
01/56	18/2 1956	Off Svinøy 62°12'N-04°09'E	O.T.	79	L.F.	N.	63-95			7	4	1	1		13
02/56	26/5 1956	Griptaren 63°17'N-07°20'E	H.L.	1	L.	N.	-								0
03/56	15/8 1956	At Havøysund 71°00'N-24°44'E	H.L.	56	S.	n.	27-42			2	1	2			5
04/56	31/7 1956	Sveet 71°06'N-25°19'E	P.S.	200	L.F.	N.	50-81			26	23	7	2		58
05/56	1/8 1956	Sveet 71°06'N-25°19'E	P.S.	198	L.F.	N.	58-82			27	32	6	2	1	68
06/56	10/8 1956	Off Akkarfjord 70°46'N-23°31'E	P.S.	300	L.F.	N.	35-76			157	10	3	2		172
07/56	14/8 1956	Tubåen 70°59'N-23°24'E	P.S.	300	L.F.	N.	45-81			26	58	18	5		107
08/56	17/8 1956	Oksefjord 71°05'N-27°25'E	P.S.	340	L.F.	N.	64-103			25	58	17	3		103
09/56	21/8 1956	Off Tufjord 70°59'N-23°49'E	P.S.	160	L.F.	N.	48-92			15	27	12			54
10/56	3/9 1956	Vatlestraumen 60°22'3 N-5°10'5 E	H.L.	7	L.	N.	31-36			1	1				2

Table I (continued)

RELEASE DATA								RECAPTURED							
Exp. No.	Date	Locality/Position	Gear	No.	Tag	Attachement	Size range	1954	1955	1956	1957	1958	1959	Not specif.	Total
11/56	4/9 1956	Vatlestraumen 60°22'3 N-5°10'5 E	H.L.	12	L.	N.	31-41					1			1
12/57	21/5 1957	Griptaren 63°10'N-07°21'E	P.S.	178	L.	N.	34-63				46	11	1		58
13/57	22/5 1957	Griptaren 63°11'N-07°18'E	P.S.	322	L.	N.	33-51				99	14	2		115
14/57	22/7 1957	Off Sørøy 70°58'N-22°40'E	P.S.	254	L.	N.	50-80				15	32	5		52
15/57	25/7 1957	Sørøysund 70°31'N-22°57'E	P.S.	245	L.	N.	43-72				63	17	2		82
16/57	26/7 1957	Tubåen 70°58'N-23°22'E	P.S.	130	L.	N.	56-80				14	21	6		41
17/57	30/7 1957	Off Sørøy 70°46'N-22°08'E	P.S.	370	L.	N.	36-73				11	34	6		51
18/57	3/8 1957	Oksefjord 71°08'N-27°10'E	P.S.	135	L.	N.	62-92				26	18	1		45
19/57	6/8 1957	Tanasnaget 70°56'N-28°58'E	P.S.	147	L.	N.	57-97				26	19	1		46
20/57	10/10 1957	Syltefjord 70°41'N-30°37'E	O.T.	1	L.	N.	88								0
21/58	5/6 1958	Griptaren 63°07'N-07°12'E	P.S.	508	L.	N.	42-60					204	3		207
22/58	22/7 1958	At Skipsholmen 70°55'N-23°46'E	P.S.	62	L.	N.	56-80					12	4		16
23/58	23/7 1958	At Skipsholmen 70°55'N-23°46'E	P.S.	79	L.	N.	55-85					10	2		12
24/58	29/7 1958	Tubåen 71°01'N-23°22'E	P.S.	333	L.	N.	37-77					50	9		59
25/58	29/7 1958	Tubåen 71°01'N-23°22'E	P.S.	524	L.	N.	42-76					100	9		109
26/58	7/8 1958	Tanasnaget 71°01'N-28°50'E	P.S.	98	L.	N.	60-95					17	3		20
27/58	12/8 1958	Tanasnaget 70°55'N-28°54'E	P.S.	320	L.	N.	64-96					41	15		56
28/58	13/8 1958	Tanasnaget 71°00'N-28°52'E	P.S.	410	L.	N.	59-95					63	16		79
29/58	2/12 1958	Langgrundsøyla 62°46'N-05°24'E	O.T.	35	L.	N.	47-65						1		1

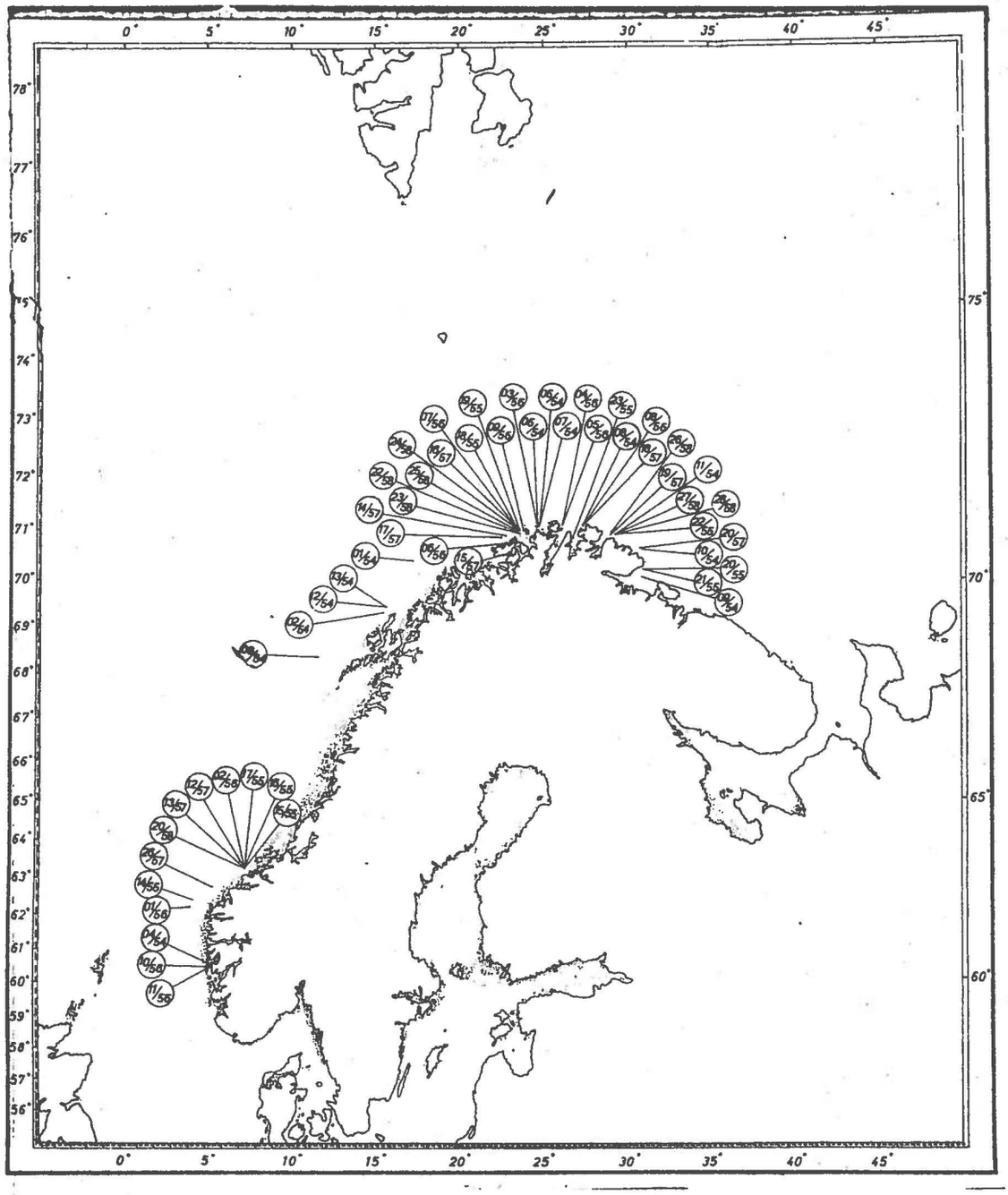

Fig. 1. Norwegian coalfish taggings 1954 to 1958. Figures encircled indicate experiment number and year of tagging. For further details see Table I.

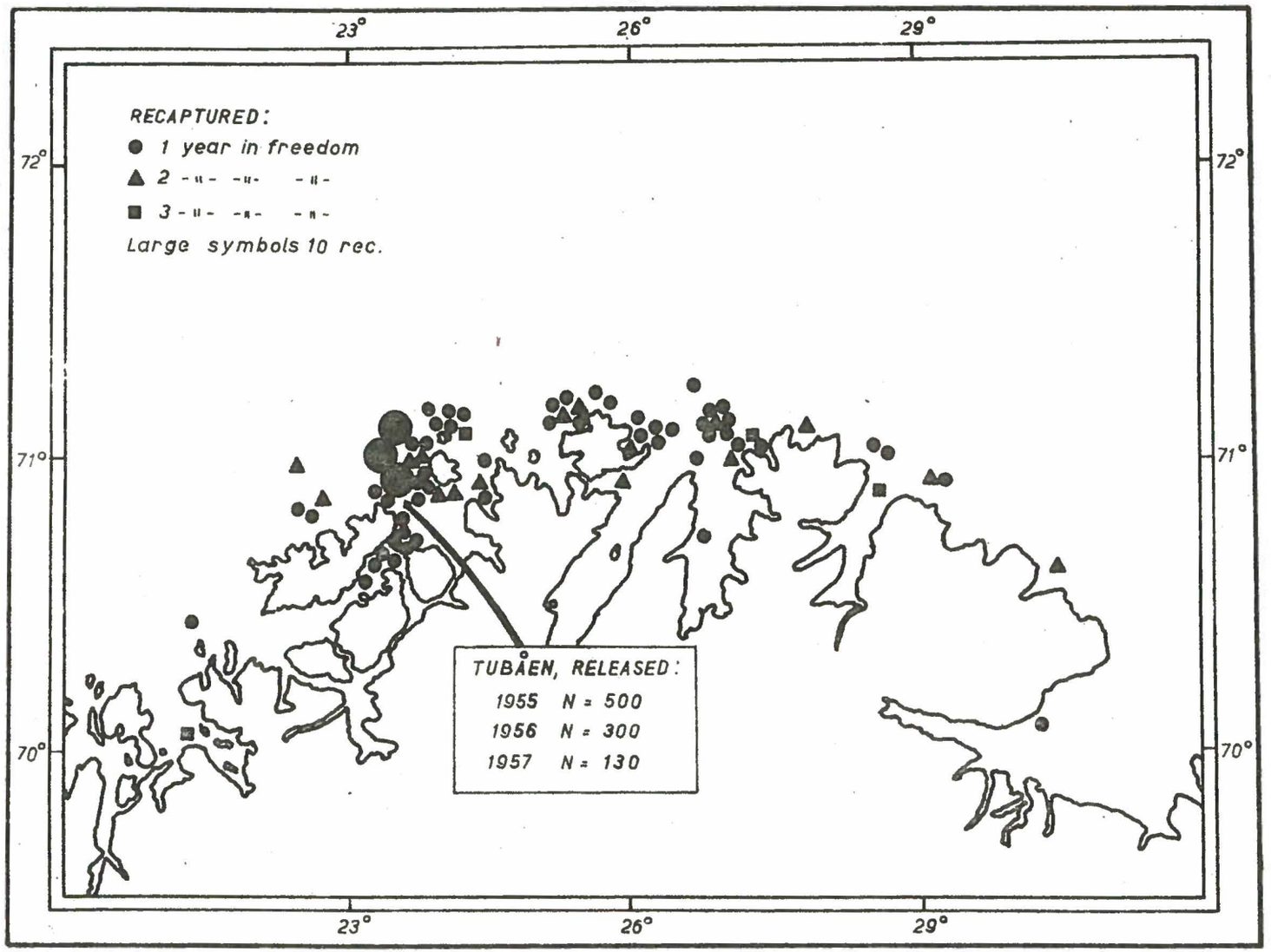

Fig. 2. Recaptures from May to November one or more years after tagging at Tubåen in 1955, 1956 and 1957.

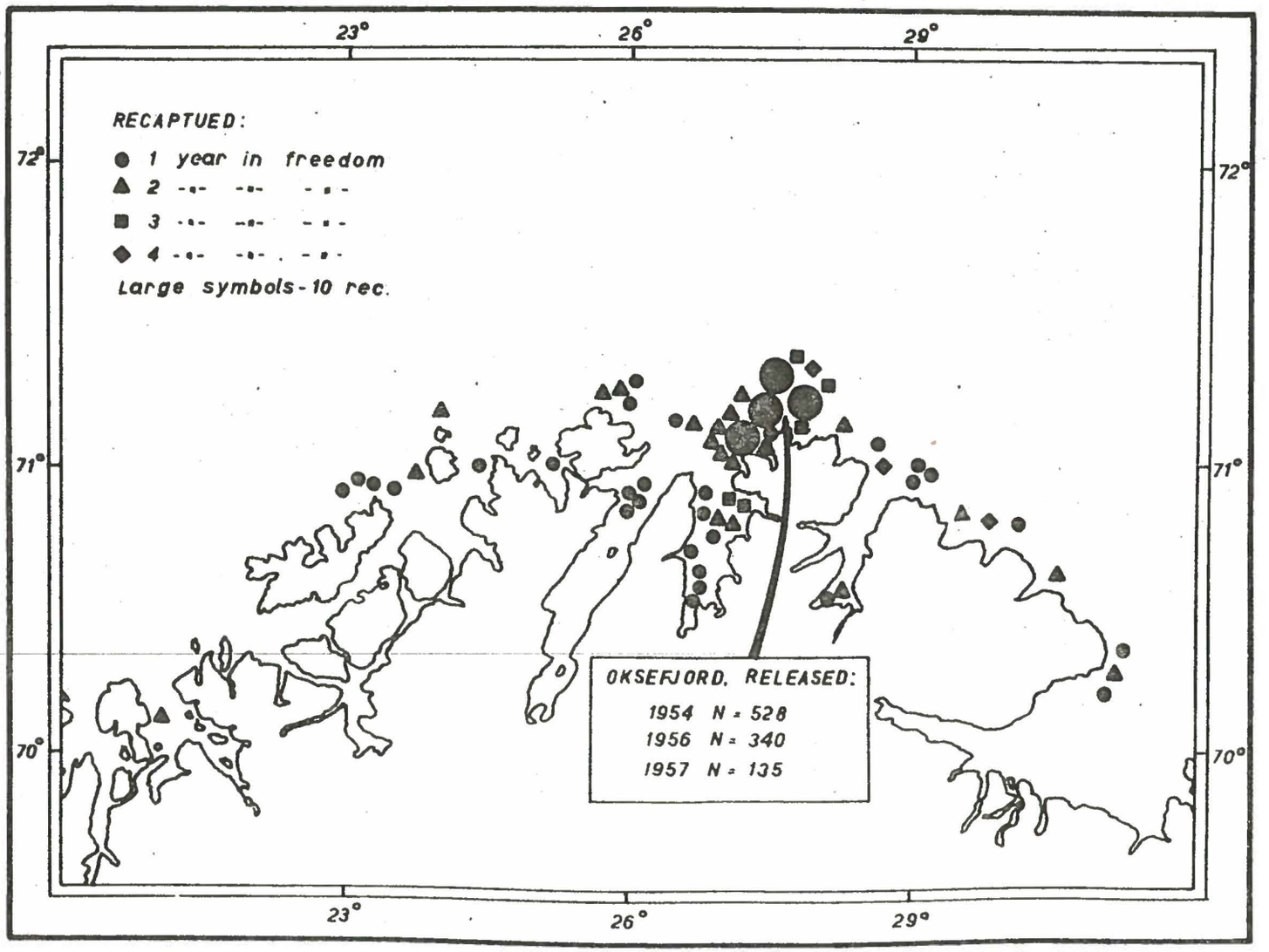

Fig. 3. Recaptures from May to November one or more years after tagging on Oksefjord in 1954, 1956 and 1957.

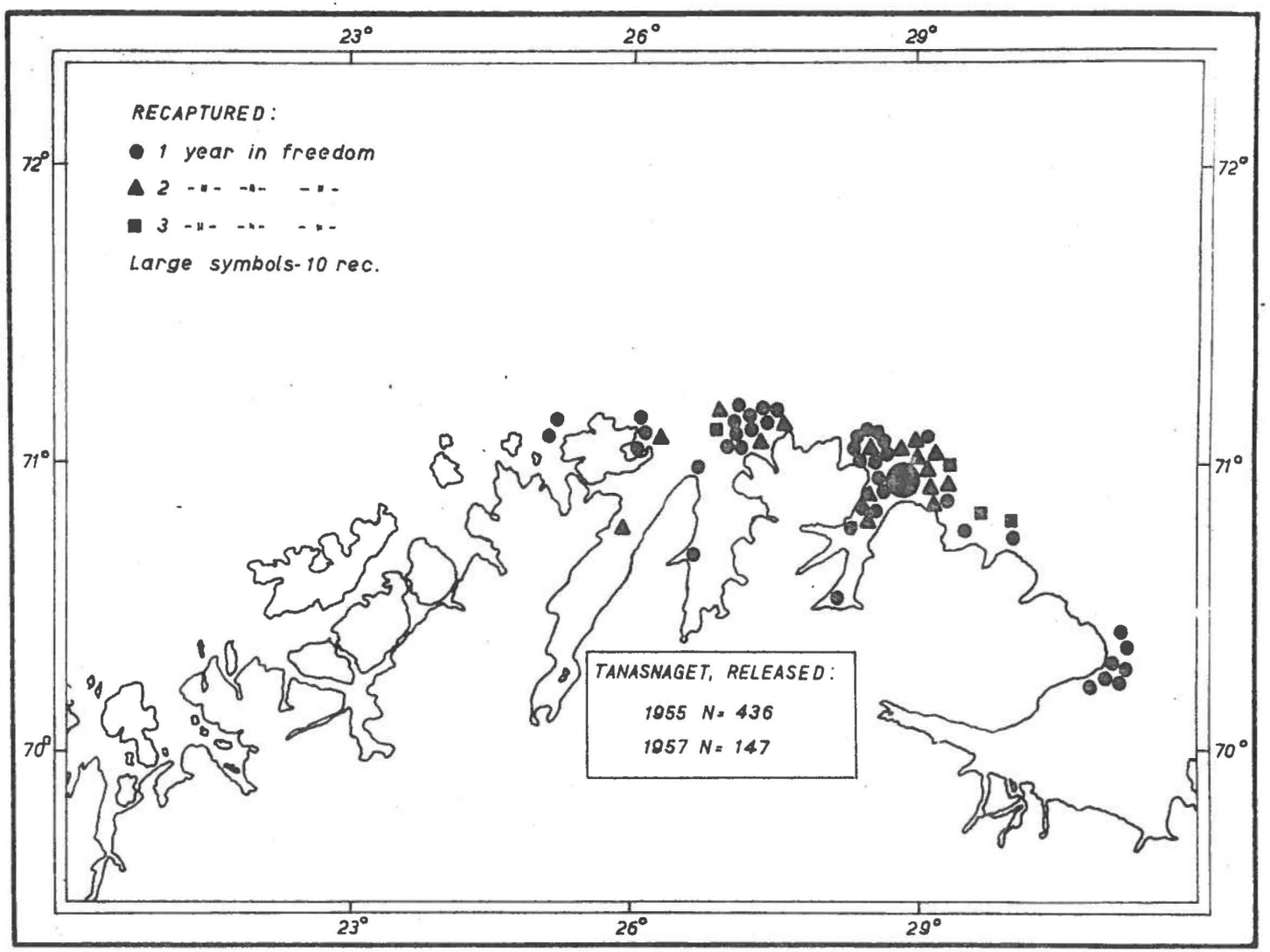

Fig. 4. Recaptures from May to November one or more years after tagging at Tanasnaget in 1955 and 1957.

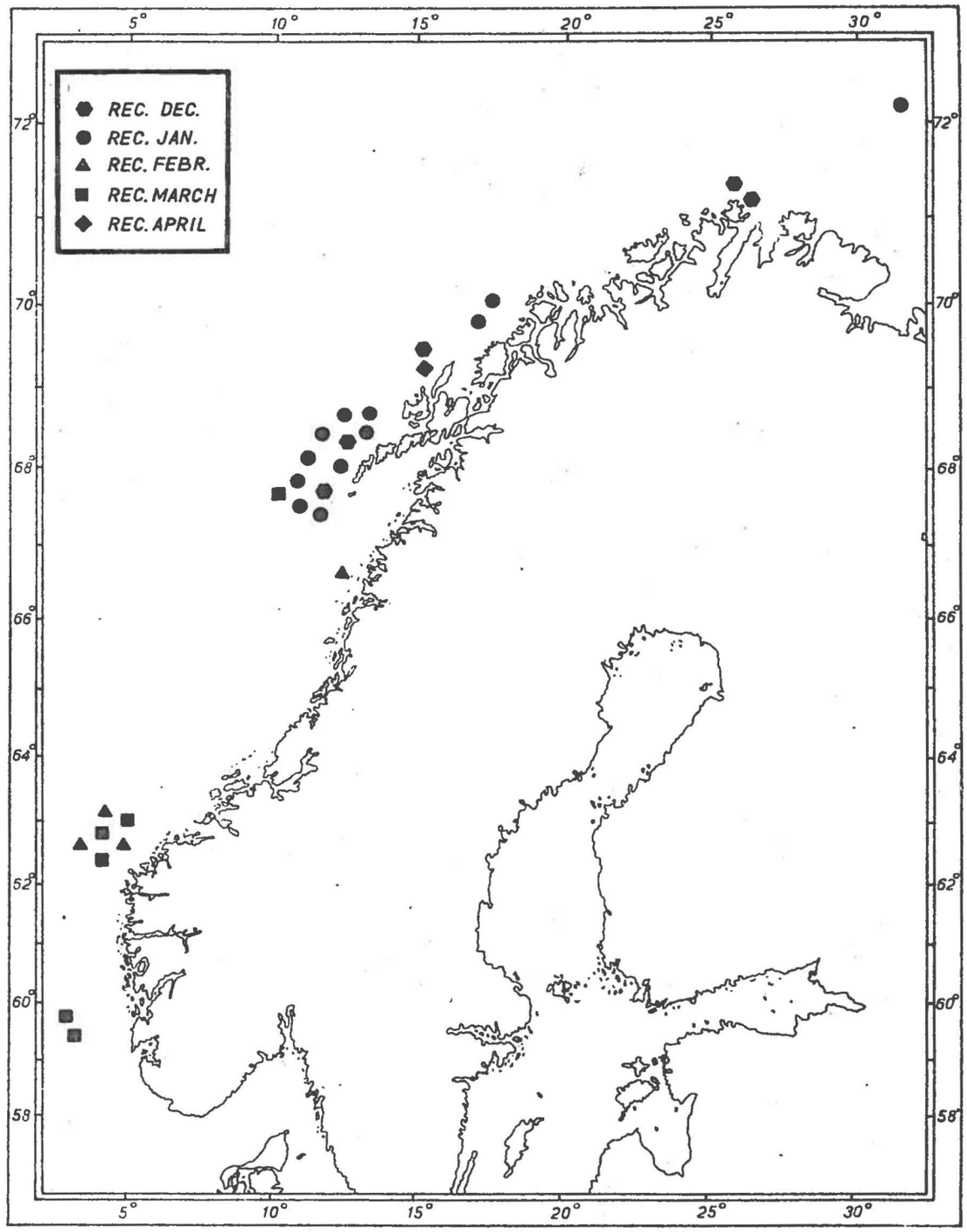

Fig. 5. Recaptures from December to April 1954/55 of coalfish tagged at the Finnmark coast in 1954.

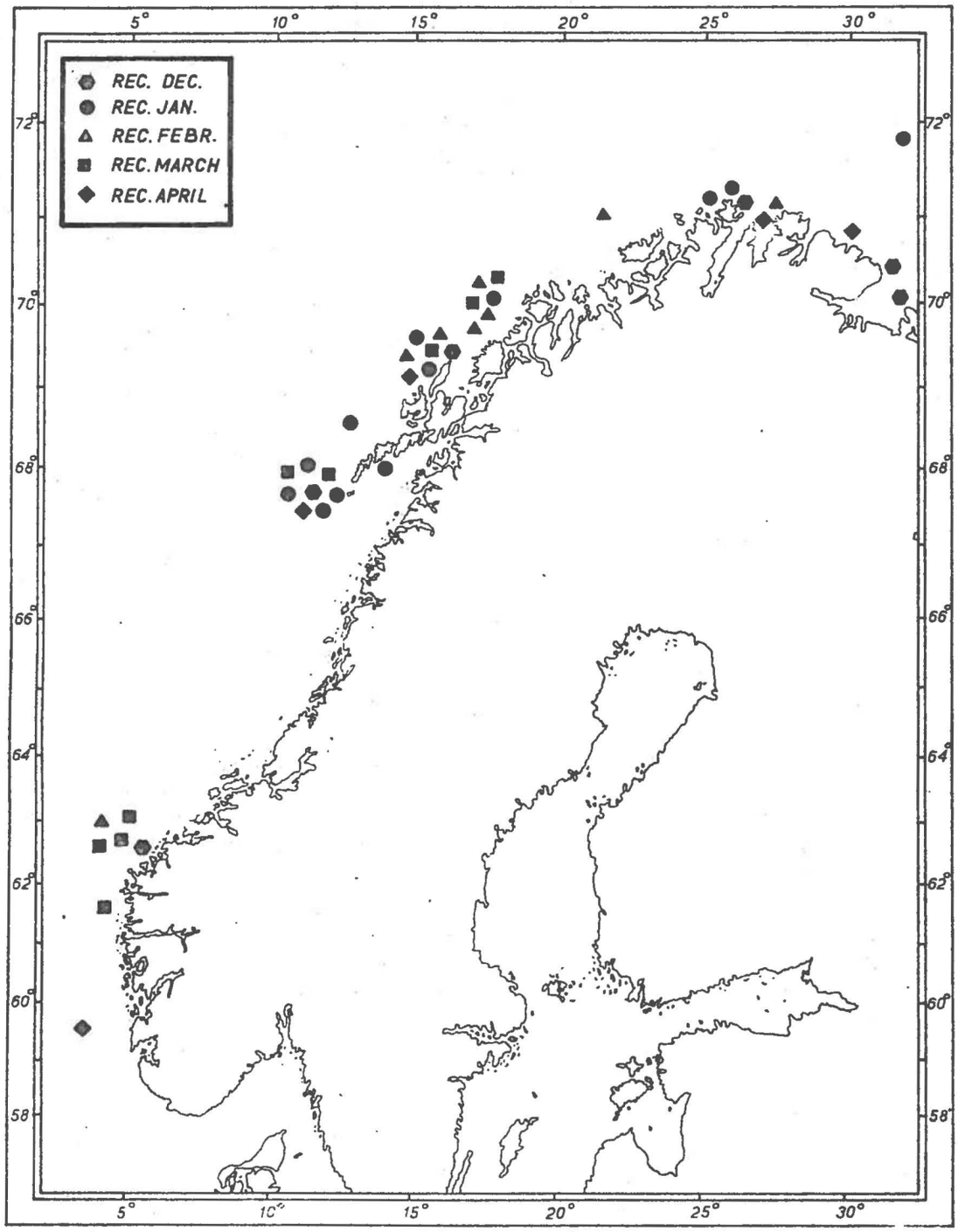

Fig. 6. Recaptures from December to April 1955/56 of coalfish tagged at the Finnmark coast in 1954 and 1955.

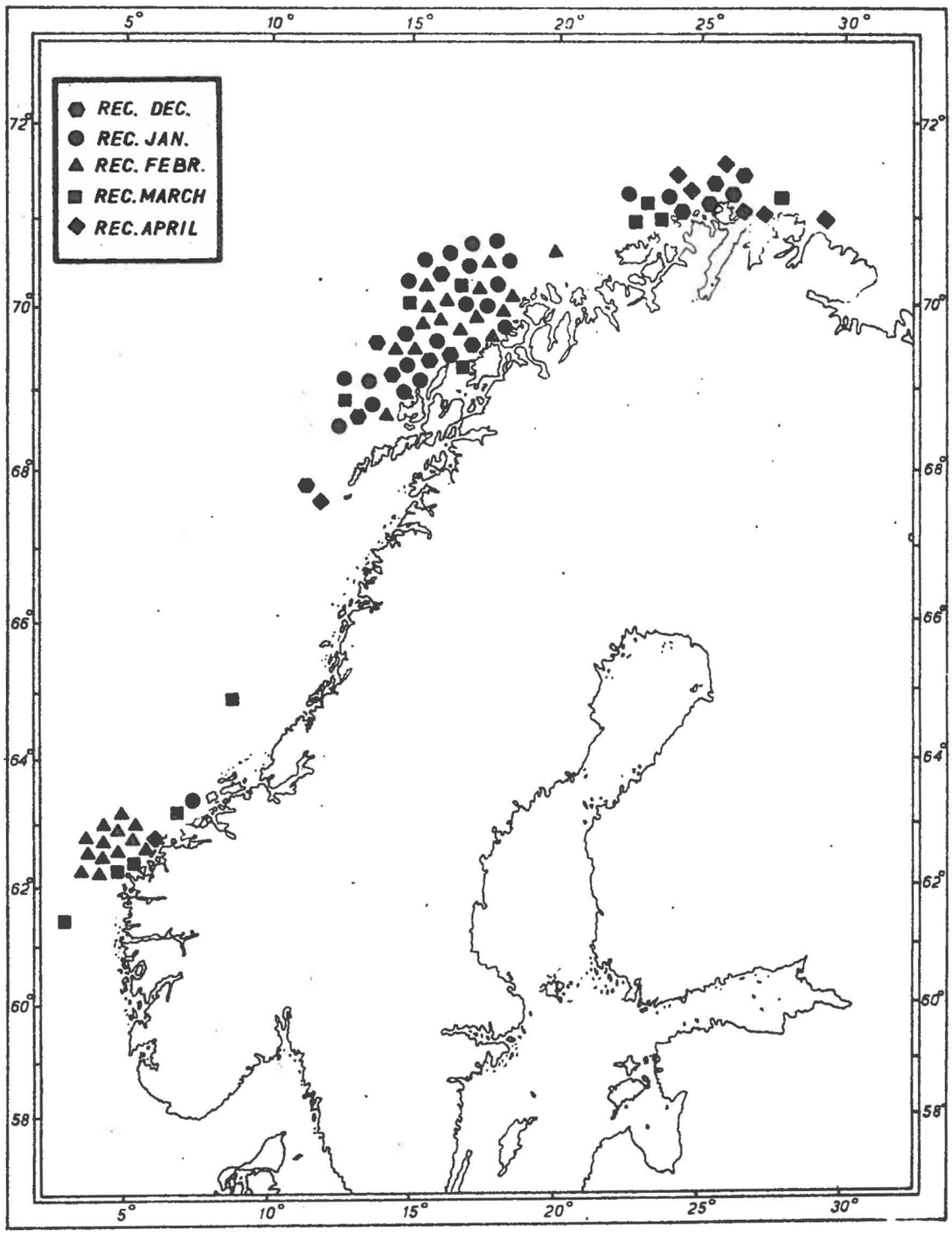

Fig. 7. Recaptures from December to April 1956/57 of coalfish tagged at the Finnmark coast in 1954, 1955 and 1956.

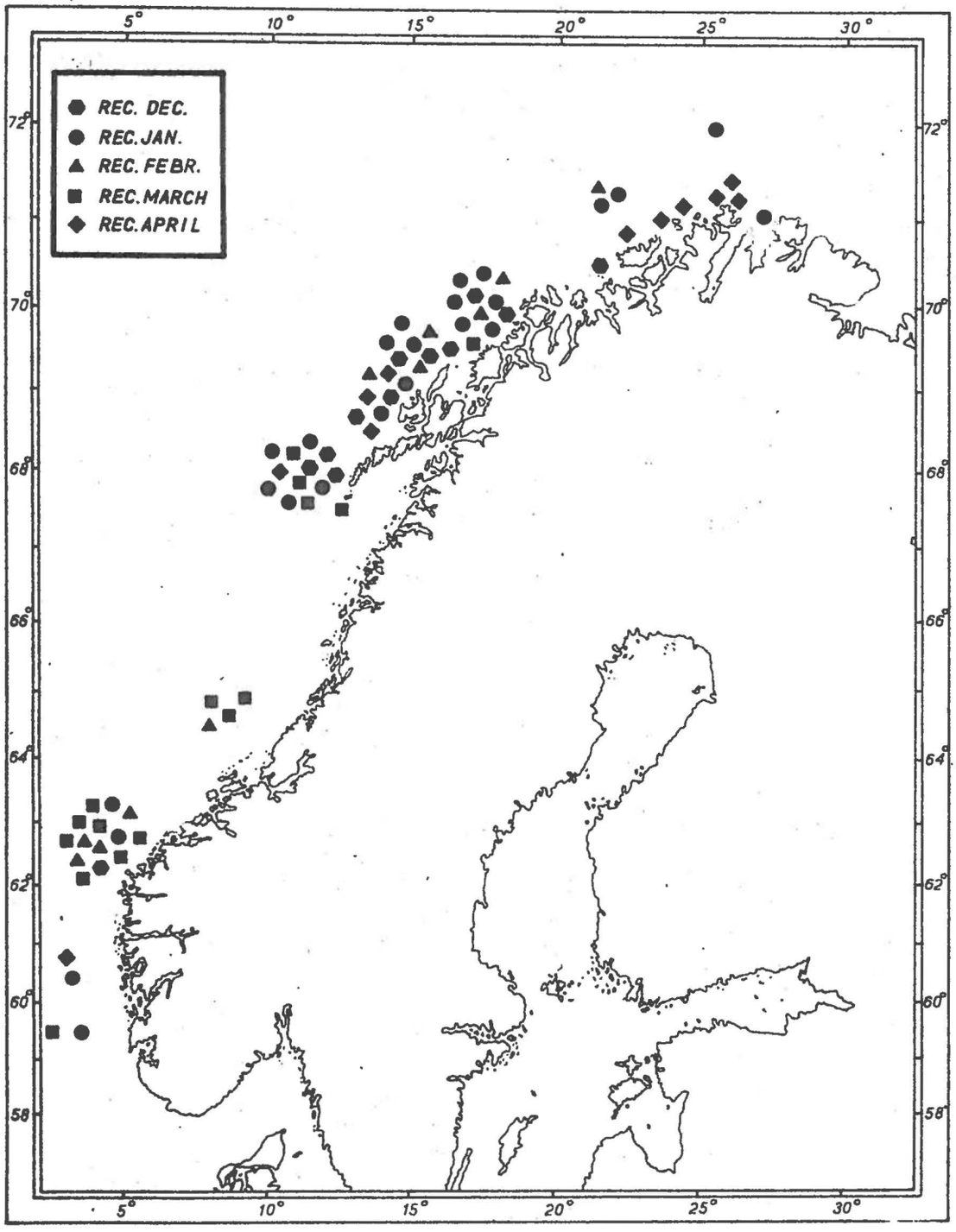

Fig. 8. Recaptures from December to April 1957/58 of coalfish tagged at the Finnmark coast in 1954, 1955, 1956 and 1957.

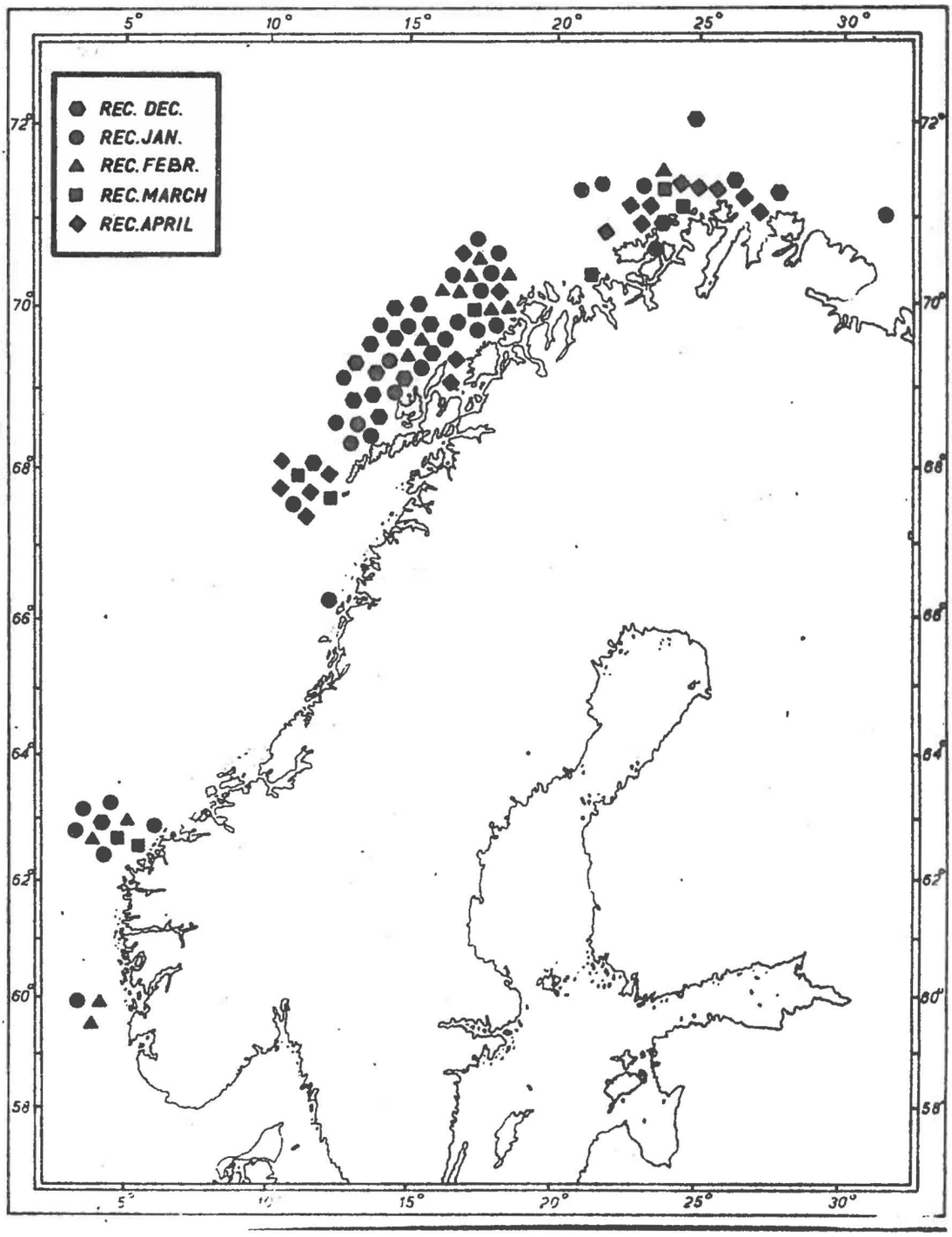

Fig. 9. Recaptures from December to April 1958/59 of coalfish tagged at the Finnmark coast in 1954, 1955, 1956, 1957 and 1958.

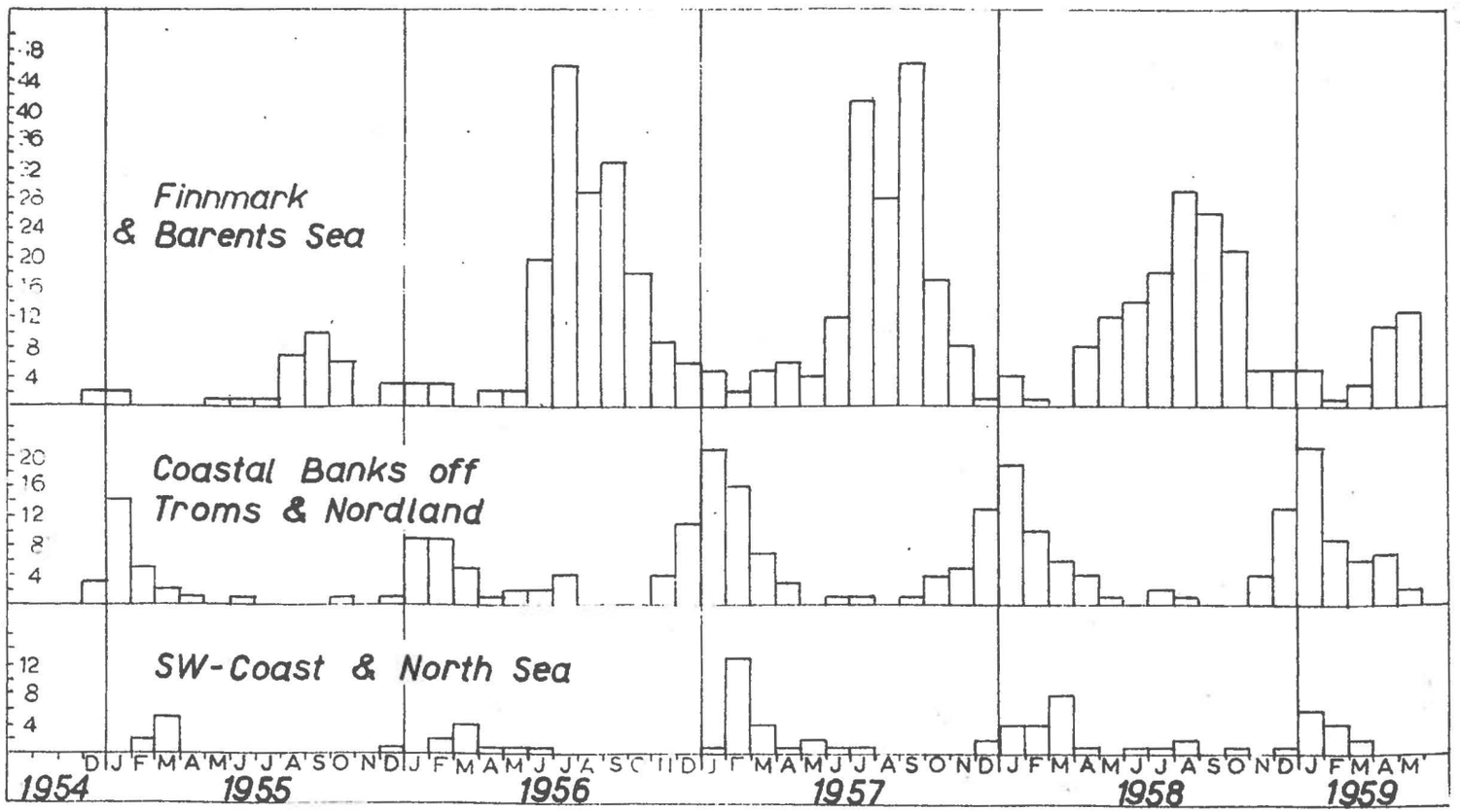

Fig. 10. Monthly numbers of recaptures in different areas from December 1954 to May 1959. Recaptures during the first four months after tagging are not included.