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Size and age composition of the Norwegian purse-seine
catches in the North Sea and the Skagerak

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Introduction

The Norwegian purse-seine fishery in the North Sea and the Skagerak has lasted for about 5 years. The first Norwegian purse-seiner equipped with power-block was already in 1962 operating in these waters, but a regular purse-seine fishery was not established until autumn of 1963. This year 16 purse-seiners participated in the fishery. The fleet increased, however, very rapidly in the following years, and in 1964 the fleet numbered 195 vessels, in 1965 and 1966 284 and 334 vessels respectively. In 1967, the participation was 326 purse-seiners.

The total annual landings of herring by Norway from the North Sea and the Skagerak for the years 1964-1967 are shown in Figure 1. It appears that the yield rose from about 200,000 tons in 1964 to about 600,000 tons in 1965. Since 1965 the landings have decreased with about 25% each year, and the catches amounted to only 335,000 tons in 1967. The autumn spawning group of herring has contributed the dominant part in the purse-seine catches from the North Sea and the Skagerak. Among the autumn spawners the Bank herring have been prevailing on all fishing grounds. Members of the Kattegat autumn spawning stock have, however, probably ^{played} some importance in the catches from the Egersund Bank and eastwards to the Skagerak. Spring spawned herring have made only a small contribution to the landings of the purse-seiners. This group of fish contributed about 20-30% of the catches from Shetland waters, about 10-15% in the north-eastern North Sea and less than 10% in the Skagerak.

Unfortunately, no satisfactory effort statistics are available from which to gauge the reality of the variations in total catch as an index of variations in stock abundance. The Norwegian purse-seine fleet is very mobile and also takes part in other fisheries, e. g. the winter herring fishery, the capelin fishery, the Norwegian Sea herring fishery and the mackerel fishery. No information^{n/} are available concerning time spent on the fishing grounds for North Sea herring and number of shots made, but in general it is evident that the effort in the North Sea herring fishery has increased very much, at least up to end of 1966.

Almost 100% of the purse-seine landings of herring from the Skagerak and the North Sea have been processed to fishmeal, and due to the marketing problems for meal and oil products in 1966 and 1967, several restrictions of landings were introduced for this fishery. Thus, in 1966 the herring fishing was stopped for 2 months and in 1967 for about 2½ months. In addition, the fishing in 1967 was subjected to a catch quota regulation during 3 months. From 1966 onwards the participation of purse-seiners in other fisheries, especially in the mackerel fishery, has increased significantly and it seems therefore obvious that the fishing effort in the North Sea herring fishery has decreased the last two years.

Since 1963 there has also been a rapid growth in fishing efficiency for the purse-seiners, due to the better experience in using the new gear and the technical advances in fish location methods. It is impossible, however, to adjust for the increased efficiency of the fleet.

The aim of this report is to give a review of distribution and age composition of the Norwegian purse-seine herring landings from the North Sea and the Skagerak during the period 1964-1967. It has been convenient to separate the landings into three main fishing areas: 1) Skagerak, 2) north-eastern North Sea and 3) north-western North Sea.

Skagerak

The purse-seine fishery in the Skagerak started in autumn/winter 1963/1964. The main fishery took place in the area of the western entrance of the Skagerak, but good catches were also taken northwards to the mouth of the Oslofjord and off Bohuslän. Also in autumn/winter 1964/1965 this area gave rise to a very productive herring fishery and yielded about 80.000 tons. A striking feature with this fishery was that about 90% of the catches were taken during the period October - January. The landings from the Skagerak in the years 1964-1967 are shown in Figure 1. It should be noted that the

total Norwegian catch from the North Sea was about three times higher in 1965 compared to the previous year, whereas the catch from the Skagerak remained at the same level. The autumn/winter fishery in the Skagerak has shown a remarkable reduction since 1965 (table 1). A large number of herring shoals were recorded at the entrance to the Skagerak in autumn 1965, but the shoals were located in relatively deep water and rarely entered the uppermost 50 m. The depth of the shoals, therefore, greatly hampered the fishery.

However, during the echo-surveys in autumn 1966 and 1967, only a few concentrations of herring were observed. The fishery was also very poor (Table 1), and it seems quite clear that the invasion of herring to the Skagerak during autumn/winter has failed the last two seasons.

In 1967 the landings from the Skagerak increased to about 95.000 tons, but more than 95% of the quantity were, in contrast to previous years, taken during the period July - August. This fishery took place between Holmen Ground and Hirtshals about 10-30 nautical miles off the Danish coast. Also, in summer of 1968 a productive fishery was carried out in this area, and the preliminary statistics show a catch of about 75.000 tons. In 1967 and 1968 the majority of the herring from this area consisted of 1-ringed fish.

The age composition of the herring from the Skagerak changed considerably during the period of the purse-seine fishery (Figure 2). In 1964 the catches were dominated by 3-ringed fish (1960 year-class), which contributed more than 55 % of the sampled herring. This year-class was in 1965 of minor importance and did not exceed 10% of the landings, whereas 1-ringed fish (1963 year-class) proved to be strong and provided more than 65% of the catches. The 1963 year-class was also of considerable importance in 1966, but the 1965 year-class (0-ringed fish) had replaced it as the most abundant one. However, in 1966 and 1967 (Figure 2), the 0-ringed fish were fished by pelagic trawl and not by purse-seine. The 0-ringed fish is too small to be taken by purse-seine net used by the North Sea fleet, and therefore, the landings of the purse-seiners in 1966 were dominated by 2-ringed fish, whereas the landings in 1967 and in 1968 until September almost exclusively consisted of 1-ringed fish. The change in age composition and the failure of the invasion of mature herring to the Skagerak in recent years is also clearly reflected in the mean age distribution of the sampled herring. The autumn/winter 1964/1965 was the last season with overwintering of mature herring in abundance in the Skagerak, and consequently the mean age dropped from 4.0 years to 2.7 - 2.6 years in 1965 and 1966 respectively. Further reduction in mean age was found in 1967 (Table 2).

North-eastern North Sea

The north-eastern North Sea was in each of the years 1963-1967 the most productive fishing grounds for North Sea herring. The landings increased from about 92,000 tons in 1964 to about 323,000 tons in 1965, but have since then been decreasing and were in 1967 about 177,000 tons (Figure 1). The main fishing ground has been the Egersund Bank where the fishery in 1964-1965 yielded about 35-50% and in 1966-1967 about 75-90% of the total catch from the north-eastern North Sea. Other productive fishing grounds in this area were the Coral Bank, SW of Lista and the Sira Hole. The concentrations of herring in the north-eastern North Sea were mainly located along the outer edge of the Norwegian Deep, especially between the depth contour lines of 150-250 m. The distribution of the fishery in the years 1964-1967 is illustrated in Figure 3.

The fishery in this area begins in March, just after the season for the winter herring fishery, and is considered to last to the end of October. The main fishery, however, has taken place during June-September, and 60-85% of the total Norwegian catch from the north-eastern North Sea in the years 1964-1967 have been landed during these 4 months.

In the years 1964-1965 the distribution of the spring fishery indicated a northward migration of herring along the western slope of the Norwegian Deep, starting on the Egersund Bank in March and continuing through the Sira Hole, the Patch Bank, and ending at the Viking Bank at the beginning of June. This northwards movement of herring was probably a segregation from the overwintering stock in the Skagerak-Lista area. Samples have shown that the mean age of herring was higher as more northerly they were collected. This northward migration of herring in spring was not pronounced in the last 3 years.

Pre-spawning herring have in recent years recruited the north-eastern North Sea in autumn at an age of 2 years. The strong 1960 and 1963 year-classes showed up in the catches from this part of the North Sea in October 1962 and August 1965 respectively. The catches have shown that the recruitment starts in the southern region and that the pre-spawning herring only ^{are} distributed south of the latitude N 59°.

The age composition of the herring from the north-eastern North Sea for the years 1963-1967 is shown in Figure 4. Compared with the herring in the Skagerak no striking change in age composition was noticed in this area. This is also reflected in the mean age of the sampled herring, which in the years 1964-1967 ranged between 3.6 - 4.7 years (Table 2). From Figure 4 it appears that the 1960 year-class has contributed a great part of the landings

from the north-eastern North Sea in recent years. This year-class was the dominant one in the catches in 1964 and 1965, and was also relatively strong in 1966 and 1967. The 1963 year-class has also been of considerable importance in this area and predominated in the catches in 1966 and 1967. The 1961 and 1962 year-classes were equally represented in the samples during the period 1964-1967, but were not as abundant as the 1960 and 1963 year-classes.

North-western North Sea

The fishery in the north-western North Sea has been concentrated to the areas off Shetland. This fishery started in summer 1965 east of Shetland and yielded during the two months July-August about 190,000 tons. In the last three seasons both the fishing area and the fishing season have been extended. The Shetland fishery continues now from end of May to mid September and includes also the areas north and north west of Shetland and as far south as off the Orkneys. In 1968 large catches were also taken as far north as 70 nautical miles north-east of Shetland, but the main centre of activity has in all years been in the waters east of Shetland and not more than 25 nautical miles off.

The total catch of the Shetland fishery in the years 1965-1967 is shown in Figures 1 and 3. The fishery in 1967 was a complete failure compared to the previous seasons and the catches went some 155,000 tons down. The main reasons for this decline were due to many factors as restrictions of landings, a fishing stop for 3 weeks, and the herring concentrations mostly being distributed inside the fishing limit of 12 nautical miles.

In the 1968 season the Shetland fishery improved and the quantity rose to about 100,000 tons. According to informations from fishermen great concentrations of herring were located in Shetland waters this season, but the shoals stayed in relatively deep water, and when entering the uppermost 40 fathoms they were often difficult to catch.

Recent tagging experiments have indicated that the communication between the feeding and spawning herring in the north-western North Sea and the overwintering herring in the north-eastern North Sea is not as strong as earlier suggested (Haraldsvik 1967). Tagging experiments with internal steel tags carried out west of Shetland in spring 1967 have given evidence of a migration to the east of Shetland (Table 3). The distribution of the fishery in 1968 indicate also a movement of herring from the Tampen area to the fishing grounds east of Shetland. The fishery this season started at the beginning of June about 70 nautical miles north-east of Shetland, and the fleet followed the herring

concentrations south to the Bressay area, where the fishery continued from end of June onwards. Thus, it seems likely that the concentrations of herring on the traditional fishing grounds east of Shetland during summer have been recruited from the west and north of Shetland and from the north-eastern North Sea.

The mean age of herring from the Shetland waters has in the years 1965-1967 been fairly constant. The mean age ranged between 5.2 - 5.7 years, and the herring in these waters were thus about 1 year older than the herring in the north-eastern North Sea (Table 2).

The age compositions of the catches in 1965-1967 from the north-western North Sea are shown in Figure 4. The 1960 year-class was most abundant in 1965 and 1966, whereas the 1963 year-class was the strongest one in 1967. Other interesting features of the age compositions are the contributions made by the 1956 year-class in 1965 and 1966 (8 and 9-ringed fish) and the importance of the 1-ringed fish in 1967. The 1956 year-class, which in 1965 and 1966 was 9 and 10 years respectively, contributed in these years not less than 11% and 12% of the catches. The 1956 year-class was thus more numerous in the Shetland waters than in the Skagerak and the rest of the North Sea.

The 1-ringed fish made up about 15% of the catches in 1967, and this is the highest abundance ever recorded of 1-ringed fish in these waters. The material for 1968 has not been worked up yet, but according to the length compositions it is likely that 1-ringed fish have been of importance this year too.

Other fishing grounds

Outside the fishing grounds mentioned above there has been only a few landings from other part of the North Sea. In summer 1967 however, a rich fishery was carried out in the Devil's Hole area (Figure 3). This fishery yielded from the beginning of June to mid July 16,560 tons of herring. The catches from this area showed a predominance of the year-classes 1963 and 1964.

The fishery in this area in summer 1968 have been out of importance.

Summary

The Norwegian purse-seine fishery in the Skagerak and the North Sea has been in operation since autumn 1963. The purse-seine fleet participating in this fishery increased very rapidly in the following years and totalled 334 vessels in 1966. In 1967 the number was 326 vessels.

The landings increased considerably during the two first years and the total Norwegian quantity amounted to about 600,000 tons in 1965. Thereafter, the total yield has been reduced with about 25% each year. The north-eastern North Sea has in the period 1964-1967 been the most productive fishing grounds and has each year contributed about 50% of the total landings of North Sea herring. The fishing grounds off Shetland were also of considerable importance in 1965 and 1966. The Shetland fishery in 1967 was, however, drastically reduced owing to unfavourable distribution of the herring and restrictions of landings due to the difficult marketing situation for oil and fishmeal products.

The rich autumn/winter fishery in Skagerak during the first years has shown a striking reduction since 1966. The decrease in the fishery has been closely connected to the failure of invasion of overwintering herring in recent years. A fishery on immature herring during summer, however, has been flourishing the last two years in shallow waters at the western entrance to the Skagerak. The age compositions of the catches from Skagerak have therefore changed considerably and have in recent years been dominated by 1 and 2-ringed fish. The mean age of herring in Shetland waters has been 1 year older than the herring in the north-eastern North Sea. In both areas, however the catches were dominated by the 1960 and 1963 year-classes. During the period 1964-1967 a total of 1580.3 thousand tons of North Sea herring ^{have} been landed in Norway, of which the 1960 year-class has contributed about 500.0 thousand tons and the 1963 year-class about 340.0 thousand tons respectively.

References

- Haraldsvik, S. 1967. Norwegian herring tagging experiments in the northern North Sea, 1966. Coun. Meet. Int. Coun. Explor. Sea, 1967. H:26, 1-7, 10 tabs., 2 figs. (Mimeo.).

Table 1. Catch of herring (in tons) from the Skagerak during the autumn/winter (October-January) fishery, 1963/64 - 1967/68.

Season	Tons
1963/64	27.785
1964/65	79.339
1965/66	34.300
1966/67	4.256
1967/68	2.946

Table 2. Mean age of herring from the North Sea and the Skagerak, 1964-1967.

Year	Area		
	Skagerak	NE North Sea	NW North Sea
1964	4.0	3.6	-
1965	2.7	4.4	5.4
1966	2.6	4.6	5.7
1967	1.8	4.7	5.2

Table 3. Returns in 1967 and 1968 from tagging experiments carried out west of Shetland in May-June 1967.

Exp.	Total tagged	Returns						Total
		W of Shetland	E of Shetland	NE North Sea	Skagerak	Other	Uncertain	
1	800	2	10	2	1	1 ¹⁾	5	21
2	700	1	17	1	1	2 ²⁾	8	30
Total	1500	3	27	3	2	3	13	51

1) from Great Fisher Bank. 2) from Great fisher Bank and Danish coast.

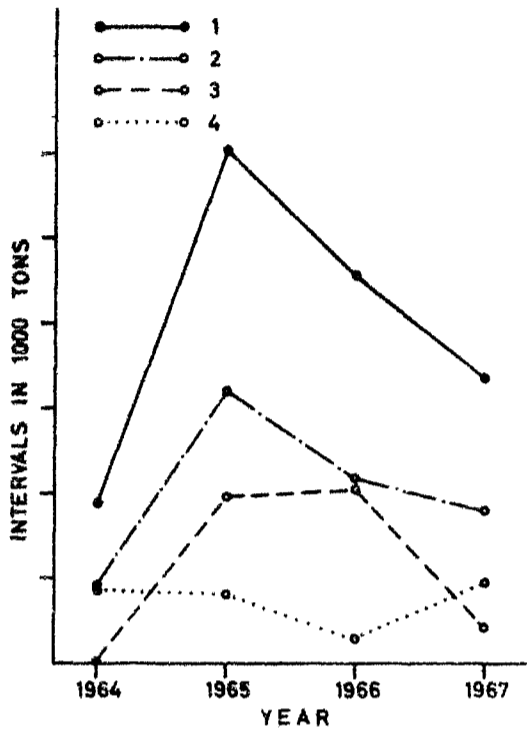


Figure 1. Norwegian landings of herring from the North Sea and the Skagerak, 1964-1967.
 1) total 2) NE North Sea 3) NW North Sea 4) Skagerak

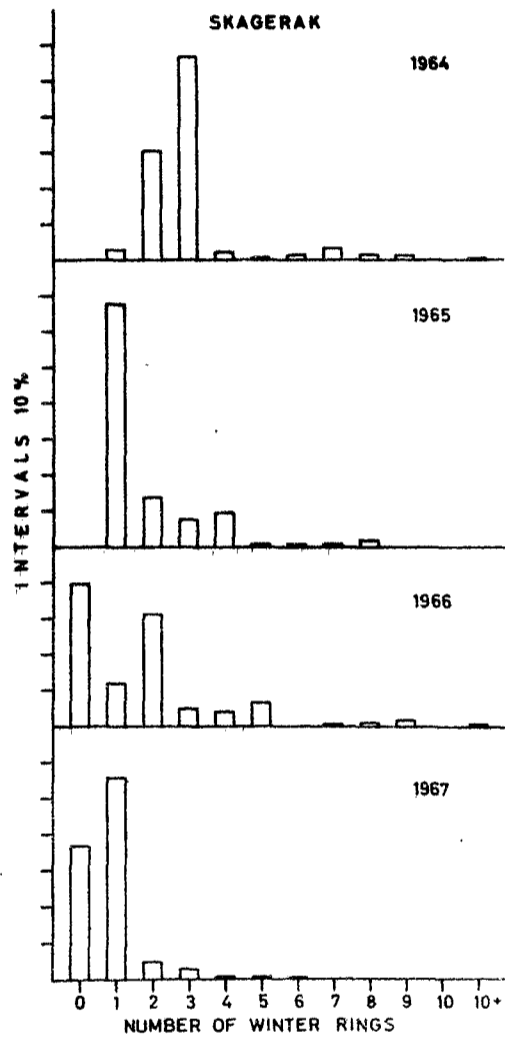
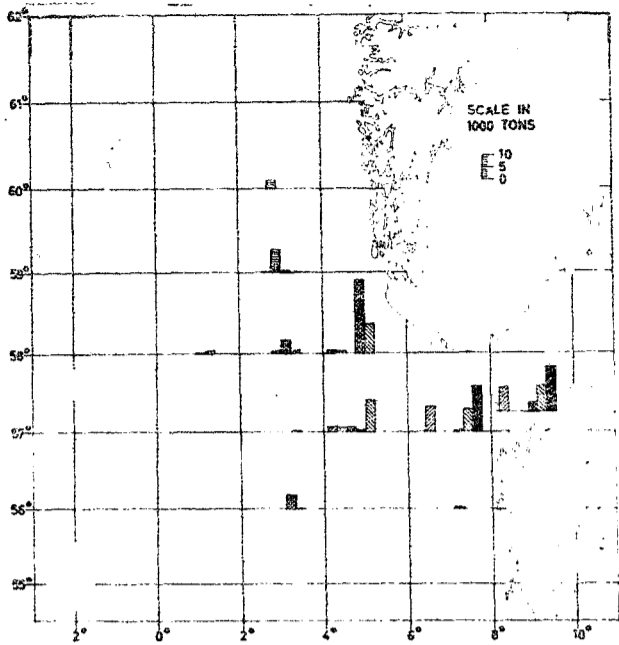
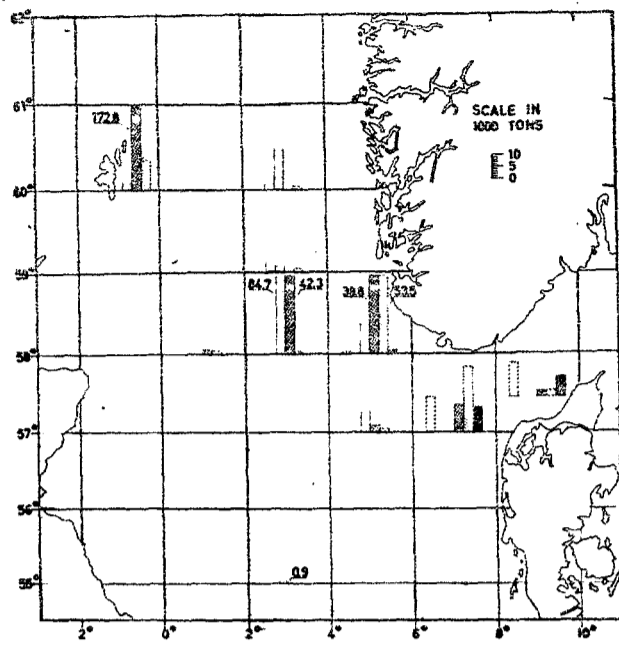


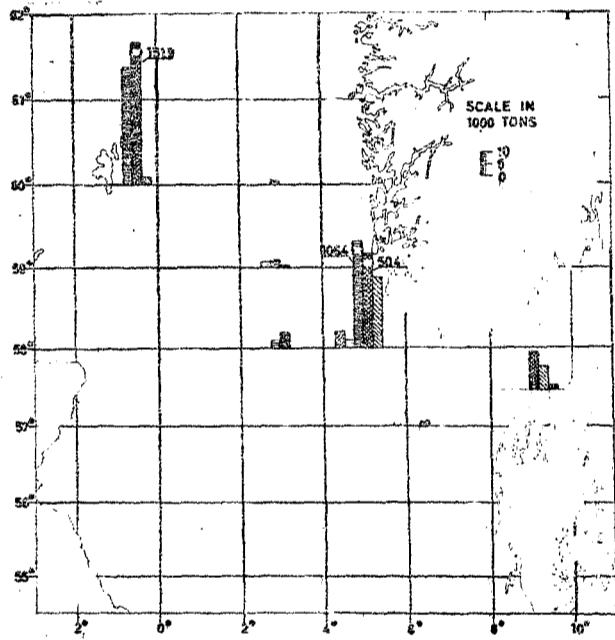
Figure 2. Age composition of herring from Skagerak, 1964-1967.



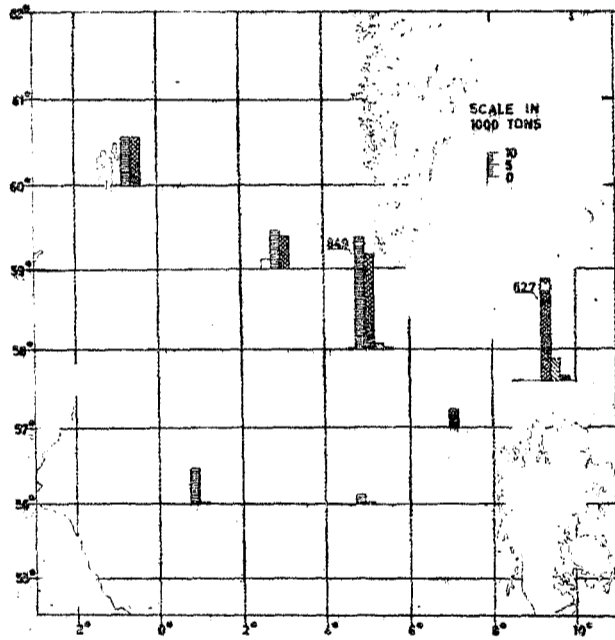
1964



1965

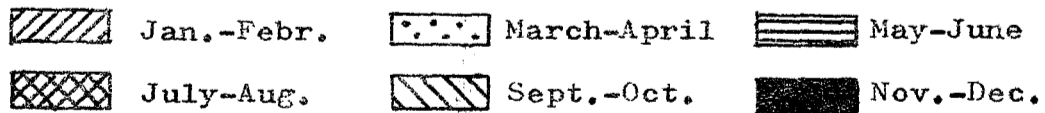


1966



1967

Figure 3. Distribution of the Norwegian landings of herring (two-monthly periods) from the North Sea and the Skagerak, 1964-1967.



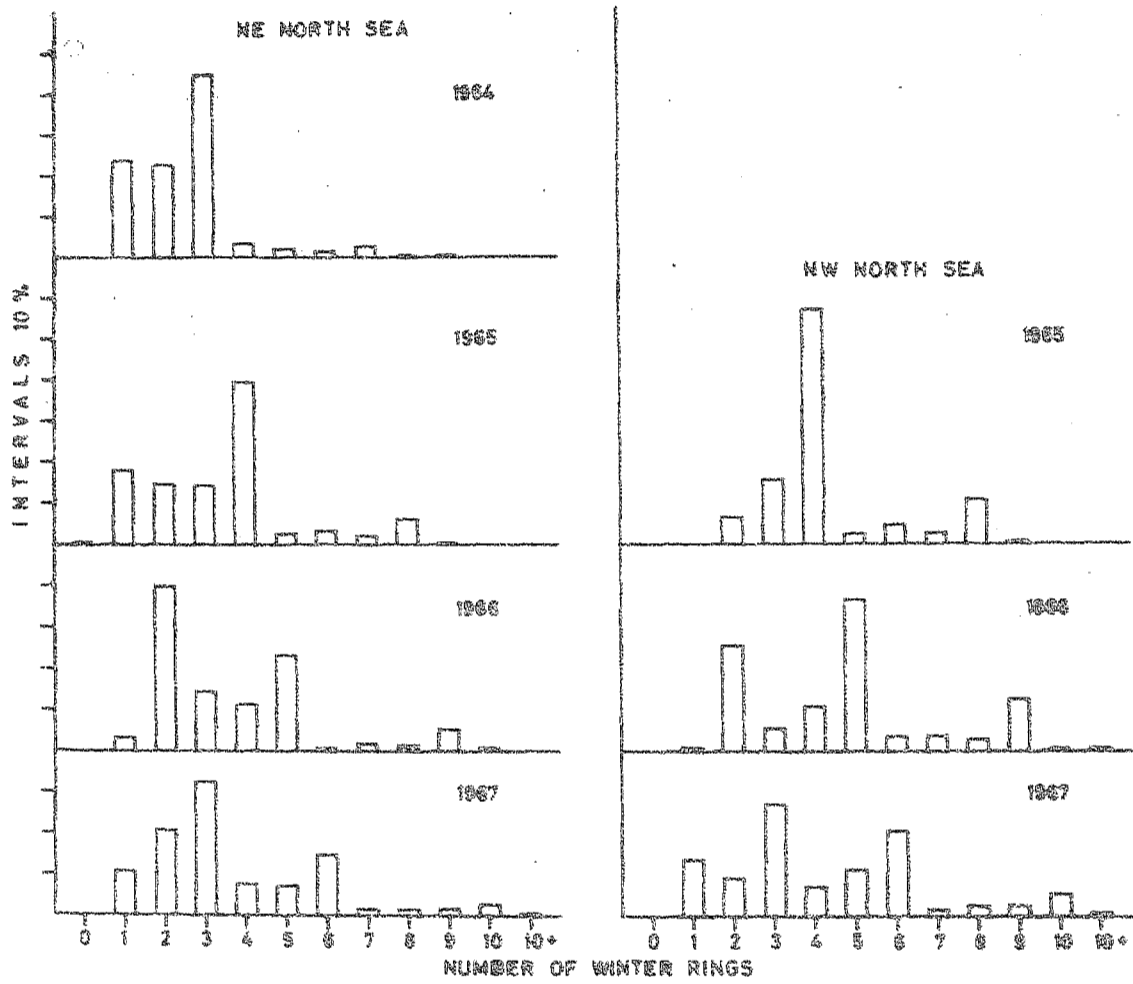


Figure 4. Age composition of herring from NE North Sea and NW North Sea, 1964-1967.