Bratberg

This paper not to be cited without prior reference to the author

International Council for the
Exploration of the Sea

C.M. 1966/H:27

Herring Committee

NORWEGIAN TAGGING EXPERIMENTS IN THE NORTH-EASTERN NORTH SEA AND SKAGERAK, 1964 AND 1965

by

Olav Dragesund and Steinar Haraldsvik

Institute of Marine Research, Bergen

INTRODUCTION

Except for the ICES herring tagging experiments in 1957 and 1958 on the Bløden Ground (Aasen, Andersen, Gulland, Popp Madsen and Sahrhage 1961) no large scale tagging of herring with internal metal tags have been carried out in the North Sea. However, in view of the rapid development of the herring fisheries in the northern and north-eastern North Sea in the recent years, the Herring Committee of ICES (Anon, 1965) in October 1965 recommended that: "for a better understanding of the relationship between the herring in the north-eastern North Sea and those on the traditional fishing grounds, and also for an estimate of the fishing mortality an international tagging programme should be launched immediately". It was recommended to carry out both internal and external tagging of overwintering herring in the north-eastern North Sea and tagging of feeding and spawning herring in the western North Sea. By that time Institute of Marine Research had already in January 1964 carried out one tagging with internal tags in the Skagerak area. Since the recommendation of the Herring Committee was given, attempts have been made by several nations to tag herring, and Norway has carried out three experiments (November 1965. June 1966 and July 1966).

The main objective of this report is to give a description of the experiments carried out in 1964 and 1965, and to consider some preliminary results that can be drawn from the recaptures. The 1966 experiments can not be dealt within this report due to the short time between the liberations and this meeting.

THE TAGGINGS

All the herring were tagged with internal steel tags and the method applied was briefly the same as described by Fridriksson and Aasen (1950 and 1952). It should be noted that the herring released were measured as to length, and scales were taken from each fish tagged. The taggings were performed from a small tagging craft at drift and the herring secured for tagging, were kept in a keep net tied to the side of the tagging craft. Herring were taken individually from the keep net by a dipnet, and released directly into the open sea. All the fish tagged had been caught by purse-seine. Weather conditions were favourable during the tagging operations.

The 1964 experiment (Fig.1)

During a cruise of R/V "G.M.Dannevig" a total number of 1000 herring were tagged about 30 nautical miles southwest of Lindesnes (Table 1). An analysis of a sample taken from the same catch as the tagged herring indicated that autumn spawners made up about 90.0 % of the herring in the sample. Unfortunately no otoliths were taken and it is difficult to give a certain classification in autumn and spring spawners according to age. However, it is likely that the 1960 year-class of the autumn spawned fish predominated the sample (Table 2).

More than 50 % of the herring in the sample were in maturity stages VII and VIII (Table 3) and consequently these herring are autumn spawners.

The mean number of vertebrae of the herring in stages VII and VIII was 56.48, and those in stages I and II 56.51, whereas the herring in maturity stage IV showed a mean number of 57.25. This latter group is certainly spring spawners, and judging from the mean number of vertebrae of herring in maturity stages I and II, it is likely, that most of these herring belong to the autumn spawned fish.

The 1965 experiment (Fig.1)

This tagging took place during a cruise of R/V "Johan Hjort" (Haraldsvik 1966). The first batch of 1700 herring (liberation 1) was released 5 November 25 nautical miles south of Ryvingen (Table 1).

The herring consisted of 91.2 % autumn spawners, and still the 1960 year-class predominated followed by the 1961 year-class (Table 2). The distribution of the maturity stages of the herring is shown in Table 3.

The next batch of 2300 herring (liberation 2) was released 7 November 20 nautical miles northwest of Skagen (Table 1). The herring tagged were almost entirely autumn spawned fish (97.9 %) of the 1963 year-class (Table 2). Most of these autumn spawners were in maturity stages I and II (Table 3) and the mean number of vertebrae was 56.59.

STATISTICS OF HERRING LANDED IN NORWAY FROM 1 JANUARY 1964 TO 30 JUNE 1966

Before analysing the tag returns it is nescessary to consider the catch statistics and some biological data of the herring collected in the area under consideration. This is especially important in case the recaptures are used for stock size and mortality estimates. For the present investigation it is suggested that the catch statistics together with biological data may give valuable information about the overwintering area for the autumn spawned stock in the north-eastern North Sea.

In 1964 the total catch of herring landed in Norway from the North Sea and Skagerak amounted to 192,520 tons, being more than five times the yield in 1963. This great increase in the yield is largely due to the purse-seiners participating in the North Sea and Skagerak fishery for the first time. The monthly catches landed in the different areas are given in Table 4. The landings from Skagerak derive mainly from an area at the entrance of Skagerak, about 20-40 nautical miles south and south-east of Lindesnes. In January 1964 the fishery mainly took place in this area, whereas during the following eight months most of the herring were caught at the Egersund Bank, and Coral Bank. From May to July (inclusive) herring were also caught at the Patch and Viking Banks. From October onwards the Skagerak again became the most important fishing area.

In 1965 the fishery yielded 603,886 tons. During the first two months of the year the main fishery took place at the entrance of Skagerak, whereas from March throughout the next eight months the fishery was centered at the Egersund Bank - Coral Bank, except in July and August, when a good purse-seine fishery east of Shetland developed for the first time (Table 5). In May also substantial catches were obtained at the Viking Bank. During the last two months of the year the fleet was fishing in the Skagerak and at the Egersund Bank.

Throughout the rest of the period from 1 January 1966 up to 30 June the fleet shifted between Egersund Bank and Coral Bank moving somewhat more towards west at the end of the period. The total catch during this period amounted to 160,000 tons (Table 6).

Pooling the samples collected during the period from 1 January to 30 June 1964 from Skagerak and Egersund Bank - Coral Bank, 85.8 % of the herring examined consisted of autumn spawners (Table 7), the 1960 year-class predominating (52.9 %), followed by the 1961 year-class (34.9 %).

Herring caught at the Egersund Bank - Coral Bank from 1 July to 31 October were also predominantly of autumn spawned fish (81.9 %) (Table 7). The 1960 and 1961 year-classes were the dominant ones in July, whereas the 1962 year-class strongly dominated the samples from the end of August to October. It should be noted that the admixture of spring spawners in August was relatively high. This is also reasonable since most of the mature herring at this time are more westerly distributed.

The samples taken from 1 November 1964 to 30 June 1965 in Skagerak and at the Egersund Bank - Coral Bank consisted of 94.9 % autumn spawners, among which the 1960 year-class predominated, followed by the 1961 and 1962 year-classes (Table 7). North of 59°N (Patch Bank and Viking Bank) the autumn spawners contributed only 66.1 %. In this latter area the older age-groups showed up somewhat more frequently than further south.

During the summer and early autumn 1965 the recruits of the autumn spawners (1963 year-class) were predominating at the Egersund Bank - Coral Bank. However, off Shetland the samples showed a completely different age composition. Also in this area the majority of the fish consisted of autumn spawners (84.2 %), but in contrast to the Egersund Bank - Coral Bank samples the older age groups were more abundant. The 1960 and 1956 year-classes were represented with 18.3 % and 14.3 % respectively.

In the samples collected from 1 November 1965 up to 30 June 1966 at Egersund Bank - Coral Bank and in Skagerak, the 1963 year-class constituted 41.2 % of the autumn spawners, whereas the 1961 and 1960 year-classes altogether contributed with only 34.5 % (Table 7).

Table 8 shows the mean number of vertebrae arranged according to period, area and spawning group. The means of the autumn spawners varied between 56.35 and 56.49 indicating that the Bank herring constituted the main bulk of the autumn spawned fish. During the summer and early autumn period (1 July to 31 October) some of the samples from Skagerak and Egersund Bank - Coral Bank show slightly lower means than in the period 1 November to 30 June. It is likely, therefore, that some admixture of Kattegat autumn spaners may take place during summer and early autumn.

The spring spawners appearing in the samples seem to originate mainly from the northern North Sea.

THE RETURNS

Comparing the biological data of the herring collected from 1 January 1964 up to 30 June 1966 with those of the herring in the samples from the same catches as the tagged herring, recaptures from the following periods and areas are of special interest: (1) 1 November to 30 June, Skagerak and Egersund Bank - Coral Bank and (2) 1 July to 30 October, Viking Bank - Shetland areas.

As it appears from Tables 4,5 and 6 the first area will probably cover the main overwintering grounds for the mature autumn spawned stock in the north-eastern North Sea. According to the biological characteristics of the herring collected in this area it is likely that no extensive emigration from and immigration to this area takes place from 1 November to 30 June the following year.

The second period and area can at present only be dealt with in connection with the 1964 experiment.

Returns from the 1964 experiment (Fig.1)

In Table 9 is given a complete list of all returns during the period from the tagging up to 30 June 1966. Altogether 17 tags have been recaptured from this experiment, of which 11 are detected at Norwegian plants equipped with magnets. Most of the tags were recaptured in the Egersund Bank - Coral Bank area. However, it should be borne in mind that internal tags recovered at oil and meal factories cannot be allocated with certainty to a particular area and day of landing, because the tag may not reach the magnet and be recovered until some time has passed after the herring have been landed. Notwithstanding this disadvantage it is likely that most of the tags recovered can be mapped out correctly according to the informations given by the factories, which usually know the time it takes a tag from landing until it passes through the machinery. As the fishing area of the catch (reduced) is known, the area of recapture can be figured out fairly well. It should be noted that only one tag of the 1964 experiment has been recovered in 1965, eventhough the yield from the North Sea and Skagerak this year was extremely high compared to the previous year. In 1966 only 3 tags have been found up to 30 June.

Returns from the 1965 experiment (Fig.1)

Table 10 shows the summary of returns for the two liberations in 1965 up to 30 June 1966. A total of 83 recoveries from liberation 1 are returned, of which 67 are detected at Norwegian plants equipped with magnets. From liberation 2, 67 tags are recovered, 36 at Norwegian plants equipped with magnets. The tags both from liberations 1 and 2 are mainly recaptured at the Egersund Bank and in the Skagerak. Most of the 26 recoveries from Skagerak are from Danish oil and meal factories.

Returns from Norwegian plants

Only the recoveries from herring landed in Norway will be dealt with quantitatively in this report, and special attention, therefore, will be paid to the returns from Norwegian oil and meal factories. However, not all the returns from factories equipped with magnets can be dealt with quantitatively due to low efficiency of the magnets and unreliable data on the catch reduced.

During the period 15 January to 30 June 1964 all the 6 recoveries were detected at one factory (Table 11). Out of a total catch of 47,828 tons landed in the same period, 18,251 tons were reduced to oil and meal at factories equipped with magnets. Unfortunately only four factories with tested magnets can be considered. The recapture rate was estimated to 0.366 per mille returns per 1000 tons.

From July to October (inclusive) it is likely that most of the herring tagged were out of the area where the Norwegian fleet operated, and judging from Table 7 the catches were also strongly dominated by recruits. The low number of returns (1 tag), therefore, is reasonable during this period. However, from 1 November 1964 up to 30 June 1965 only one tag was recovered (Table 12). This low figure is strange taking into account the relatively good fishery that took place in this period (Tables 5 and 6) and bearing in mind that the same year-classes predominated the catches as the year before. (The per mille returns per 1000 tons was only 0.008).

During the summer/autumn period from 1 July to 31 October 1965 no herring were recaptued from Skagerak and Egersund Bank - Coral Bank. This is also reasonable since the 1962 and 1963 year-classes made up more than 60 % of the herring caught (autumn spawners). Off Shetland, however, the purse-seiners exploited the same year-classes as those tagged. Out of a catch of 187,842 tons from this area only one tag was recovered (Table 9).

Turning to the returns of the 1965 experiment (Table 10) it will be seen that almost all the tags were recovered in the Skagerak and Egersund Bank - Coral Bank area. Taking into account the recoveries only from this area and pooling the number of returns from liberations 1 and 2 a total number of 99 tags were detected at 10 factories (Table 13), giving a per mille returns of 0.239 per 1000 tons.

FACTORS AFFECTING THE RETURNS OF TAGS

The percentages of returns of tags may be influenced by several factors, among which the following are the most important: (1) uneven dispersal of the tagged fish and the fishing effort in the area under consideration, (2) non-returns of tags recovered and losses of tags not being detected, (3) mortalities due to tagging, handling and bad condition of the fish tagged, (4) losses of tags from the fish by shedding and (5) losses of tags through migration.

Uneven dispersal of the tagged fish and the fishing effort

It is striking that only one factory (No.2) has detected all the tags from the 1964 experiment (Tables 11 and 12). It should be noted that during the first 6 months of 1964 the herring landed were reduced at only a few factories compared with the period from 1 November 1964 to 30 June 1965. Nevertheless, it is expected to find tags at all factories listed in Tables 11 and 12. The explanation for this bias in returns must be the failure of the tagged herring to disperse randomly. Since also the fleet obviously did not fish at random, such an uneven distribution of the returns may occur.

Nor did the herring tagged in 1965 seem to mix evenly during the first 8 months after release (Table 13). By using the mean number of tags per 1000 tons of reduced herring as the expected number and comparing it with the actual number of returns per 1000 tons in each reduction plant , it proved possible to carry out a χ^2- test. The χ^2- values obtained ($p < 0.05$) indicate that the tags are not randomly distributed between reduction plants, both when considering the returns from liberations 1 and 2 separate and pooling them. Also when excluding the recaptures during the first three months after the release the distribution of the tag returns was biased ($p < 0.05$).

Non-return of tags recovered and losses of tags not being detected

Not all the tags from recaptured fish are returned, some tags are not sent to the Institute of Marine Research, some fish are processed at factories not equipped with magnets, and some tags are not detected by the magnets.

The non-returning rate of recovered tags of cod, coalfish, haddock, halibut and catfish in Norway was estimated to be at least 4-6 % (Hylen 1963). However, it should be noted that the reward for each of these tags is 5 N.kr., whereas the reward for a herring tag is 10 N. kr. Almost all the recoveries of internal tags come from oil and meal factories and in these plants there are only a few workers who attend to that part of the machinery where the magnets are placed. Thus, only a fairly limited number of people are dealt with, and in all the plants there are placed posters with detailed instructions of what to do with the recovered tags. Due to this circumstances and a worth while reward, the loss in Norwegian plants due to non-returns of tags recovered is probably negligible.

The returns from factories without magnets and with magnets of especially low efficiency are rejected for further quantitative treatment in this report. To test the efficiency (e) of the magnets the returns from a known number of tagged fish introduced into each factory is measured. The figures for e at the different plants are listed in Table 11, 12 and 13. The efficiency (e) at each factory multiplied by the quantity (p) give the effective quantity of herring reduced (e x p) in Tables 11, 12 and 13.

Mortality due to tagging, handling and bad condition of the fish

No special test was carried out to investigate the tagging mortality in connection with the present tagging experiments. However, several attempts have been done to study this problem on Norwegian spring spawners (Fridriksson and Aasen 1950, 1952). These experiments indicate that the tagging mortality can be regarded as almost insignificant.

During the summer 1966 a tank experiment was carried out at Institute of Marine Research, Bergen, to test the mortality of internal tagged herring. In August 1965 herring were brought to the Institute from a purse-seine catch near Bergen. The herring were kept under observation by Haraldsvik for growth studies (these experiments are not yet finished), and on 17 June 1966 104 of these herring (Table 14) were taken from one of the tanks and tagged with internal steel tags and transferred into a tank of the same size $(6x3x1.80)m^3$ close by.

The herring swam restless around without forming a shoal just after the tagging and did not eat the first two days. When the experiment was finished 9 September 1966, unfortunately 25 of the tagged herring were lacking, those fish probably being caught by birds. A total of 8 herring were picked up as dead, of which 4 died during the first three days of the experiment. When examining the dead herring and the position of the tag, it seems likely that non of the herring had been directly hurt by the tag itself. A more likely reason for the mortality is the tagging operation, including catching and handling of the fish.

Excluding the loss of the 25 herring the tagging mortality is estimated to 10.1 per cent, whereas including these herring the mortality amounts to 7.7 per cent. For calculating the effective number of herring tagged the mean value of these two figures (8.90 %) is used.

Differences in percentages of returns of herring tagged by various taggers have been demonstrated by Aasen et al. (1961). In the present investigation all the herring tagged in 1964 were tagged by the same tagger, whereas the 1965 experiment was performed by three different persons. Judging from Table 15 no special trend is noticed, and it seems likely ($p > 0.01$) that the herring have been subjected to the similar handling by the different taggers.

Especially in open sea taggings, where herring have to be provided by purse-seiners and transferred into a keep net before the tagging can start, sometimes in unfavourable weather, the herring may soon be descaled and the condition of the fish will become reduced.

If this was the case in the present experiment one might expect to find more returns from fish tagged early in each liberation (first half of release) than those from the second half of release. In two cases (Table 16) the rate of recaptures is slightly higher for the first half of release, whereas it is lower in one. Testing the 1:1 ratio by applying a χ^2-test no significant differences could be found ($p > 0.01$). The extremely favourable weather during all the tagging operations may explain this close agreement in returns.

Shedding of tags

The present tank experiment showed that 4 tags were lost by shedding. Control sampling the tagged herring it was revealed that the wound caused by the insertion of the tag had healed after 9 weeks, and loss of tags due to shedding will not take place after this time.

Tests have also been made on Norwegian spring spawners by Dragesund (unpublished data), and according to these experiments special attention should be given to herring tagged in prespawning and spawning stages. Tags were frequently found in one or both gonads, and these tags will be subjected to a pressure during the spawning process. Consequently the shedding will be relatively high when fish are tagged in these stages. Since the herring tagged in the present experiments were all in post spawning stages or immature, the shedding rate should be compareable with those of the herring in the tank experiment, giving an average value of 4.45 per cent.

Variations assosiated with the size of fish and losses from migration

Almost all the herring (98 %) landed from the North Sea and Skagerak have been caught by purse-seine, and it is unlikely, therefore, to expect any selection effect due to fishing on the number of returns. However, the mortality of the tagged herring may be associated with the size of the fish so that the larger fish survive better than the smaller ones, or vice versa.

In Table 17 is given the length distributions of the tagged and recaptured fish, together with the means and variances. The differences between the means are small and far from being significant both separately and combined.

Losses of tags may also take place by segregation. From Table 7 it will be seen that mainly old herring were caught off Shetland by the purse-seiners in the summer 1965. It could be that the older age-groups of the tagged herring remained in this area and did not return to the Skagerak and Egersund Bank - Coral Bank after spawning to the same extent as the younger mature fish. However, this possibility can hardly explain the low rate of recapture of the 1964 experiment during the period from 1 November 1964 to 30 June 1965, since the same year-classes occurred in the catches from Skagerak and Egersund Bank - Coral Bank as of the tagged fish (Table 2).

CONCLUDING REMARKS

The present results are not sufficient to give a description of the movement of the herring from the overwintering area in the north-eastern North Sea to the feeding and spawning area in the northern and western North Sea. It should be pointed out that for more detailed and reliable analysis of the migration pattern as indicated by tagging experiments, external as well as double tagging should be carried out.

Even though not all the requirements for an unbiased stock size estimate are fulfilled a tentative estimate for the overwintering stock in the north-eastern North Sea is given. For an ideal experiment of this kind it is necessary that: (1) the tagged fish or the fishing effort is evenly dispersed throughout the area under consideration, (2) data for adjustment for losses of tags in reduction plants and tagging mortality, handling of the fish and shedding of tags is available, (3) there is no recruitment during the period in question and (4) no migration of fish into or out of the tagging and recapture areas takes place.

Defining the overwintering area as the Skagerak and Egersund Bank - Coral Bank and considering the returns of the 1965 experiment during the period from tagging to 30 June 1966, the requirement (1) is not fulfilled. This is shown by the results from the χ^2- test comparing the expected number with actual number of returns in the reduction plants.

It should be noted that not the whole quantity reduced in the plants come from the overwintering area. However, making correction for the amount caught outside this area would hardly influence the test. The further analysis of the results would be more reliable if the local fishing intensity on each liberation could be calculated. This requires detailed effort statistics by areas and some assumptions about the movements and dispersal of the tagged fish. Unfortunately no effort statistics is available at present and consequently the figure of the stock size will be biased.

To adjust for losses of tags mentioned under requirement (2) the data presented in Table 13 and the results of the tank experiment are used. Applying the figures obtained for tagging mortality and shedding of tags in the tank experiment, the effective number of tagged herring is calculated to be 3465.

The third and fourth requirements are difficult to judge thoroughly from the present material. It is likely that recruits were present throughout the period in question although the samples collected indicate that the 1963 year-class is less abundant from March onwards (Table 18). The rate of mixture between the spring and autumn spawners were almost the same during the period under consideration.

The westward migration from the overwintering area to the feeding and spawning grounds in northern and western North Sea usually starts in June and it is reasonable therefore, to assume that the dominant part of the autumn spawners is concentrated in the Skagerak and north-eastern North Sea during the period from November to June (inclusive).
On the other hand it should be noted that the fishery off Shetland started somewhat earlier in 1966 than in 1965 and the first catches from this area were caught in the middle of June. However, only a few herring have been recaptured in this area up to the end of June 1966.

In the absence of reliable effort statistics and data on local fishing intensity a reasonable estimate of the stock size in the overwintering area can be obtained from the 1965 experiment using a modification of the simple Petersen method (Aasen et al. 1961). In Figure 2, the number of tags returned each month by factories equipped with tested magnets have been plotted against the weight of herring reduced at the same factories in that month. These data have been fitted by a simple proportional line, giving 9.7 tags per 10 000 tons landed.
The individual fish may have grown since the time of tagging, so that the 10 000 tons of fish in May/June represented less than 10 000 tons at the time of tagging. However, during the time in question the number of tagged herring has decreased due to fishing and natural mortality and this will to some degree balance the increase both in the length and fatness. For the present calculations therefore, no correction has been made for these factors influencing the number of returns in relation to the quantity landed.

The number of herring effectively tagged was 3465 and the estimated stock at the time of tagging is calculated to 3465 x 10,000/9.7= 3,572 mill. tons.

Omitting liberation 2 and only taking into account the herring tagged in liberation 1, the estimated stock size is calculated to 1473 x 10,000/6.2= 2.376 mill. tons. The cause of this difference in stock size is probably that the herring tagged in the eastern part of Skagerak (liberation 2) were mainly recruits and did not appear in the main fishery area for the Norwegian fleet to the same extent as the herring tagged further to the west (liberation 1). From Table 10 it will be seen that a difference in pattern of returns exists between the two liberations as 80.7 % of the returns from liberation 1 and 53.7 % of the returns in liberation 2 are recovered by Norwegian plants equipped with magnets respectively. The rest of the tags not returned from Norwegian plants, are recaptured by foreign vessels, mainly Danish and German.

At present no further steps can be taken to estimate the total catch/stock size relationship in the overwintering area as the catch statistics for the other nations fishing in the same area are not yet available. However, the catch taken by the Norwegian fleet from 1 November 1965 to 30 June 1966 expressed as percentage of the stock present at the time of tagging is 5.29 per cent and 7.96 per cent respectively.

Further experiments are needed to confirm the validity of the results obtained from the present investigation. However, the tagging experiments have already shown some reasonable estimates of the stock size in the north-eastern North Sea, and further tagging will be of great importance to solve some of the urgent problems in the North Sea.

REFERENCES

Anon. 1965. Resolutions passed by the 53rd Statutory Meeting. Proces-Verbal de la Reunion 1965. ICES meeting, 1965: 110-121. (Mimeo.).

Aasen, O., Andersen, K.P., Gulland, J., Popp Madsen, K. and Sahrhage, D. 1961. ICES Herring Tagging Experiments in 1957 and 1958. Rapp. Cons. Explor. Mer, 152: 1-50.

Haraldsvik, S. 1965. Sildeundersøkelser i Nordsjøen og Skagerak med F/F "Johan Hjort" 18. oktober - 10. november 1965. Fiskets Gang, 52: 813-817.

Hylen, A. 1963. The non-returning of fish tags recovered by Norwegian fishermen. FiskDir. Skr. Ser. HavUnders., 13(6): 80-87.

Fridriksson, A. and Aasen, O. 1950. The Norwegian - Icelandic herring tagging experiments. Report No. 1. FiskDir. Skr. Ser. HavUnders., 9(11): 1-43.

- " - 1952. The Norwegian - Icelandic herring tagging experiments Report No. 2. Rit. Fiskid., 1(1): 1-54.

Table 1. Norwegian tagging experiments in north-eastern North Sea and Skagerak, 1964 and 1965

Date	Position N	Position E	Mode of catch	Lib. No.	Type of tag	Serial numbers	Total
1964 17 Jan.	57°37'	06°35'	Purse-seine	1	Internal	N 240501-241500	1000
1965 5 Nov.	57°30'	07°20'	Purse-seine	1	Internal	N 255501-256900	1400
" " "	-"-	-"-	- " -	"	- " -	N 257001-257300	300
" 7 Nov.	58°12'	10°53'	Purse-seine	2	Internal	N 256901-257000	100
" " "	-"-	-"-	- " -	"	- " -	N 257301-259500	2200
						Total	5000

Table 2. Age composition of autumn and spring spawners in samples taken from the same catches as the tagged herring *

1964				1965						
Lib. 1				Autumn spawners					Spring spawners	
Winter-rings	N	%	Year-class	Lib. 1 N	Lib. 1 %	Lib. 2 N	Lib. 2 %	Year-class	Lib. 1 N	Lib. 2 N
0	-	-	1963	4	4.8	91	96.8	1964	-	1
1	-	-	1962	13	15.7	2	2.1	1963	1	1
2	28	30.4	1961	23	27.7	-	-	1962	3	-
3	53	51.6	1960	33	39.8	1	1.1	1961	3	-
4	2	2.2	1959	-	-	-	-	1960	1	-
5	-	-	1958	2	2.4	-	-	1959	-	-
6	2	2.2	1957	1	1.2	-	-	1958	-	-
7	2	2.2	1956	7	8.4	-	-	1956	-	-
8	4	4.3	1955	-	-	-	-	1955	-	-
8+	1	1.1								
Total	92	100.0		83	100.0	94	100.0		8	2

* 8 herring from liberation 1 (1964) did not fit for age determination, nor did 9 herring from liberation 1 (1965) and from liberation 2 (1965) fit for age and type determinations.

Table 3. The maturity stages of the herring in samples taken from the same catches as the tagged herring

Maturity stage	1964 Liberation 1 N	1964 Liberation 1 %	1965 Liberation 1 Autumn spawners N	1965 Liberation 1 Autumn spawners %	1965 Liberation 1 Spring spawners N	1965 Liberation 2 Autumn spawners N.	1965 Liberation 2 Autumn spawners %	1965 Liberation 2 Spring spawners N
I	27	27.0	4	4.7	1	57	60.6	1
II	14	14.0	4	4.7	1	35	37.2	-
III	3	3.0	-	-	-	1	1.1	2
IV	4	4.0	-	-	3	-	-	-
V	-	-	-	-	4	-	-	-
VI	-	-	-	-	-	-	-	-
VII	5	5.0	7	8.2	-	1	1.1	-
VIII	46	46.0	70	82.4	1	-	-	-
Total	100	100.0	85	100.0	10	94	100.0	3

Table 4. Landings of herring in Norway (in tons) from the North Sea and Skagerak arranged according to month and fishing area, 1964

Approx. rect. ref. to in (Stat. Newsletter)	Fishing area	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
18 E	Bressay shoal	-	-	-	-	2.0	186.5	177.0	54.2	299.7	-	-	-	719.4
15 E	Fladen Ground	-	17.7	25.1	-	-	-	182.3	377.0	1222.4	68.2	-	-	1892.7
	West of 02°E	-	17.7	25.1	-	2.0	186.5	359.3	431.2	1522.1	68.2	-	-	2612.1
20 H	Viking Bank	-	71.4	162.1	2.1	1562.3	2140.1	155.6	2.8	-	-	-	-	4096.4
17 G	Patch Bank	-	281.0	358.9	231.8	26.9	9343.1	1226.6	144.8	527.9	82.7	4.4	-	12228.1
	North of 59°N	-	352.4	521.0	233.9	1589.2	11483.2	1382.2	147.6	527.9	82.7	4.4	-	16324.5
16 G	Coral Bank	-	-	-	-	-	1306.7	6201.4	54.0	836.1	199.8	-	-	8598.0
15 G	Ling Bank	-	-	-	-	-	-	-	207.9	299.8	174.3	-	-	682.0
15 J-K	Egersund Bank	123.2	1602.7	399.5	936.6	62.0	27.4	7989.6	22968.0	8265.3	4235.5	-	-	46609.8
14 G	West Bank	87.2	-	-	-	-	-	-	-	-	-	-	-	87.2
14 J-K	Jaeren Riff	346.6	1582.5	649.2	1107.1	1343.2	598.7	1086.9	-	1796.2	11846.1	87.8	-	20462.3
14 L-M	Lista	138.3	-	-	-	-	-	-	-	-	-	-	-	138.3
	South of 59°N	713.3	3185.2	1048.7	2043.7	1405.2	1932.8	15277.9	23299.9	11197.4	16455.7	87.8	-	76577.6
Sum area IV a		713.3	3555.3	1594.8	2277.6	2994.6	13602.5	17019.4	23808.7	13247.4	16606.6	92.2	-	95514.2
12-13 G	Stone Riff	-	-	-	-	-	-	-	292.0	67.5	979.2	-	-	1338.7
11 L	Bløden Ground	-	-	-	-	-	-	-	869.1	51.4	-	-	-	920.5
10-12 H	Danish Coast	-	-	-	-	-	-	3883.9	2247.4	-	-	-	-	6131.3
9 G	Dogger Bank	-	-	-	-	5.6	-	-	-	-	-	-	-	5.6
Sum area IV b		-	-	-	-	5.6	-	3883.9	3408.5	118.9	979.2	-	-	8396.1
15 N	Skagerak Coast	22875.5	19.8	3.3	19.4	0.4	-	-	1557.5	2391.1	16869.1	19438.4	20503.1	83677.7
14 O	Halse Bank	-	-	-	-	1.2	119.2	2190.2	918.1	1072.3	135.6	-	-	4436.6
13 N	Hanstholmen	-	-	-	-	-	-	-	450.4	-	-	-	-	450.4
14 P	Skagen	-	45.1	-	-	-	-	-	-	-	-	-	-	45.1
Sum area III a		22875.5	64.9	3.3	19.4	1.6	119.2	2190.2	2926.0	3463.4	17004.7	19438.4	20503.1	88609.8
Grand Total		23588.8	3620.2	1598.1	2297.0	3001.8	13721.7	23093.5	30135.7	16829.7	34590.5	19530.6	20503.1	192520.1*

* tons landed by foreign vessels in Norway

Table 5. Landings of herring in Norway (in tons) from the North Sea and Skagerak arranged according to month and fishing area, 1965

Approx. rect. ref. to in (Stat. Newsletter)	Fishing area	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
20 G	Tampen	-	34.4	-	-	1.7	-	-	-	-	-	-	-	36.1
19-20 D	Shetland	-	-	-	-	2693.6	158.8	83781.6	91563.0	12497.3	-	-	-	190694.3
18 E	Bressay shoal	-	-	-	-	93.2	-	1.5	-	-	-	-	-	94.7
15 E	Fladen Ground	-	8.5	-	-	-	-	47.0	1846.3	1234.4	155.2	30.2	-	3321.6
West of 02°E		-	42.9	-	-	2788.5	158.8	83830.1	93409.3	13731.7	155.2	30.2	-	194146.7
20 H	**Viking Bank**	-	7.2	30.4	2522.5	17253.1	-	-	1.7	1647.2	1.5	-	-	21463.5
17 G	**Patch Bank**	-	133.3	406.1	3478.9	1291.8	921.3	3.1	128.1	1805.5	85.8	0.8	-	8257.8
17 H	**Sirahola**	-	-	71.3	393.8	77.7	-	-	-	-	-	-	-	542.8
North of 59°N		-	140.5	507.8	6395.2	18622.6	921.3	3.1	129.8	3452.7	87.3	0.8	-	30246.1
16 G	Coral Bank	-	-	-	-	3514.4	79874.5	41884.0	246.9	1047.2	-	-	-	126567.0
15 G	Ling Bank	-	-	-	4.7	193.9	1089.9	147.3	-	-	-	-	-	1435.8
15 J-K	Egersund Bank	381.3	478.6	2256.0	1139.6	807.7	12154.8	17993.7	20786.4	18159.3	35553.4	134.9	1525.7	111370.8
14 J-K	Jaeren Riff	2.8	74.8	833.3	5066.6	7619.0	1186.2	815.9	1645.4	245.9	833.2	-	-	18323.1
14 L-M	Lista	-	-	-	-	-	-	-	9991.0	6328.1	18157.9	1540.3	233.8	36251.1
South of 59°N		384.1	545.9	3089.3	6210.9	12135.0	94305.4	60840.3	32669.7	25780.5	54544.5	1675.2	1759.5	293947.8
Sum area IV a		384.1	729.3	3597.1	12606.1	33546.1	95385.5	144673.5	126208.8	42964.9	54787.0	1706.2	1759.5	518358.6
11 L	Bløden Ground	-	-	-	-	-	-	-	130.4	-	-	-	-	130.4
9 G	Dogger Bank	-	-	-	-	122.2	788.6	-	-	-	-	-	-	910.8
Sum area IV b		-	-	-	-	122.2	788.6	-	130.4	-	-	-	-	1041.2
15 N	Skagerak Coast	24122.4	20790.9	340.4	-	-	-	-	3282.8	2435.7	6300.8	24594.7	988.3	82856.0
14 O	Halse Bank	-	-	-	-	-	-	1046.3	430.7	-	-	78.3	-	1555.3
13 N	Hanstholmen	-	-	-	-	-	-	44.6	-	-	-	-	-	44.6
Sum area III a		24122.4	20790.9	340.4	-	-	-	1090.9	3713.5	2435.7	6300.8	24673.0	988.3	84455.9
Not specified		-	29.9	-	-	-	-	-	-	-	-	-	-	29.9
Grand Total		24506.5	21557.6	3937.5	12606.1	33668.3	96174.1	145764.4	130052.7	45400.6	61087.8	26379.2	2747.8	603885.6*

* 1668.3 tons landed by foreign vessels in Norway

Table 6. Landings of herring in Norway (in tons) from the North Sea and Skagerak arranged according to month and fishing area, 1 January to 30 June 1966

Approx. rect ref. to in (Stat. Newsletter	Fishing area	Month						
		Jan.	Febr.	March	April	May	June	Total
20 G	Tampen	-	-	-	12.3	-	-	12.3
19-20 D	Shetland	-	49.3	66.5	-	-	30083.0	30198.8
15 E	Fladen Ground	-	-	118.8	5.4	-	-	124.2
West of 02°E		-	49.3	185.3	17.7	-	30083.0	30335.3
20 H	Viking Bank	-	76.3	109.9	50.9	1327.0	154.5	1718.6
17 G	Patch Bank	-	2.6	-	165.4	-	263.3	431.3
17 H	Sirahola	-	-	-	2463.7	3201.7	14.6	5680.0
North of 59°N		-	78.9	109.9	2680.0	4528.7	432.4	7829.9
16 G	Coral Bank	-	-	-	422.1	-	3113.1	3535.2
15 G	Ling Bank	-	-	-	-	-	-	-
15 J-K	Egersund Bank	7166.4	292.7	254.9	2933.0	49888.6	54509.9	115045.5
14 J-K	Jaeren Riff	84.3	14.3	108.2	446.4	99.6	159.5	912.3
14 L	Lista	-	-	-	-	-	-	-
	Lindesnes	1917.8	-	-	-	-	-	1917.8
South of 59°N		9168.6	307.0	363.1	3801.5	49988.2	57782.5	121410.8
Sum area IV a		9168.6	435.2	658.3	6499.2	54516.9	88297.9	159576.0
15 N	Skagerak Coast	419.8	-	-	3.8	-	-	423.6
Sum area III a		419.8	-	-	3.8	-	-	423.6
Sum Total		9588.4	435.2	658.3	6503.0	54516.9	88297.9	159999.6*

* 360.7 tons landed by foreign vessels in Norway

Table 7. Age composition of herring from Skagerak and northern North Sea arranged according to period, area and type (the figures in brackets, %)

Period	Area	Type		Year class																			
				Autumn spawners										Spring spawners									
		Autumn spawn.	Spring spawn.	1964	1963	1962	1961	1960	1959	1958	1957	1956	<1956	1964	1963	1962	1961	1960	1959	1958	1957	1956	<1956
1964 1 Jan. - 30 Jun.	Skagerak, Eger-sund B., Coral B.	338 (85.8)	56 (14.2)				114 (34.9)	173 (52.9)	9 (2.7)	1 (0.3)	4 (1.2)	22 (6.8)	4 (1.2)			3 (5.3)	43 (76.8)	7 (12.5)	3 (5.3)				
1964 1 Jul. - 31 Oct.	Eger-sund B., Coral B.	506 (81.9)	112 (18.1)			218 (44.8)	97 (19.9)	143 (29.4)	9 (1.8)	6 (1.2)	4 (0.8)	9 (1.8)	1 (0.2)		1 (1.0)	3 (3.1)	71 (73.2)	8 (8.2)	9 (9.3)	4 (4.1)			1 (1.0)
1964/65 1 Nov. - 30 Jun.	Skagerak, Eger-sund B., Coral B.	460 (94.9)	25 (5.1)			78 (17.8)	134 (30.5)	197 (44.9)	4 (0.9)	4 (0.9)	3 (0.7)	18 (4.1)				3 (12.0)	16 (64.0)	5 (20.0)		1 (4.0)			
1965 1 Jul. - 31 Oct.	Skagerak, Eger-sund B., Coral B.	465 (86.3)	74 (13.7)		212 (49.1)	58 (13.4)	16 (3.7)	90 (20.8)	7 (1.6)	6 (1.4)	13 (3.0)	29 (6.7)	1 (0.2)	5 (7.1)	7 (10.0)	3 (4.3)	35 (50.0)	6 (8.6)	12 (17.1)	1 (1.4)		1 (1.4)	
- " -	Shetland	358 (84.2)	67 (15.8)			25 (7.6)	60 (18.3)	168 (51.7)	5 (1.5)	10 (3.1)	12 (3.7)	47 (14.3)	1 (0.3)			2 (3.1)	48 (73.8)	4 (6.2)	11 (16.9)				
1965/66 1 Nov. - 30 Jun.	Skagerak, Eger-sund B., Coral B.	902 (91.2)	87 (8.5)	2 (0.2)	365 (41.2)	160 (18.1)	98 (11.1)	207 (23.4)	5 (0.5)	5 (0.5)	7 (0.8)	36 (4.1)	1 (0.1)	29 (33.7)	15 (17.4)	16 (18.6)	12 (14.0)	3 (3.5)	8 (9.2)	1 (1.2)	1 (1.2)	1 (1.2)	

Table 8. Mean number of vertebrae of herring from Skagerak and northern North Sea arranged according to period, area and type (figures in brackets, number)

Period	Area	Mean number of vertebrae	
		Autumn spawners	Spring spawners
1964 1 January - 30 June	Skagerak, Egersund B., Coral B.	56.43 (334)	56.89 (55)
1 July - 31 October	Egersund B., Coral B.	56.35 (494)	57.01 (106)
1964/65 1 November - 30 June	Skagerak, Egersund B., Coral B.	56.49 (443)	56.88 (24)
- " -	North of 59 N	56.46 (144)	57.00 (77)
1965 1 July - 31 October	Skagerak, Egersund B., Coral B.	56.42 (335)	57.01 (48)
- " -	Shetland	56.45 (222)	57.17 (35)
1965/66 1 November - 30 June	Skagerak, Egersund B., Coral B.	56.40 (712)	56.73 (74)

Table 9. Summary of returns from the 1964 experiment arranged according to area and month after release. The figures in brackets are number of tags recovered at Norwegian plants equipped with magnets

	Month after release																																
	1964													1965												1966							
Area	1	2	3	4	5	6	7	8	9	10	11	12	Uncertain	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Uncertain	Total
Skagerak											1 (1)		1 -																				2 (1)
Egersund B., Coral B.	3 (3)	1 (1)	1 (1)	1 (1)				1 (1)																							2 (2)		9 (9)
Shetland																					1 (1)												1 (1)
Uncertain				3 -									1 -																			1 -	(5 -
Total	3 (3)	1 (1)	1 (1)	4 (1)				1 (1)			1 (1)		2 -								1 (1)										2 (2)	1 -	17 (11)

Table 10. Summary of returns from the 1965 experiment arranged according to area and month after release. The figures in brackets are number of tags recovered at Norwegian plants equipped with magnets

Liberation	Area	Month after release								
		1965		1966						
		1	2	3	4	5	6	7	8	Total
1	Skagerak	11 (6)	1 -							12 (6)
"	Egersund B., Coral B.		1 (1)	2 (2)			6 (6)	8 (7)	32 (30)	49 (46)
"	Shetland								8 (7)	8 (7)
"	Uncertain	3 (1)		2 -	1 (1)	2 -			6 (6)	14 (8)
"	Total	14 (7)	2 (1)	4 (2)	1 (1)	2 -	6 (6)	8 (7)	46 (43)	83 (67)
2	Skagerak	7 -	3 (1)		1 -	1 -	2 -			14 (1)
"	Egersund B., Coral B.		1 (1)	3 (3)			1 (1)	14 (14)	16 (16)	35 (35)
"	Shetland									
"	Uncertain	4 -	1 -	1 -	1 -	8 -	1 -	1 -	1 -	18 -
"	Total	11 -	5 (2)	4 (3)	2 -	9 -	4 (1)	15 (14)	17 (16)	67 (36)
1 and 2	Grand total	25 (7)	7 (3)	8 (5)	3 (1)	11 -	10 (7)	23 (21)	63 (62)	150 (103)

Table 11. Quantity of herring (in tons) processed and number of returns from the 1964 experiment at Norwegian plants equipped with magnets, 15 January to 30 June 1964

Factory No.	Month						Quantity (p)	Efficiency (e)	Corrected quantity (e x p)	Returns
	Jan.	Febr.	March	April	May	June				
2	5125.0	898.5	391.5	343.1	61.5	282.6	7102.2	0.95	6747.1 *	6
12	233.7	567.6	199.6	546.9	27.4	534.7	2109.9	0.94	1983.3	-
16	56.4	502.6	189.8	170.2	-	2346.7	3265.7	0.93	3037.1	-
31	21.3	172.7	146.9	424.0	2034.8	2973.9	5773.6	0.80	4618.9	-
Total	5436.4	2141.4	927.8	1484.2	2123.7	6137.9	18251.4		16386.4	6

* 953.7 tons derive from landings of foreign fishing boats in Norway.

Table 12. Quantity of herring (in tons) processed and number of returns from the 1964 experiment at Norwegian plants equipped with magnets, 1 November 1964 to 30 June 1965

Factory No.	Month								Quantity (p)	Efficiency (e)	Corrected quantity exp	Returns
	Nov.	Dec.	Jan.	Febr.	March	April	May	June				
2	5439.2	4146.2	6517.0	570.6	678.0	337.3	4482.3	11531.5	33702.1	0.95	32017.0 *	1
3	-	-	2725.1	-	-	351.0	268.3	5969.8	9314.2	0.81	7544.5	-
7	-	-	5269.9	4671.1	680.0	300.4	1011.4	15546.3	27479.1	0.80	21983.3	-
12	480.8	473.5	436.0	741.5	156.8	77.2	527.2	2263.2	5156.2	0.94	4846.8	-
16	618.5	1249.2	650.5	807.0	24.2	1556.9	3603.5	6127.5	14637.3	0.93	13612.7	-
18	-	-	511.5	511.5	182.4	692.2	2396.2	6632.3	10926.5	0.87	9506.1	-
20	-	-	1062.8	2042.7	131.3	295.2	1701.3	6043.5	11276.8	0.86	9698.0	-
31	631.4	1222.7	1082.0	2109.7	166.5	2641.6	12686.3	10662.7	31202.9	0.80	24962.3	-
42	-	-	-	-	-	-	-	834.4	834.4	0.72	600.8	
Total	7169.9	7091.6	18255.2	11454.1	2019.2	6251.8	26676.5	65611.2	144529.5		124771.5	1

* 1602.2 tons derive from landings of foreign fishing boats in Norway.

Table 13. Quantity of herring (in tons) processed and number of returns from the 1965 experiment at Norwegian plants equipped with magnets, 1 November 1965 to 30 June 1966

Fact. No.	Eff. (e)	November			December			January			February			March			April			May			June		
		Corr. Quant. (exp)	Returns		Corr. Quant. (exp)	Returns		Corr. Quant. (exp)	Returns		Corr. Quant. (exp)	Returns		Corr. Quant. (exp)	Returns		Corr. Quant. (exp)	Returns		Corr. Quant. (exp)	Returns		Corr. Quant. (exp)	Returns	
			Lib. 1	Lib. 2		Lib. 1	Lib. 2		Lib. 1	Lib. 2		Lib. 1	Lib. 2		Lib. 1	Lib. 2		Lib. 1	Lib. 2		Lib. 1	Lib. 2		Lib. 1	Lib. 2
1	0.93	2557.0						534.7		3							1151.9	1		4066.1	3	3	7816.3	9	6
2	0.95	4187.0	3		130.6	1	2	1116.4	2		34.0			124.8			1131.4	5	1	4781.6	1	5	9279.7	6	5
3	0.81	1422.1						326.0												941.5			1590.1	2	1
7	0.80	2049.1			375.2			1198.2												4498.6	1		5852.1	3	
12	0.94	432.4			6.8			165.3			47.8			129.5			162.8			962.9			1361.9		
16	0.93	573.1	1					26.2						9.0			210.5			3030.3	2	4	3713.1	2	
18	0.87	492.6	1					79.2			5.3						338.1			1914.7			2873.7	2	
20	0.86	582.3										1					133.2			2898.0			4453.4	4	
31	0.80	1796.3	1														123.3			4407.4			6629.1	4	2
42	0.72	115.8	1																	235.7			1621.2	2	
Total		14207.7	7		512.6	1	2	3446.0	2	3	87.1	1		263.3			3251.2	6	1	27736.8	7	12	44726.6	34	14

Table 14. Length distribution (number) of herring tagged with internal steel tags in the tank experiment

Dimension of tag (mm)	Length in cm														Total
	13	.5	14	.5	15	.5	16	.5	17	.5	18	.5	19	.5	
15x2x0.5	1		5	10	6	14	4								40
20x3x1					1	3	17	14	15	4	3	2	2	2	63
Total	1		5	10	7	17	21	14	15	4	3	2	2	2	103

Table 15. Number of herring tagged and tags returned separated according to taggers (1965 experiment)

Liberation	Tagger	Number tagged	Returns	Rate of recapture (%)
1	1	850	46	5.41
"	2	850	39	4.59
2	1	750	20	2.67
"	2	750	18	2.40
"	3	300	7	2.33

Table 16. Number of returns from the first and second half of the tagged batch of each liberation

Experiment	Number of returns from the first half of the tagged batch	Number of returns from the second half of the tagged batch	Total
1964 (lib. 1)	9	6	15
1965 (lib. 1)	42	43	85
" (lib. 2)	35	32	67

Table 17. Comparison of length at liberation for the total number of herring tagged and herring recaptured

Length at liberation (cm)	Lib. 1 1964		Lib. 1 1965		Lib. 2 1965	
	Number of fish tagged	Number of fish recapt.	Number of fish tagged	Number of fish recapt.	Number of fish tagged	Number of fish recapt.
19.0	-	-	-	-	3	-
.5	1	-	-	-	1	-
20.0	3	-	-	-	27	1
.5	2	-	1	-	59	1
21.0	14	-	1	-	190	3
.5	15	-	-	-	352	9
22.0	20	1	1	-	408	8
.5	26	-	2	1	413	14
23.0	63	1	9	-	371	10
.5	51	-	5	-	229	8
24.0	68	1	11	1	130	7
.5	63	-	9	1	61	1
25.0	84	1	15	-	14	-
.5	79	-	17	1	7	-
26.0	97	3	50	4	7	1
.5	75	1	36	1	6	-
27.0	91	3	84	5	2	-
.5	52	-	92	4	2	1
28.0	54	-	147	5	1	1
.5	41	1	105	9	2	2
29.0	24	1	181	15	-	-
.5	20	-	137	8	3	-
30.0	27	2	236	8	2	-
.5	6	-	132	2	2	-
31.0	13	-	182	7	1	-
.5	5	-	86	3	1	-
32.0	2	-	83	6	-	-
.5	-	-	25	-	1	-
33.0	3	-	29	-	-	-
.5	1	-	9	-	-	-
34.0	-	-	4	-	-	-
.5	-	-	4	-	-	-
35.0	-	-	2	-	-	-
Total	1000	15	1695	81	2296	65

$\bar{x}$ = 25.86 tagged	$\bar{x}$ = 26.47 recapt.	$\bar{x}$ = 29.32 tagged	$\bar{x}$ = 29.07 recapt.	$\bar{x}$ = 22.46 tagged	$\bar{x}$ = 22.48 recapt.
s^2 = 5.14 tagged	s^2 = 5.34 recapt.	s^2 = 3.95 tagged	s^2 = 3.74 recapt.	s^2 = 1.48 tagged	s^2 = 3.27 recapt.

Table 18. Age composition (%) of the autumn spawned herring in the samples from Skagerak - Egersund Bank - Coral Bank, 1 November 1965 to 30 June 1966

Year class	1965		1966								Total	
	8/11	10/12	22/1	10/3	10/3	20/4	25/5	27/5	26/6	27/6	n	%
1964	-	1.1	-	1.2	-	-	-	-	-	-	2	0.2
63	63.0	94.3	70.0	85.2	18.7	23.1	8.7	19.6	20.9	24.2	365	41.2
62	31.0	4.6	11.3	3.7	11.0	24.1	18.4	29.3	33.7	12.6	160	18.1
61	1.2	-	2.5	3.7	9.9	17.2	21.4	15.2	22.1	13.7	98	11.1
60	3.6	-	15.0	5.0	40.6	26.4	39.8	31.5	18.6	44.1	207	23.4
59	-	-	-	-	-	-	1.9	2.2	-	1.1	5	0.5
58	-	-	-	-	2.2	-	1.0	-	1.2	1.1	5	0.5
57	1.2	-	-	-	3.3	2.3	1.0	-	-	-	7	0.8
56	-	-	1.2	1.2	14.3	6.9	6.8	2.2	3.5	3.2	36	4.1
< 1956	-	-	-	-	-	-	1.0	-	-	-	1	0.1
Number	84	87	80	81	91	87	103	92	86	95	886	100.0

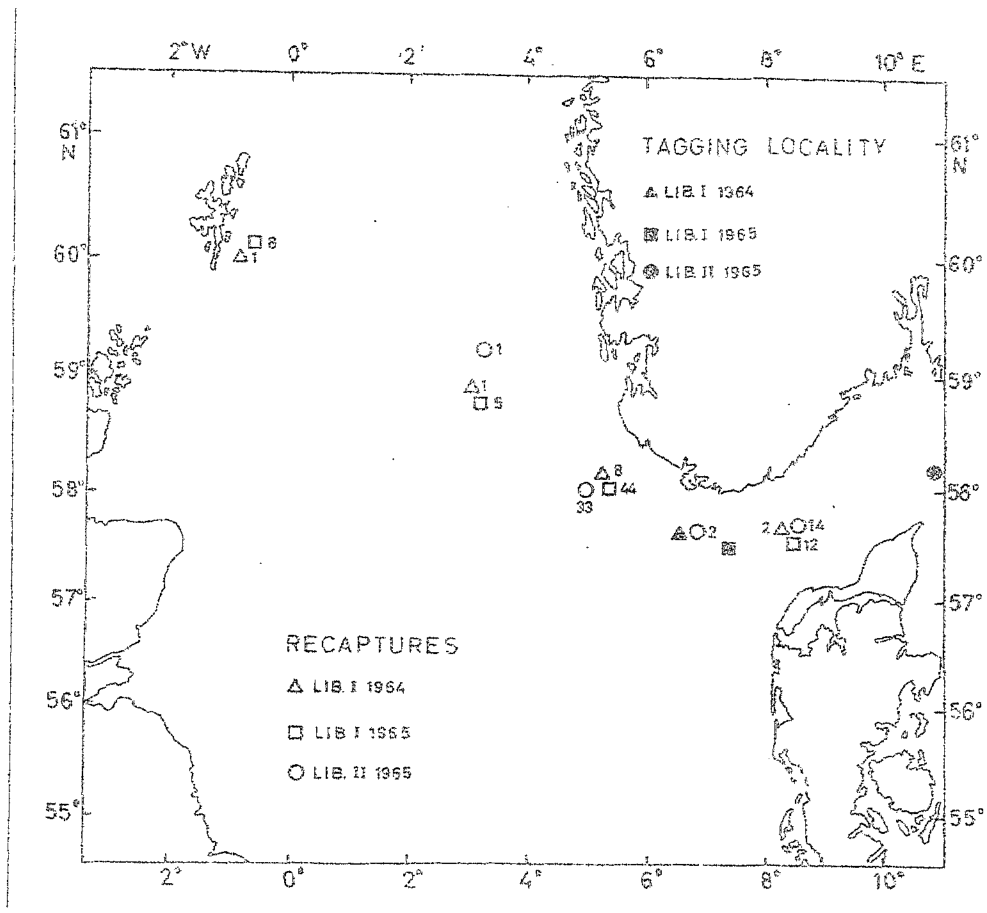

Fig. 1. Tagging localities and distribution of recaptures for the tagging experiments in 1964 and 1965.

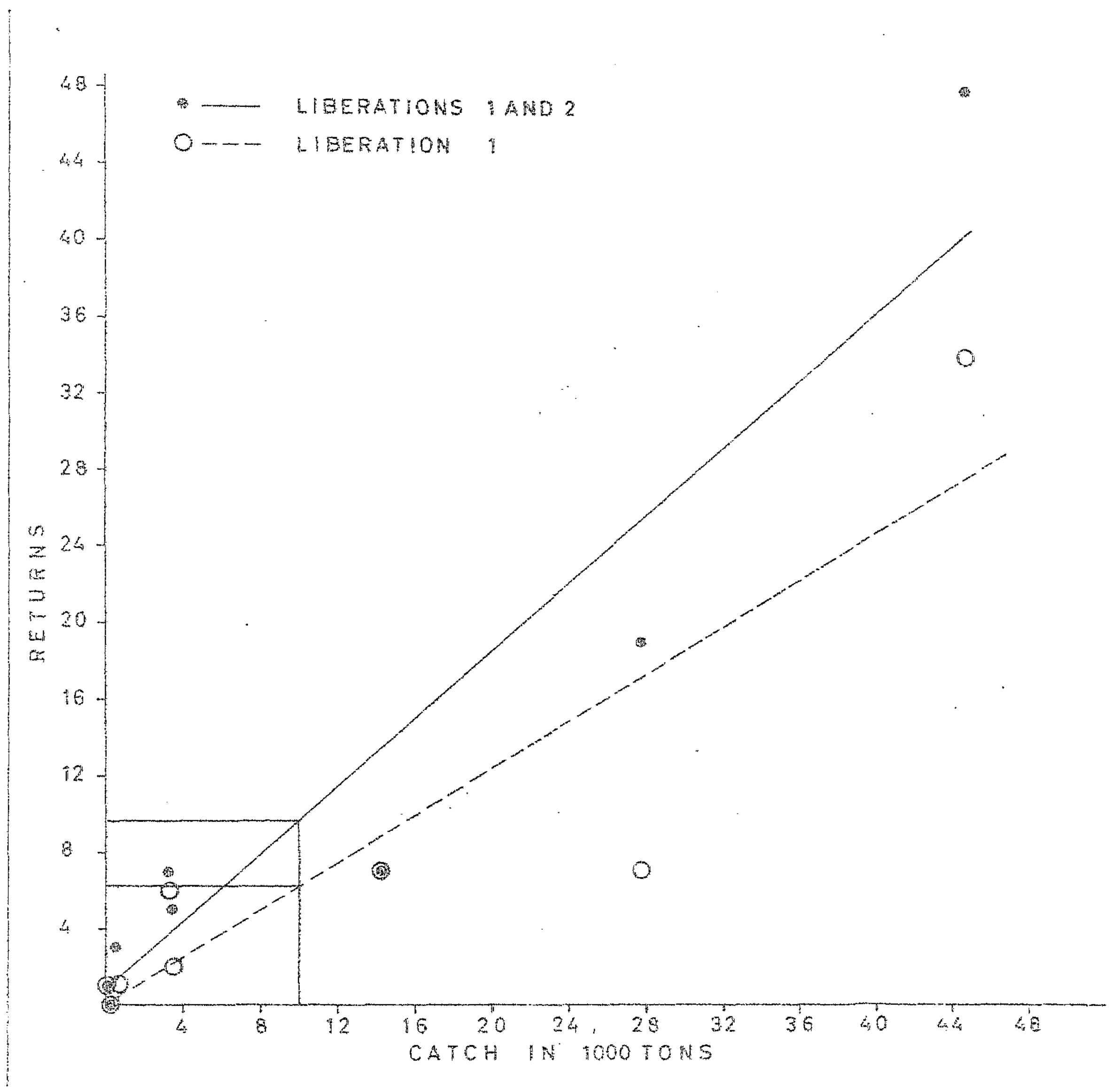

Fig. 2. Relation between the number of returns and monthly effective quantity reduced at factories equipped with magnets.