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## THE STOCK SIZE OF HERRING IN THE NORTHERN SEA IN 1966

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### INTRODUCTION

During summer 1966 two tagging experiments were carried out in the North Sea, one in the Egersund Bank area and one in the Shetland area. The recaptures from these experiments have demonstrated a connection between the herring populations on both sides of the northern North Sea (Haraldsvik 1967). In this report the recaptures have been used for tentative estimates of the stock size in the Shetland and Egersund Bank areas.

### MATERIAL

A total of 8000 herring were tagged, of which 4000 were released in Shetland waters (Lib. 2) and 4000 in the Egersund Bank area (Lib. 1). Lib. 1 consisted of 2 batches of release, each totalling 2000 herring, and Lib. 2 consisted of 4 batches, each of 700, 950, 1250 and 1100 herring respectively. All the herring were tagged with internal steel tags, and the herring seemed to be in good condition when released. For the present experiments no special test was carried out to investigate the loss due to tagging mortality and shedding. However, investigations on Norwegian spring spawners have shown that these losses are small (Fridriksson and Aasen 1950, 1952). A tank experiment has given a tagging and shedding loss of 15 % (Dragesund and Haraldsvik 1968), and this figure has been applied to calculate the effective number of tagged herring for the present experiments.

### RESULTS AND DISCUSSION

A dominant part of the Norwegian catches of North Sea herring have been processed to meal and oil. The majority of the reduction plants have installed magnetic separators, and the two tagging experiments therefore, have given a fairly high number of recaptures to be dealt with. The reliability of the returns from reduction plants with regards to fishing area, fishing time and the non-returns of tags recovered have been discussed by Dragesund and Haraldsvik (1968). The losses of tags not detected by the magnets have been adjusted for by reducing the amount of herring processed in accordance with the efficiency of the magnets.

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The efficiency of the magnets was tested by measuring the returns from a known number of tagged fish introduced into each factory.

Only returns from factories with magnets of high efficiency were dealt with for the quantitative treatment. This procedure left returns from 18 factories to be studied.

Table 1 summarizes the corrected quantities and number of returns from the north-eastern North Sea and Shetland waters at these factories during the period July - October 1966.

The dominant part of the returns were from the same area as liberated (Haraldsvik 1967), and in Table 1 only returns of Lib. 1 from the north-eastern North Sea and returns of Lib. 2 from the Shetland area are included. The corrected quantities and number of returns from the north-eastern North Sea during July-October 1966 and from the Shetland area during August - September 1966 for the various reduction plants are given in Table 2.

The stock size estimates for the Shetland area and the north-eastern North Sea were obtained by using a modification of the Petersen method (Aasen *et. al.* 1961). Returns of Lib. 1 have been used for estimates of the stock size in the north-eastern North Sea. In Fig. 1 is the number of tags returned each month (July - October 1966) plotted against the effective quantity processed at the same factories in that month ( $r = 0.73$ ). In Fig. 1 is also the number of tags and the effective quantity processed at the various factories plotted against each other ( $r = 0.99$ ). The two regression lines were calculated, and the stock size was estimated by multiplying the number of the effectively tagged herring by the ratio of the quantity processed and the number of returns. These estimates gave a stock size in the north-eastern North Sea during summer 1966 of 9.57 mill. hl and 6.11 mill. hl respectively. The stock size estimate of 6.11 mill. hl seems most reasonable, since this estimate is based on more reliable data, i. e. the data are independent of the monthly grouping of the returns.

Returns of Lib. 2 have been used for estimating the stock size in the Shetland area. The Norwegian fishery in 1966 in this area lasted for two months only. In Fig. 2, therefore, only the correlation between the number of tags returned and the effective quantity processed at the various factories is given ( $r = 0.70$ ). The calculated number of effectively tagged herring was 3400, and the stock size estimate gave 5.83 mill. hl in the Shetland area during summer 1966.

Some of the errors which affect the stock estimates have been discussed before. However, the most important factors affecting the estimates are probably a non-uniform distribution of tagged fish and the calculations of the effectively tagged herring. In the summer period both the north-eastern North Sea and the Shetland area will have an emigration and immigration of herring, and it seems difficult to get the ratio of tagged to untagged fish the same throughout the population. A more evenly spaced grid of liberations than in the present experiments would most likely have speeded up the mixing and made the estimates more reliable.

The calculation of effectively tagged herring is based on tagging mortality and shedding experiments carried out in sheltered waters and in aquaria. The tagging mortality and shedding are most likely varying from experiment to experiment depending on the maturity, the handling and the condition of the fish. The tagged herring in the Shetland waters were in a higher maturity stage than those liberated in the Egersund Bank area. Dragesund (unpublished data) found that the shedding rate was relatively high for herring in immediate prespawning and spawning stages. Because the present tagging experiments were carried out in open sea and the difference in maturity stage of the herring in the two experiments, the calculated number of effectively tagged herring probably is too high, especially in the Shetland waters, which again have resulted in an overestimate of the stock size.

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Table 1.

Quantity of processed herring ( in 1000 hl ) and number of returns at Norwegian plants equipped with magnets, July - Oct. 1966.

Month	NE North Sea		Shetland	
	Corr. quant. (e•p)	Returns Lib. 1	Corr. quant. (e•p)	Returns Lib. 2
July	314,0	115	-	-
August	156,3	112	431,0	245
September	110,2	36	12,9	10
October	122,1	31	-	-

Table 2.

Quantity of processed herring ( in 1000 hl ) and number of returns at Norwegian plants equipped with magnets, July - Oct. 1966 in NE North Sea and Aug. - Sept. 1966 in Shetland area.

Fact. no.	Eff. (e)	NE North Sea		Shetland	
		Corr. quant. (e•p)	Returns Lib. 1	Corr. quant. (e•p)	Returns Lib. 2
1	0,88	154,1	85	15,7	-
2	0,94	179,4	90	21,6	6
3	0,77	47,8	7	6,6	2
4	0,81	109,1	43	12,1	6
7	0,75	115,5	64	17,5	14
12	0,77	9,0	-	4,6	3
16	0,80	21,9	3	24,1	14
18	0,90	17,1	-	33,6	25
20	0,74	14,6	1	30,6	23
21	0,70	13,9	-	31,5	27
24	0,66	1,9	-	37,3	19
31	0,76	5,2	1	33,0	10
35	0,86	1,4	-	61,3	33
37	0,89	3,3	-	27,3	21
38	0,91	1,1	-	28,3	19
42	0,81	1,3	-	24,9	29
43	0,94	4,6	-	30,4	4
45	0,69	1,3	-	3,2	-

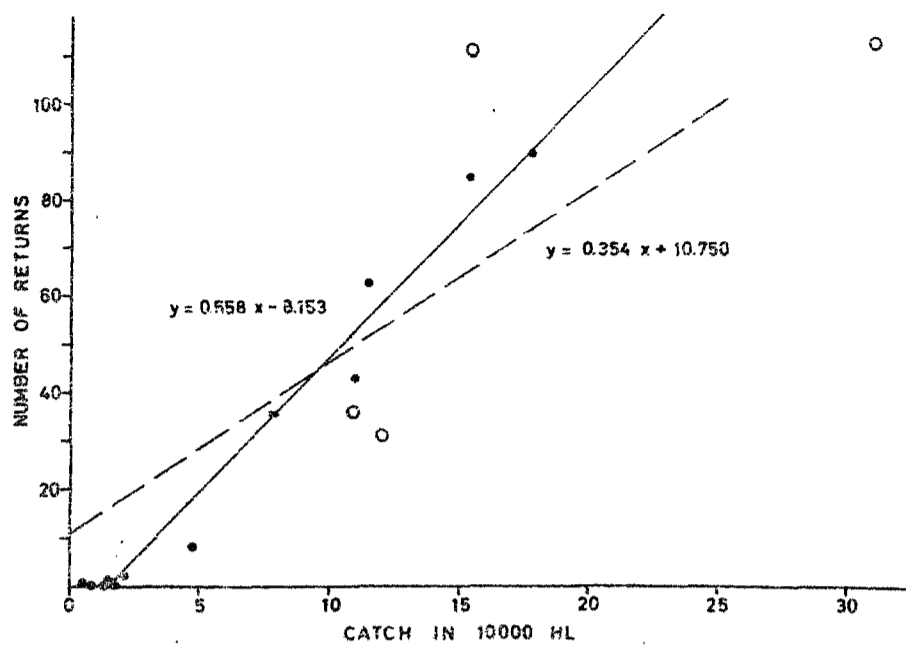


Fig. 1. Calculated regression lines fitted to: 1) the monthly catch of herring from the north-eastern North Sea processed at factories equipped with magnets and the monthly number of returns (July - Oct. 1966, open symbols), 2) the total catch during July - Oct. 1966 from the north-eastern North Sea and the number of returns during the same period for the various factories equipped with magnets (closed symbols).

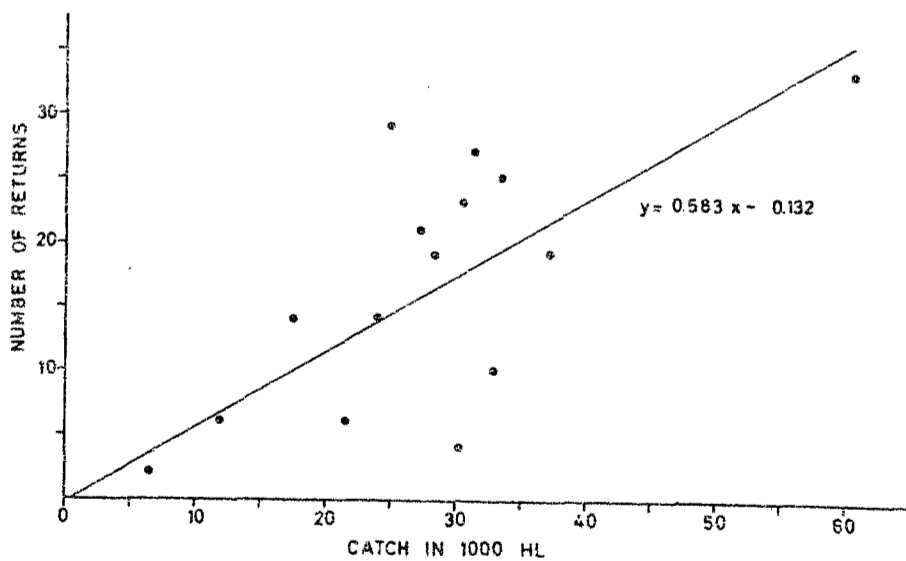


Fig. 2. Calculated regression line fitted to the total catch during Aug. - Sept. 1966 from the Shetland area and the number of returns during the same period for the various factories equipped with magnets.