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Norwegian trawl fishery for saithe in the area limited by 62° and 64°N and east of 4°E

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Introduction

By the North-east Atlantic Fisheries Commission's recommendation at the Third Annual Meeting the minimum mesh size in trawl nets was increased from 1st January 1967 by 10 mm to 130 mm (120 mm) in Region I, east of the meridian of Greenwich. This recommendation was based on a Norwegian proposal to increase the minimum mesh size by 10 mm in the 120 mm area east of Greenwich, which at that time corresponded to the area north of 66°N. As the recommendation comprised the whole Region I east of Greenwich the consequence was an increase of the mesh size from 80 mm to 130 mm (120 mm) between 62° and 66°N off the Norwegian coast (Figure 1). This extension of the northern mesh size area has raised serious difficulties for a Norwegian trawl-fishery in the affected area.

The Norwegian Ministry of Fisheries has felt compelled to introduce a preliminary limited exemption from the general mesh size regulation for this fishery. According to the preliminary limited exemption given trawlers less than 200 gross tonnage when fishing for saithe in the area limited by 62° and 64°N and east of 4°E, a smaller mesh size in trawl nets than prescribed may be used, provided that the mesh size is not less than 80 mm.

The Commission took at the Sixth Annual Meeting note of the difficulties created for the Norwegian fishery for saithe in the area by the decision at the Third Meeting to increase the minimum size for trawl nets in Region I. However, ICES was requested by the Commission to examine information to be submitted by the Norwegian delegations together with any relevant information which other delegations may be able to provide and to report to the Seventh meeting of the Commission on:

1) the relationship between the stocks of coalfish within the area of the proposed exemption and those in adjacent areas of the north east Atlantic,

2) the relationship between coalfish and other associated species in this area, and
3) the effect upon the stocks of coalfish and associated species of exempting the fishery in this area from the provisions of Reccommendation 1 (a)(i).

This paper deals with the items mentioned by the Commission. All Norwegian data and some published German data from the area are used.

Material

Norwegian trawlers less than 200 gross tonnage have licence to operate outside the 4 nautical miles limit. Data, locality, hours fishing and landings of each species are recorded by these trawlers in a special logbook. The statistical investigation cover the period 1961-67.

The relationship between the stock of saithe, cod and haddock in the area and those in adjacent areas, have been studies by tagging experiments in the period 1955-1966 (Table 2). Lea hydrostatic tag has been used in all experiments, fastened with nylon thread in front of the first dorsal fin. All cod and haddock tagging experiments have been made inside the 4 nautical miles limit, while the saithe tagging experiments comprise one experiment at a distance of 8 nautical miles from the base line and 3 inside the 4 nautical miles limit.

Two saithe trawlers were hired from 6th to 9th May 1968 to collect more detailed data from the special saithe fishery. Most of the experiments were made on the edge of the Continental shelf. Trawler X and Y used in series A a mesh size of 88 mm and 122 mm respectively, while the same vessels in series B used a mesh size of 120 and 99 mm respectively (Table 1). The posterior part of the cod-ends used were made of nylon, while the anterior part were made of courlene. In estimating the immediate losses by increasing the mesh size the selectivity of a cod-end made of polyamide was used. Experimental trawling in the period 1952-1968 by Norwegian research vessels have been analysed together with these data.

The official Norwegian statistics comprise figures for total landings in the area by each species. These figures may therefore comprise landings from fishing localities outside the area. However these figures are recorded elsewhere, and an estimate of the total landings in the area from Norwegian waters can be given. These figures may still comprise some quantities from other parts of the Norwegian coast, but vessels using other gears than trawl on the Norwegian coast are usually landing their catches at the nearest port.

An improvement in the statistical system of the sales organisation was introduced in 1967 for the northern part of the area, and a splitting of the landings on gear were possible (Table 6).

Age- and length-compositions of saithe, cod and haddock from catches taken by commercial fishing vessels using trawl, Danish seine, gill net, purse seine, hooks and trap nets and from trawl catches taken by research vessels, have been analysed. The saithe data cover the period 1954-1968, while the cod and haddock data cover the years 1956-1968 and 1948-1966 respectively.

Description of the fisheries in the area

German and Norwegian trawlers are during January-April fishing for spawning saithe at the Aktivneset, named Svinøy ground by the Germans. Some gill net fishing is also made at the same time and ground by the Norwegians.

About 50-60 Norwegian trawlers, less than 200 gross tonnage, are fully occupied in a fishery for immature saithe on the edge of the continental shelf. Trawlers of the same size categories are also fishing for saithe, cod and haddock on the shelf outside the 4 nautical miles limit. Prawn trawling is made by small vessels in the same area, and they get saithe, cod and haddock as by-catch. Trawling for other Article-6 species is also going on in the northern part of the area. Undersized Annex-II species and Article-6 species are used for industrial purposes, while Annex-II species of market size-categories are used for human consumption.

Smaller Norwegian vessels are in January-April exploiting spawning cod by trawl, gill net, long-line and handline on the shelf. Some vessels are fully occupied with Danish seining for cod, haddock and saithe, mostly inside the 12 nautical miles limit. During summer and autumn purse seining for immature saithe is going on in the same area.

A cod fishery with trap net take place from August to April in shallow waters of the northern part of the area. The living fish is collected in net bags in the sea and later transported by well boats to the bigger cities for human consumption. (Sundnes 1958).

Up to the 1st January 1967 Norwegian trawlers had to use a mesh size of 80 mm in cod-ends. From this date a 130 mm (120 mm) mesh size should have been introduced, but according to the Norwegian exemption from the Reccommendation of the Commission a mesh size of 80 mm is still legal. The mesh size in cod-ends of Danish seine were 80 mm up to the

end of 1966 which was in accordance with the Recommendation of the Commission. From the 1st January 1967 the mesh size should have been increased to 110 mm, but a Norwegian exemption made it possible for the seiners to use 80 mm in a temporarly transitional period.

The Norwegian mesh regulation of Article-6 fisheries follow the Recommendation of the Commission, which prescribe a mesh size in Article-6 fisheries less than 50 mm. In addition the Norwegian provision says that the mesh size in prawn trawls shall not be less than 30 mm.

Earlier investigations

Saithe

The growth, age at maturity, otolith types, relative strength of year-classes etc. have been found to vary between the stocks of saithe in Icelandic, Faroes and Norwegian waters (Sæmundsen 1929, Schmidt 1955 and Bertelsen 1942). Consequently the stocks of saithe in these areas have been regarded as more or less independent populations. During the winter 1957 Norwegian tagged fish occured in catches from Faroe waters and later that year from the SE and NW coast of Iceland (Olsen 1959). Saithe of Icelandic origin appeared in 1956 in catches from the Faroe waters (Schmidt 1957), and migration of saithe from the Faroes and from Shetland to Icelandic waters, to the North Sea and to the Norway coast (Anon 1965) have later been shown. These findings show that the stocks of saithe in the north-east Atlantic areas could not be regarded as completely isolated population, they intermingle to some extent.

The very young saithe (0- and I-groups) are mainly living in the littoral zones off the Norwegian coast (Olsen 1966). Results of tagging experiments in the Møre area indicate that young saithe, as they grow older, gradually move northwards and recruit the stock of medium and large fish which during feeding season is mainly distributed in northern areas (Olsen 1961, Anon 1965). A regular spawning migration from the Finnmark area to the west coast of Norway and Northern North Sea are clearly demonstrated (Olsen 1961, Anon 1965). The eventual return migrations are not clearly demonstrated. Most likely the majority returns to the northern areas for feeding, but there may be some dispersal of fish remaining in the southern areas after spawning (Olsen 1961).

The Coalfish Working Group (Anon 1965) concluded that their report do not give reason to assume that the various saithe stocks in the ICES

area have been seriously effected by the fishing, in spite of the great increase in total fishing activity of the North-east Atlantic after 1945. This was caused by that the young fish was to a great extent protected from trawl exploitations. The young stages were at that time little fished, except by purse seine in Norwegian coastal waters.

Cod

Two main cod populations excist in Norwegian waters (Rollefsen 1933 and Møller 1968). These types which are distinguished by the shape of the otoliths, the relative breath of the zones in the otoliths and the finer structures, are called coastal cod and Arctic cod. Up to maturity the Arctic cod is living in the Barents Sea, round Bear Island and along the West-Spitsbergen Coast. At maturity the fish migrate each year to the Norwegian coast for spawning, where it stays during January-May. Tagging experiments have shown that some part of the spawning stock reach the West Coast of Norway (Sætersdal and Hylen 1959 and Hylen et. all 1961).

The migration of coastal cod within the west coast of Norway have been studied by Hylen (1964 a and b). Young cod which is exploited by trap net in the northern part of the area, is during autumn living not deeper than about 10 m. Gradually the fish migrate to deeper water within the tagging localities, and from March-April it start migrating to shallow water again. As the fish grow older, it is migrating to the southern part of the area, where it is exploited by several gears. Fish tagged in the middle of the area (caught by Danish seine) seems to be stationary, and emigration to more distant areas seems to be of minor importance.

Haddock

Uniformity in vertebrae number, brood strength and growth excisting in young haddock from Northern Norway, north of 64°N (Sætersdal 1952), the Barents Sea included imply that these areas are inhabited by one main population. Tagging experiments made in the Finnmark area have given returns as far south as the Røstbank (Sætersdal 1954). This together with the Norwegian eggs and larvae-investigations (Wiborg 1950, 1952) indicate that the spawning ground was located south of Lofoten. Eggs and larvae have in more recent years been found as far south as 63°50'N (Wiborg 1960 and 1961) and the spawning area have by Sonina (1967) been extended as far south as south of 64°N.

Relationship between the stocks within the area and those in adjacent areas of northern Atlantic

Saithe

Immature saithe tagged and released in the area limited by 62° and 64°N have according to the returns emigrated to other parts of the Norwegian coast, to the North Sea, to the Faroes and to the Icelandic waters. A high percent of saithe released inside the 4 nautical miles limit, have been recaptured on the tagging locality (Table 2). Some returns are known from the Area between 4°E and the 4 nautical miles limit, and from both inside and outside the 4 nautical miles limit on other parts of the Norwegian Coast. Recaptures of saithe released between 4°E and the 4 nautical miles limit give nearly the same picture, except that the highest number of recapture are reported from the areas west of the 4 nautical miles limit.

The returning rate for Norwegian fishermen in areas outside the 4 nautical miles limit along the Norwegian coast are 81 and 71 for the two series of experiments. However, the Norwegian fishermen have returned 95 percent of the total number of tags reported from the experiments inside the 4 nautical miles limit and 50 percent from the experiments outside the 4 nautical miles limit. An increase in the rate of returns from foreign fishermen are observed with time in liberty (Table 3).

Cod

A southward migration is observed for young cod tagged in shallow waters in the northern part of the area (Table 2), one as far south as west of Skagen. Two recaptures have been reported from the Finnmark coast and from Bear Island respectively. The first was a coastal cod, while the other was a mature Arctic cod. All together 94 percent of the recaptures are returned from the areas inside the 4 nautical miles limit within 62° and 64°N, and one from the area west of the 4 nautical miles limit. Only two out of 187 returns have been reported by foreigh fishermen.

The geographical distribution of the returns from tagging experiments in the middle part of the area show that 8 percent of the total returns are reported from the area between the 4 nautical miles limit and 4°E, limited by 62° and 64°N, while the figure for the area east of the 4 nautical miles limit is 89 percent. Up to the 1st July 1968 only one of 145 returns have been reported by foreign fishermen.

Haddock

Few haddock tagged in the area have been recaptured outside the tagging locality (Table 2). The number of returns from the area inside the 4 nautical miles limit are 39 out of 40. One of these is recaptured south of 62°N, and the forthies are recaptured in the area west of the 4 nautical miles limit. All returns are reported by Norwegian fishermen.

Compositions of catches and landings

Statistics

Total Norwegian landings of Annex-II species and none Annex-II, none Article-6 species within the area limited by 62° and 64°N are given in Table 4. Landings from distant fishing areas, as Faroes, Iceland and Western Atlantic is not included here, but some landings from the Norwegian coast outside the area might be included. The landings of the different Annex-II species have been fluctuating, while the figures for saithe show increasing landings since 1961. The figures given could only be splitted in landings by trawl, trap net (Table 5) and "other gears". However, for 1967 the landings in the northern part of the area could be splitted on gears (Table 6). This is still a statistic based on landing ports, not on fishing localities, and some figures may include small quantities from areas outside the area limited by 62° and 64°N. According to this table 88 percent of the trawl landings were saithe and 10 percent were cod and haddock. The greatest quantity of saithe was landed by purse seiners, and the rate of Annex-II species in these landings were negligible. Only small quantities of saithe were landed by other gears.

Since the trawl statistics are based on log-books, the landings can be referred to fishing localities. Landings of Annex-II species and none Annex-II, none Article-6 species from the Møre area are given for trawlers of 150 gross tonnage and less (Table 7). Landings from trawlers between 150 and 200 gross tonnage are not included in the figures for 1961-1966, because the data could not be made available in time. However, this is of minor importance. In 1967 were only 2 vessels above 150 tons (151 and 153 tons), and they landed only saithe, which was 3.3 percent of the total trawl landings. The yearly landings of cod and haddock from this area have been fluctuating between 464 and 894 tons and 349 and 665 tons respectively. Landings of mature Arctic cod are included. Landings of other Annex-II species have been less than 40 tons per year (Table 7). However, the saithe landings have been steadily increasing from 981 tons in 1961 to 12.020 tons in 1967. Landings of other none Annex-II, none Article-6 species which com-

prise redfish, ling, torsk etc. have been increasing. German landings of saithe and other species from the SvinøyGround have been decreasing year by year since 1961 (Table 8).

A decrease in Norwegian catch of cod and haddock per hour trawling and an increase in catch of saithe per hour trawling are observed since 1961 (Table 9). However, catch of saithe and other species per catching day of German trawlers have been fluctuating (Table 8).

Trawling experiments

Some trawling experiments have been made during the period 1954-1968 by Norwegian research vessels (Table 10). Most of the experiments in January-March have been made on the edge of the continental shelf. The main part of the catch have been saithe, and the content of Annex-II species has been a few fish and up to about 30 specimens.

Two saithe trawlers were hired in May 1968 to complete our knowledge of the special Norwegian saithe trawling on the edge of the shelf (Table 11). Saithe was dominating the catches of both trawlers as about 95 percent was saithe and 5 percent other species. The main part of the catch of other species was made up by cod and haddock.

Trawler Y which used a mesh size of 122 mm in serie A got a catch which was 88 percent less than that of the trawler X with a mesh size of 88 mm. Trawler X changed in serie B to 120 mm and Y to 9[illegible] mm meshes, and this was followed by 80 percent smaller catch of trawler X than Y. The differences in catches of cod and haddock were small in both series (Table 11).

A Norwegian research vessel made in January 1968 some trawling on the shelf in the area (Table 10). Saithe was the dominating species in these hauls, but a high content of haddock was observed. The same observation was made in May 1968 also by one of the hired commercial trawlers (Table 11, serie C).

Trawler statistics for 1967

Both the data from the experimental trawling in May 1968 and from earlier year indicate that the content of Annex-II species in the catches from the edge are less than from the shelf (Table 12). In verifying the indication given, the landings of the commercial trawlers for 1967 have been splitted in edge and shelf catches. About 3.5 percent of the quantity of Annex-II species could not be splitted. However, the data show that the landings from the edge in 1967 contained between

1.5 - 5.0 percent of Annex-II species (Table 12). Only 3.6 percent of the total landings of saithe could according to incomplete recording in the log-books not be splitted in landings from the edge and the shelf respectively. However, the landings from the edge were between 74-78 percent of the total trawler landings from the area. Saithe was the dominating species in landings from both the edge and the shelf. Its relative importance in the edge landings was 95 percent in weight, while the corresponding figure for the shelf landings was 30 percent.

Age- and length composition

Saithe

The landings in 1967 from the northern part of the area are recorded in 5 length-groups (Table 13). Fish used for animal food and for fish meal production contain all size-groups. This category may therefore contain small fish not used for human consumption and bigger fish of bad quality.

The trawlers landed mainly fish in the length-group 40-60 cm (88 percent) and only 5 percent were less than 40 cm. Size-group compositions of purse seine landings differ, as only 51 percent of the landings were recorded in length-groups 40-60 cm and 48 percent were less than 40 cm. Composition of prawn trawl landings were to some extent similar to that of the trawlers, but the landings of long and hand line and gill net contained more in length-group greater than 60 cm. These indications are supported by the length and age compositions of samples taken from commercial landings and from research vessel catches (Figure 2). The gill net and trawl samples (except 1958 and 1966) are taken in January-February on the edge of the shelf, Aktivneset, and the fish caught are mature saithe. The length frequency distribution in trawl catches from 1958 and 1968 which were taken on the shelf in December and May respectively, contained smaller fish than the other trawl-samples. These distributions are similar to those of the purse-seine catches (Figure 2).

From May 1968 there excist samples of fish caught on the edge and the shelf by trawl of 99 mm. The length distributions of the samples were similar. Length compositions of samples taken with a mesh size of 88 and 99 mm on the edge give near identical distribution. However, some selection occured in the experiments on the edge with a mesh size of 122 mm.

Age-compositions give the same overall picture. Gill net and trawl catches from the winter season contain older fish than purse seine and trawl catches from summer (Figure 3).

Cod

Cod in Norwegian waters are composed of two types, Arctic cod and coastal cod. Immature cod is living in the Barents Sea, around Bear Island and along West-Spitsbergen coast, and mature fish migrate every year to the Norwegian coast for spawning, and to some extent as far south as Møre. Landings in February-April from this area have in 1963 and 1965 been composed of about 4 percent Arctic cod (Table 14). The length groups of fish landed are more than 70 cm (Figure 4), and the age is more than 6 years (Figure 5). Except the spawning period for Arctic cod, the landings are exclusively composed of coastal cod. The smallest coastal cod are landed by trap net, which is used in shallow waters (mostly less than 10 m). These fish measured 30 cm and more (Figure 4), and they are from 1-5 years old (Figure 5).

Landings from the northern part of the area are recorded in size-groups as for saithe (Table 13). The dominating category have been bigger than 62 cm for all gears, and the relative importance of the category 47-62 cm in trawler landings was 32 percent, while it was less than 21 percent for the other gears. Fish less than 47 cm is very scarce in the landings from all gears (Table 13). Even in trawl hauls made with cod-ends covered with a net of small meshes on the shelf and the edge (Table 11), the length-groups less than 50 cm was not represented in the catches.

Some trawling for industrial purposes are going on in the middle part of the area. These trawlers are working on deeper fields with muddy bottom. Three industrial catches were analysed in September 1963, and all cod caught were suitable for human consumption.

Haddock

Haddock landings from the northern part of the area have also been recorded in size categories (Table 13). Fish more than 60 cm have been the dominating size-groups in landings from all gears, and the content of other categories have been of minor importance. Very small quantities have been used for animal food.

Few samples of commercial landings for human consumption excists. However, there excists length- and age-samples from experimental fishing with prawn trawl, Danish seine and trawl with the cod-end covered with a net of small meshes (Figure 6). All available data indicate that haddock from about 12 cm and greater are found on localities over the whole area, both on the edge and the shelf. However, haddock caught in May 1968 on the edge and on the shelf by the hired

trawlers were more than 40 cm. According to age-determinations the haddock are represented in the area as 0-group fish and older (Figure 6).

The effect upon the stocks in this area and adjacent areas by using a mesh size less than described for Region I

Mass spawning of saithe is known to take place at Iceland, Faroes and off the west coast of Norway (Anon 1965). Tagging experiments have shown a considerable mixing between fish of different regions, at least, outside the spawning season, but the mixing of saithe from the different areas may according to the tagging experiments vary from year to year. However, it might according to the Coalfish Working Group (Anon 1965) be reasonable to assume that each spawning population constitute a separate stock.

Several gears are exploiting the saithe in the Møre area. Trawl and purse seine are exploiting to a great extent the same size-groups (Figure 2 and Table 13). As much as 77 percent of the saithe landings from the Møre area in 1967 were taken on the edge, while the rest was caught on the shelf itself. The length and age-distributions of samples from the two localities were similar (Figures 2 and 3).

With the same relative importance of saithe caught by purse seine in the southern part of the area, as in the northern (Table 6), the total landings by purse seine from the area were estimated to 27,451 tons. The landings by Norwegian trawlers from the area limited by 62°and 64°N made up about 15 percent of the total landings by purse seine from the Norwegian waters north of 62°N, where this stock is assumed to be distributed. The total landings of saithe by trawlers fishing at Møre made up less than 4 per cent of the total international landings from sub-area I and division IIa and IIb (Table 15). We accieve therefore by increasing the cod-end mesh size to 130 mm (120 mm) for Norwegian trawlers fishing in the area limited by 62° and 64°N only to regulate a small part of the fishery for small saithe. However, the results of the Working Group (Anon 1965) do not at that time give reason to assume that the various saithe stocks in the ICES areas have been seriously depleted, because of fishing. How far this is a safe conclusion for the saithe stock in Norwegian waters to day, can only be found by a substantial analysis of the data from the whole area.

Trawler X and Y used in serie A cod-ends with a mesh size of 88 mm and 122 mm respectively. The total catch of saithe in weight by trawler Y was only 12 percent of that by the trawler X (Table 16). When trawler X used 120 mm and Y 99 mm mesh size (serie B) the total catch of saithe

taken by trawler X was 20 percent of that taken by trawler Y. However, the immediate reduction in weight by increasing the mesh size in serie A and B from 85 mm and 100 mm respectively have been estimated (Table 16) by using a selection factor of 3.79 (Hylen 1967). A disagreement between the estimated figures are shown. The immediate loss in weight by increasing the mesh sizes in cod-ends are about half of the corresponding figures estimated directly (corrected for differences in fishing time). This means that the selection factors used may be too small or that the fishing power of the vessels have been smaller when using the 120 mm cod-end, or that they were fishing on smaller concentrations with the highest mesh size. The discrepency might in serie A to a certain extent be caused by the fact that trawler X which used the smallest mesh size was the most powerful vessel. However, the difference in catches in serie B should have been smaller than the estimated, because trawler X, which used the biggest mesh size have the highest fishing power. A reduction in trawling speed was observed for trawler X in some hauls of serie B, and this might have been of some significance.

Arctic cod and coastal cod are exploited by several gears in the area limited by 62° and 64°N. As far as the Arctic cod is concerned only small quantities of spawning fish are caught (Table 14), and the fish caught are more than 60 cm and older than 6 years (Figures 4 and 5). With a selection factor of 3.7 for Arctic cod (Hylen 1967) the 50 percent length for a cod-end with mesh size 130 mm (120 mm) is 48 cm which means that the conservation effect on Arctic cod by increasing the mesh size from 80 mm to 130 mm for Norwegian trawlers in the area would be neglegible.

Small coastal cod are exploited in the area by trap nets in very shallow waters. No mesh size regulation excist for this fishery, and fish of 30 cm and more is caught (Figure 4). Other gears seem to catch few fish less than 47 cm, the trawl included (Table 13). Since there is a demand for small cod for animal food, there are no reason to discared fish between the minimum size limit and 47 cm (Table 13). This indicate that small cod are not caught by trawl. However, tagging experiments in the northern part of the area, limited by 62° and 64°N, the trap net area (Hylen 1964a) have shown that the fish emigrate at a certain length to the middle part of the Møre area, where these fish are exploited by several gears.

This stock seems to be little exploited by Norwegian and foreign trawlers on the edge of the shelf (Table 2), but more by the Norwegians on the banks from about the 12 nautical miles limit and eastward. An

increase in the mesh size from 80 mm to 130 mm (120 mm) means that the 50 percent length is increased from 27 to 44 cm, when a selection factor of 3.4 as for North Sea cod is used (Anon 1968). The selection factor for North Sea cod is chosen in preference to that for Arctic cod, because the coastal cod have a more lumped body shape than the Arctic cod (Rollefsen 1954). A selection factor of 3.7 as used for Arctic cod, may therefore be too high. Since the length groups in the selection ranges seems to be not very abundant in the trawling area, the immediate loss and longterm gain following an increase in the mesh size to 130 mm may be small. An eventual longterm gain following an increase in cod-end mesh size may give most benefit to Norwegian fishermen.

Norwegian trawlers are landing small quantities of haddock from the edge (Table 12). Haddock for human consumption, and industrial purposes are mostly caught on the shelf from about 12 miles limit and eastward. This means that the haddock stock in the area is almost entirely exploited by Norwegian fishermen with all types of gears. The size composition of landings from the northern part of the area indicate that fish less than 60 cm are scarce (Table 13). However, the size composition of haddock caught by trawl with cod-ends covered with a net of small meshes, by prawn trawl and by industrial trawl show that all sizes of haddock are living in the area (Figure 6). With a selection factor of 3.4 as for North Sea haddock (Anon 1968), the 50 percent selection length for a mesh size of 80 mm is 27 cm. By increasing the mesh size to 130 mm (120 mm) the 50 percent length will be increased to 44 cm. This cause an immediate reduction in yield, but the data are too scarce to estimate the effect in quantitative terms. However, an eventual gain following an increase in cod-end mesh size, might give most benefit to Norwegian fishermen.

Other Annex-II species are caught in small quantities by trawl in the Møre area (Table 7). No biological data excist either for commercial landings or from experimental catches.

References

Anon 1965. Report of the Coalfish Working Group. Co-op.Res.Rep.int.Coun.Explor.Sea(A),6:1-23.

" 1966. Co-opted members report to the Liaison Committee. Co-op.Res.Rep.int.Coun.Explor.Sea(B), 1964:26-48.

" 1967. Co-opted members' report. Matters arising at the 1965 ICES meeting. Ibid., 1966:59-64.

" 1968. Report of the North Sea Working Group. Coun.Meet. int.Coun.Explor.Sea,1968(F:4):1-13, 36 tables and 16 figures [Mimio].

Bertelsen, E.1942. Contributions of the biology of the coalfish (Gadus virens L.) in Faroe waters. MeddrKommnDanm. Fisk.- og Havunders. Ser.Fiskeri, 11(2):1-68 and 10 tables.

Hylen, A., Midttun, L. and Sætersdal, G. 1961. Torskeundersøkelsene i Lofoten og i Barentshavet 1960. Fiskets Gang, 47 (5):101-114.

Hylen, A. 1964a. Merking av rusefanget torsk i områdene Smøla-Helgeland. Fiskets Gang, 50 (5):87-93.

" 1964b. Kysttorskmerkinger 1964. Ibid., 50(52):773-774.

" 1968. Selectivity experiments with a cod-end made of polypropylene splitfiber. Co-op.Res.Rep.int. Coun.Explor.Sea(B), 1968: [In press].

Møller, D. 1968. Genetic diversity in spawning cod along the Norwegian coast. Hereditas,60:1-32.

Olsen, S. 1959a. Migrations of coalfish (Gadus virens L.) from Norway to Faroe Islands and Iceland. Coun.Meet. int.Coun.Explor.Sea, 1959(12):1-5 [Mimio].

" 1959b. Preliminary results of the Norwegian coalfish taggings 1954-58. Coun.Meet.int.Explor.Sea,1959 (114):1-20 [Mimio].

Olsen, S. 1961. An account of the Norwegian coalfish investigations with special reference to the tagging experiments. Coun. Meet.int.Explor.Sea,1961 (125):1-8 [Mimio].

" 1966. Density-dependent growth in saithe. Coun.Meet. int.Coun.Explor.Sea, 1966(G:2):1-7 [Mimio].

Rollefsen, G.1933. The otoliths of the cod. FiskDir.Skr.Ser.Havunders., 4(3):1-14 and 3 plates.

" 1954. Observations on cod and cod fisheries in Lofoten. Rapp.P.-v.Réun.Cons.perm.int.Explor.Mer.82(2):1-15.

Schmidt, U. 1955. Beiträge zur Biologie des Köhlers (Gadus virens L.) in den isländischen Gewässern. Ber.lt.wiss.Kommn Meeresforsch. 14(1):46-82.

Schmidt, U. 1957. Die deutschen Køhleranlandingen 1946/47-1956/57 aus norwegischen und isländischen Gerwässern und ihre Abhängigkeit vom Fischbestand. [Manus].

Sonina, M.A. 1967. The Barents Sea haddock, Melanogrammus aeglefinus, migrations and factors determining them. Coun. Meet.int.Coun.Explor.Sea 1967(F:18):1-7 [Mimio].

Sundnes, G. 1957. On the transport of live cod and coalfish. J.Cons perm.int.Explor.Mer, 22(2):191-196.

Samundsson, B.1929. On the age and growth of the coalfish (Gadus virens L.), the Norway pout (Gadus esmarki Nilsson) and the poutassou (Gadus poutassou Risso) in Icelandic waters. Meddr.KommnHavunders.Ser.Fiskeri, 8(7):1-37.

Sætersdal, G. and Hylen, A. 1959. Skreiundersøkelsene og skreifisket i 1959. Fisken og Havet 1:1-20.

Sætersdal, G.1952. The haddock in Norwegian waters. I Vertebrae counts and brood strength variations of young fish. FiskDir. Skr.Ser.HavUnders., 10(4):1-14.

" 1954. Some investigations of the Arcto-Norwegian haddock. Coun.Meet.int.Coun.Explor.Sea, 1954 (47):1-15 [Mimio].

Wiborg, Kr.Fr.1950. Utbredelse og forekomst av fiskeegg og fiskeyngel på kystbankene i Nordnorge våren 1948 og våren 1949. Fiskets Gang, 36 (7 and 8):67-68 and 80-85.

" 1952. Forekomst av egg og yngel av fisk i nordnorske kyst- og bankfarvann våren 1950-51. Foreløbig beretning II. Fiskets Gang, 38 (4):36-41.

" 1960. Investigations on eggs and larvae of commercial fishes in Norwegian coastal and offshore waters in 1957-58. FiskDir.Skr.Ser.Havunders., 12(7):1-27.

" 1961 Forekomst av egg og yngel av fisk i vest- og nordnorske kyst- og bankfarvann våren 1960. Fiskets Gang, 47(9):190-195.

Table 1. Experimental trawling experiments at Møre 6th-9th May 1968.

Vessel characteristic			Serie A			Serie B		
Vessel	Length	Horse power	Mesh size mm	No.of hauls	Fishing hour	Mesh size mm	No.of hauls	Fishing hour
X	73	290	87,6	5	9,6	119,7	4	10,3
Y	61	400	122,1	5	9,4	93,7	4	9,3

Table 3. Recapture of saithe tagged in the area limited by 62° and 64° N: A inside and C outside the 4 nautical miles limit. Recaptures by foreign fishermen given in brackets.

Release data				Recapture year after tagging							
Year	Month	Gear	No	0	1	2	3	4	5	6	7
A											
1955	05	P.S	490	125	11(1)	11(6)	9(1)	3(2)	2(2)	1(1)	
1957	05	"	509	136	26(3)	7(2)	6(2)	6(2)	2		2
1958	06	"	508	219	9(1)	6(4)	3(1)	2(2)		2(2)	1
C											
1956	02	O.T	79	7(2)	4(2)	1	3(3)	3(1)			
1958	12	"	35		2	4(3)	2(2)	3(1)	1(1)		

Table 2. Recaptures of saithe, cod and haddock tagged in the area limited by 63° and 64° N: A inside and C outside the 4 nautical miles limit. Recaptures by foreign fishermen given in brackets. * See figure 1.

Release data				Recapture area*					Recaptures		
									Norway		
Year	Month	Gear	No	A	B	C	D	E	Inside 4 miles	Outside 4 miles	Others
A.Saithe											
1955	05	P.S	490	143	4	2(1)	7(7)	6(5)	147	2	13
1957	"	"	509	163	10	5(2)	2(2)	5(5)	173	3	9
1958	06	"	508	223	7	3(2)	6(5)	3(3)	230	2	10
S.Saithe											
1956	02	O.T	79	5	2	10(7)	1(1)		7	3	3
1958	12	"	35	2		2(1)	3(2)	5(4)	2	3	7
A.Cod											
1956	01	T.N	150	61	2				63		
"	"	H.L	25	11		1		1(1)	12		1
1957	03	T.N	220	60				2(1)	61		1
"	11	"	110	43	6				49		
1964	02	D.S	271	90	3	12		1(1)	93	12	1
"	06	"	33	13					13		
"	09	"	10	2					2		
1965	02	"	30	14					14		
"	03	"	18	11					11		
A.Haddock											
1961	08	"	48	12	1				13		
"	09	"	22	8					8		
1964	02	"	11	1		1			1	1	
"	09	"	28	4					4		
1965	03	"	101	13					13		

Table 4. Total Norwegian landings within the area limited by 62° and 64° N.

Metric tons, round fresh.

Year	Annex-II species						None Annex-II, none Article-6 species	
	Cod	Haddock	Whiting	Halibut	Plaice	Other Flatfishes	Saithe	Others
1961	22 776	2 571	-	580	134	14	17 507	19 385
1962	14 233	2 152		382	29	111	33 129	17 047
1963	18 527	3 135		306	142	13	43 471	11 771
1964	20 197	4 828		477	163	15	31 382	12 863
1965	19 842	4 003		383	170	19	43 767	14 609
1966	20 129	3 115		318	148	15	49 984	10 503
1967*	15 000	2 500		300	60	10	45 000	9 000

* To some extent estimated.

Table 5. Trap net landings of cod in the area south of 64° N. Metric tons, round fresh.

Years						
1961	1962	1963	1964	1965	1966	1967
751	744	917	1005	1035	1112	991

Table 6. Norwegian landings in 1967 in the northern part of the area limited by 62° N and 64° N.
Metric tons, round fresh.

Gear	Annex-II species						None Annex-II, none Article-6 species		
	Cod	Haddock	Whiting	Halibut	Plaice	Other flatfishes	Saithe	Others	?
Otter Trawl	993	78		5			9 767	185	49
Prawn trawl	234	48		16	3		92	15	7
Purse sein	15	(+)					16 775	-	
Gill net	889	45		6	16	12	225	120	51
Long line	132	193		60	11	2	51	2 476	155
Hand line	151	4		2			348	227	2
Others	5						7		(+)
Total	2 419	368		89	30	14	27 265	3 023	264

Table 7. Norwegian landings from the area limited by 62° N and 64° N by Norwegian trawlers of 150 gross tonnage and less. Metic tons, round fresh.

Year	Annex-II species					None Annex-II, none Article-6 species		Total
	Cod	Haddock	Whiting	Halibut	Plaice	Saithe	Others	
1961	848.3	509.5	22.5	9.2	1.0	981.3	32.9	2 424.7
1962	498.8	345.2	30.5	6.0	0.3	1 753.2	61.6	2 712.6
1963	627.9	532.0	17.1	13.9	1.9	2 070.4	56.2	3 319.4
1964	711.8	664.7	20.6	22.6	2.6	2 913.8	179.0	4 515.1
1965	509.9	526.4	15.4	16.1	2.8	7 145.8	335.2	8 551.6
1966	464.4	452.3	1.5	10.9	0.5	8 751.0	209.9	9 890.5
1967	903.0	643.0	3.0	8.0	2.0	12 020.0	206.0	13 785.0

Table 8. German landings and landings per days fishing from the Svinøy ground. Metric tons, round fresh.

Year	Total landings		Landings per fishing days	
	Saithe	Others	Saithe	Others
1961	4973	1052	11,2	3,0
1962	1387	717	6,9	1,9
1963	1267	831	7,2	2,5
1964	1030	475	10,4	1,8
1965	696	119	14,2	2,4
1966	621	299	10,7	5,2

Table 9. Catch per hours trawling by Norwegian trawlers of 150 gross tonnage and less in the area limited by 62° and 64° N. Kg, round fresh.

Year	Cod	Haddock	Saithe
1961	93	56	108
1962	55	39	194
1963	42	35	138
1964	42	40	174
1965	21	22	300
1966	31	30	589

Table 10. Experimental trawling within the area limited by 62° N and 64° N and east of 4° E. Number caught.

Date	Locality	No of hauls	Vessel	Gear	Annex-II species					None Annex-II, none Article-6 species	
					Cod	Haddock	Whiting	Halibut	Other flatfishes	Saithe	Others
February 1952	Edge on the shelf	1	G.O.S.	O.T						3	100
April 1953	"	1	"	"						1	16
March 1954	"	4	"	"		30	50			192	19*
February 1955	"	3	"	"						594	17
" 1957	"	4	"	"						239	-*
January 1961	"	2	J.Hj.	"		3				19	4
" 1963	"	9	G.O.S.	"	10	20				39	89
January 1964	"	2	"	"	9	8			2	42	390
February 1965	"	1	"	"		3				6	6
January 1968	"	1	"	"	8	64				26	86
December 1958	Shelf	1	J.Hj.	"	4	8				369	-
September 1961	"	3	P.R.	"		3	1		1		386
January 1968	"	5	G.O.S.	"**	15	394		2		195	94

* Species measured in basket not included

** Cod-end with cover of small meshes

Table 11. Trawling experiments with hired commercial trawlers in the area limited by 62° and 64° N and east of 4° E.

Date	Locality	Vessel	Serie	Mesh size (mm)	No of hauls	Annex-II species									None Annex-II, none Article-6 species			Others
						Cod			Haddock			Halibut	Saithe					
						No	Weight kg	Length cm	No	Weight kg	Length cm	No	No	Weight kg	Length cm	No
6th-9th May	Edge of the shelf	X	A	87,5	5	83	160		104	57		1	10208	11816	38-73	19
" " "	"	Y*	A	122,1	5	13	38	50-98	8	6	23-50		1037	1426	39-86	5
9th May	"	X	B	119,7	4	24	74	53-102	21	26	49-60		889	1396	41-84	3
" "	"	Y*	B	98,7	4	2	4	60-62	47	25	22-52		5790	6807	38-70	-
" "	The shelf	Y	C	98,7	1	5		50-72	18		29-45		300	298	36-55	-

* Catch quantities adjusted to the same fishing time as for trawler X

Table 12. Trawler landings in 1967 from the area limited by 62° N and 64° N and east of 4° E. Metric tons, round fresh.

Locality	Annex-II species					None Annex-II, none Article-6 species		
	Cod	Haddock	Whiting	Halibut	Plaice	Saithe	Others	?
Edge of the shelf	11	13		(+)		8 946	107	30
Shelf	848	609	3	8	2	2 642	99	97
?	44	21		(+)		432	-	1
Total	903	643	3	8	2	12 020	206	128

Table 13. Landings in the northern part of the area limited by 62° and 64° N. Per mille.

Saithe

Gear	Landings ton	Relative landings in size categories			
		<40 cm	40-60 cm	>60 cm	All size-groups
Otter trawl	9 767	53	879	29	39
Prawn trawl	92	106	779	87	28
Purse seine	16 775	476	514	2	8
Gill net	225	36	135	784	45
Long line	52	67	304	511	118
Hand line	349	166	470	346	18
?	7	166	816	18	-

Cod

Gear	Landings ton	Relative landings in size categories			
		<47 cm	47-62 cm	>62 cm	All size-groups
Otter trawl	992	1	320	668	11
Prawn trawl	234	8	130	844	18
Purse seine	15	-	105	888	7
Gill net	889	4	137	846	13
Long. line	132	8	77	880	35
Hand line	151	7	207	759	27

Haddock

Gear	Landings ton	Relative landings in size categories			
		<42 cm	42-60 cm	>60 cm	All size-groups
Otter trawl	79	1	-	995	4
Prawn trawl	48	1	-	998	1
Purse seine	-	-	-	-	-
Gill net	44	33	+	958	9
Long line	194	14	-	981	5
Hand line	5	70	-	927	3

Table 14. Arctic cod and coastal cod in samples from the area limited by 62° and 64° N and east of 4° E.

Gear	1958			1963			1965		
	No	Arctic cod	Coastal cod	No	Arctic cod	Coastal cod	No	Arctic cod	Coastal cod
Trawl	52	65	35	617	13	87			
Gill net	222	65	35	51	4	96	246	4	96
Long line	131	22	78						

Table 15. Landings of saithe in the area limited by 62° and 64° N and from the area north of 62° N. Round fresh, metric tons

Year	Landings within 62° and 64° N		Norwegian landings by purse seine north of 62° N	International landings from sub-area I and division IIa and IIb
	Trawl	All gears		
1961	981	17 507		109 999
1962	1 758	33 129		114 052
1963	2 070	43 471		145 914
1964	2 914	31 382		197 506
1965	7 146	43 767		185 600
1966	8 751	49 984		202 975
1967	12 020	45 000	81 286*	

*Estimated

Table 16. Immidiate loss of saithe by increasing mesh size: in serie A from 85 mm and in serie B from 100 mm. Per cent.

Trawler	Serie	Mesh size (mm)		
		100	110	120
X	A	14	30	48
Y	A			88*
Y	B	-	19	41
X	B	-		80*

* The loss in catch of the trawler using the biggest mesh size, relative to the catch of the trawler using the smallest mesh size.

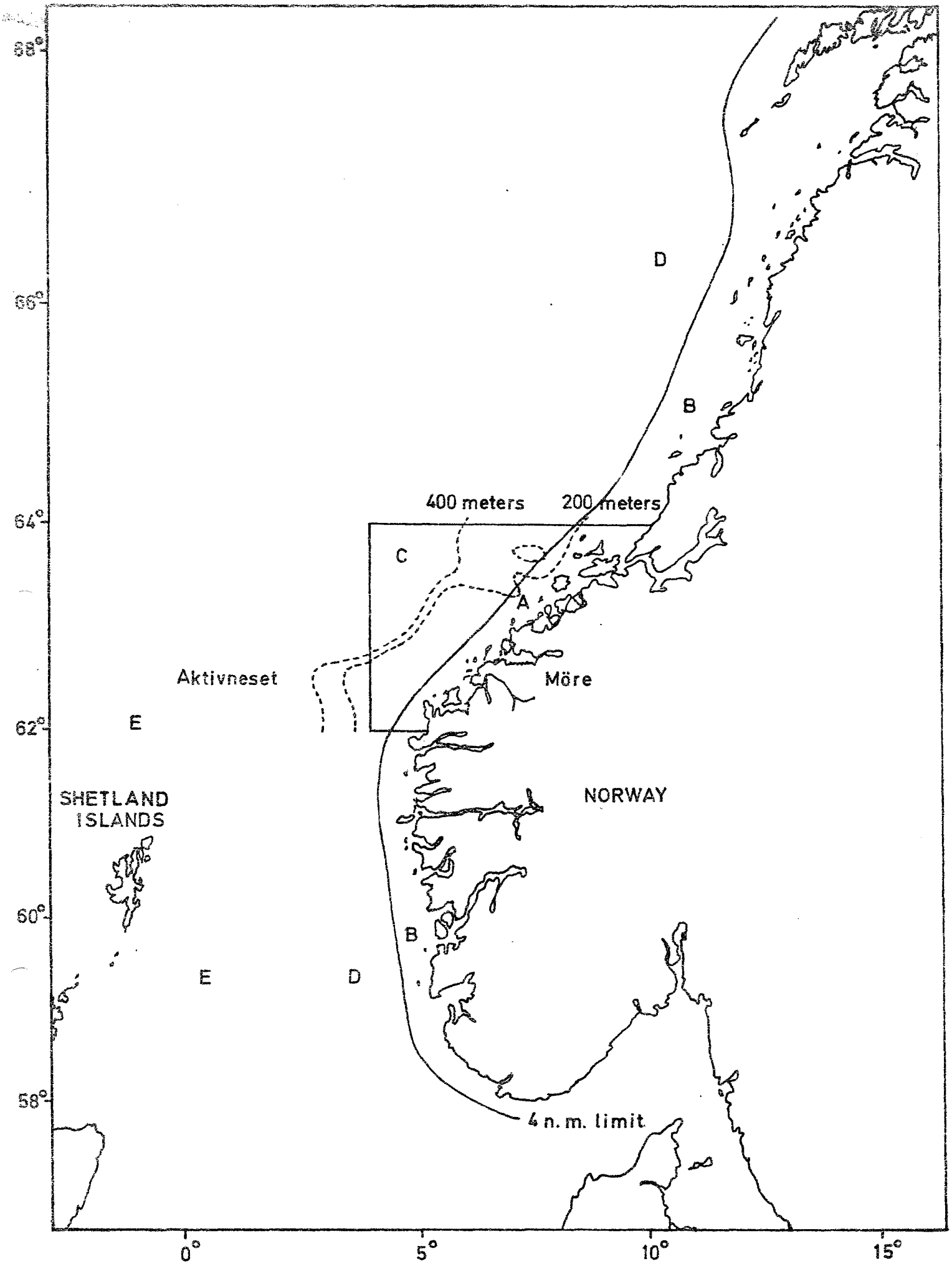

Figure 1. Norway Coast,

A: East of the 4 nautical miles limit between 62° and 64° N.

B: East of the 4 nautical miles limit on other parts of the Norwegian Coast.

C: East of the 4° E and west of the 4 nautical miles limit between 62° and 64° N.

D: West of the 4 nautical miles limit on other parts of the Norwegian Coast.

E: Outside the Norwegian waters.

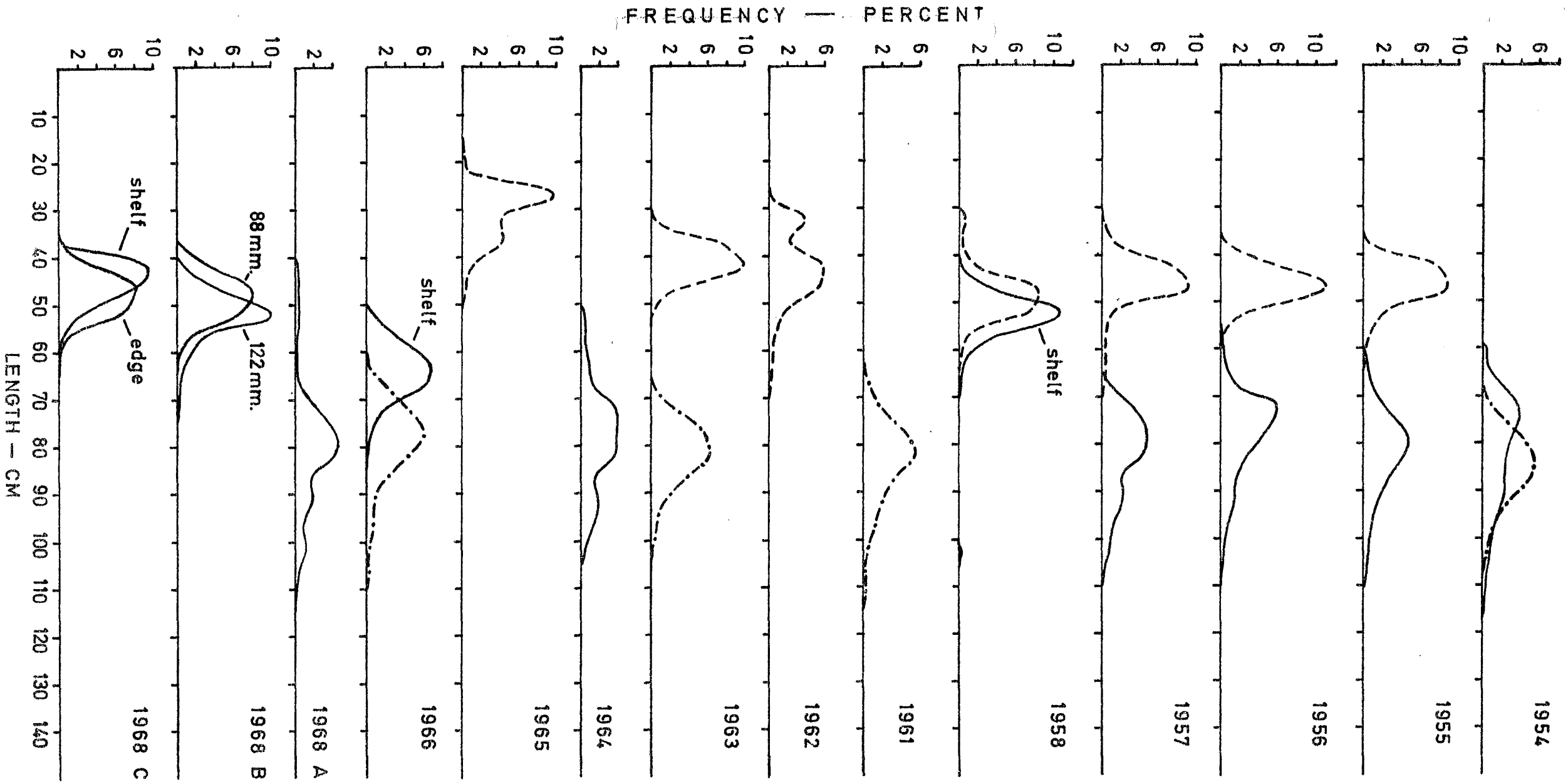

Figure 2. Length-distributions of saithe caught in the area limited by 62° and 64° N.

——— Otter trawl. Research vessels 1954-1958, 1964, 1968 A

-.-.- Gill net. Commercial landings

----- Purse seine. Commercial landings

A. Cod-end with a net of small meshes

B. Hired trawlers fishing on the edge

C. Hired trawler. Mesh-size in cod-end 99 mm

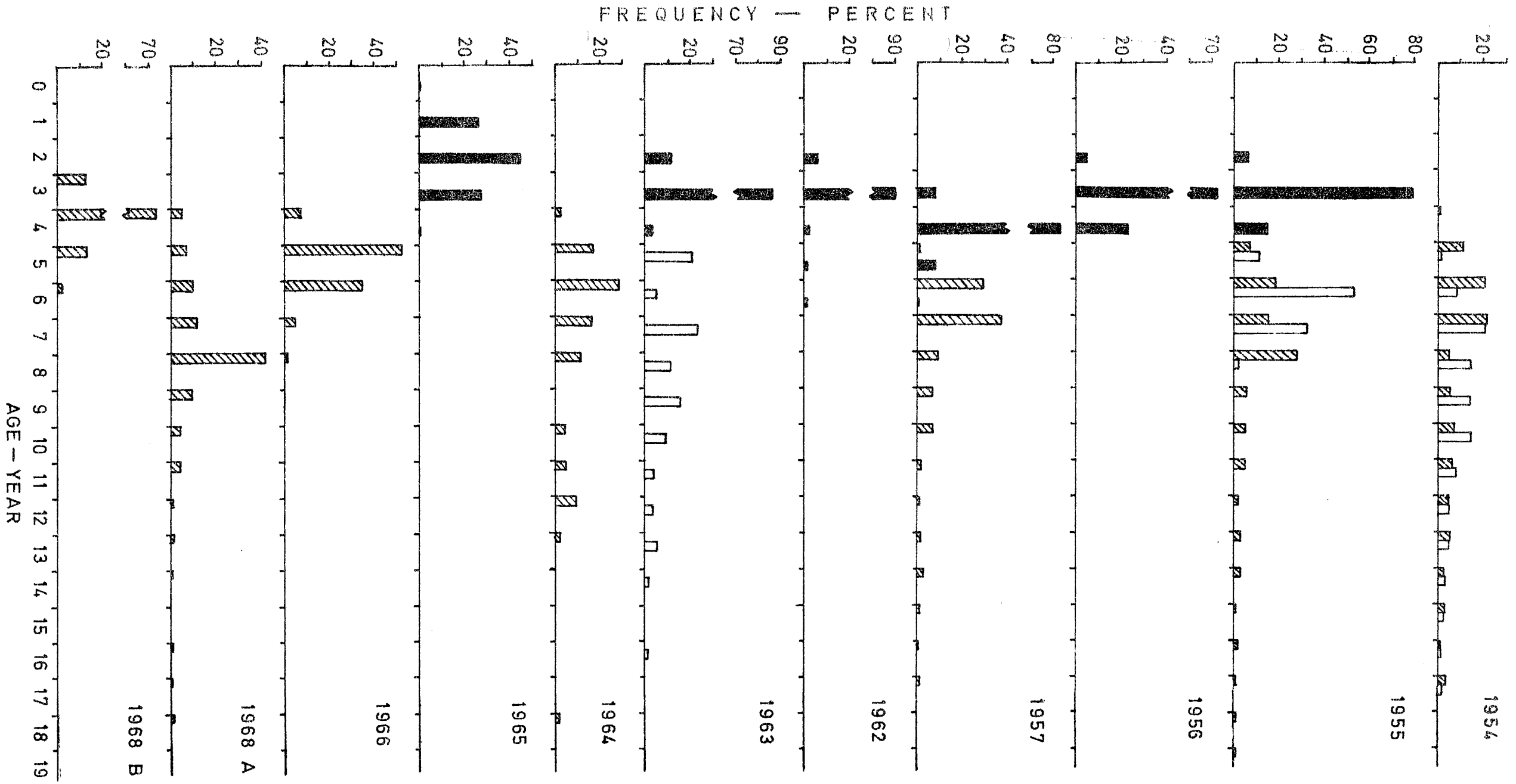

Figure 3. Age-distributions of saithe caught in the area limited by 62° and 64° N.

Otter trawl. Research vessels 1954, 1955, 1957, 1964, 1968 A — A. Research vessel. Cod-end with a net of small meshes

Gill net. Commercial landings — B. Hired trawler. Mesh-size in cod-end 99 mm

Purse seine. Commercial landings

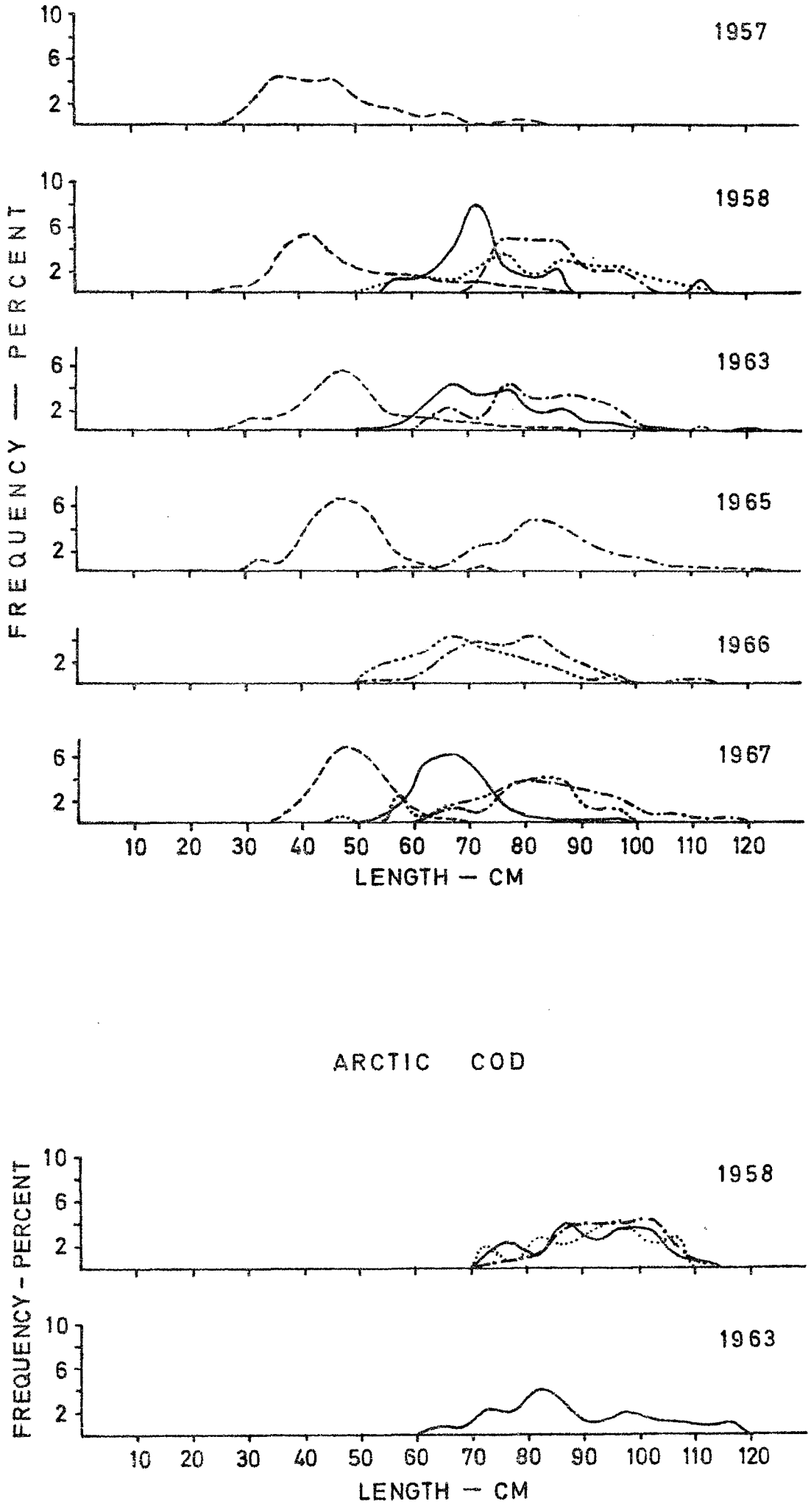

Figure 4. Length-distributions of Coastal and Arctic Cod landed by commercial vessels in the area limited by 62° and 64° N.

———— Otter trawl
-·-·-·-·- Danish seine
– – – – – Trap net
-·-·-·-·- Gill net
..... Longe line

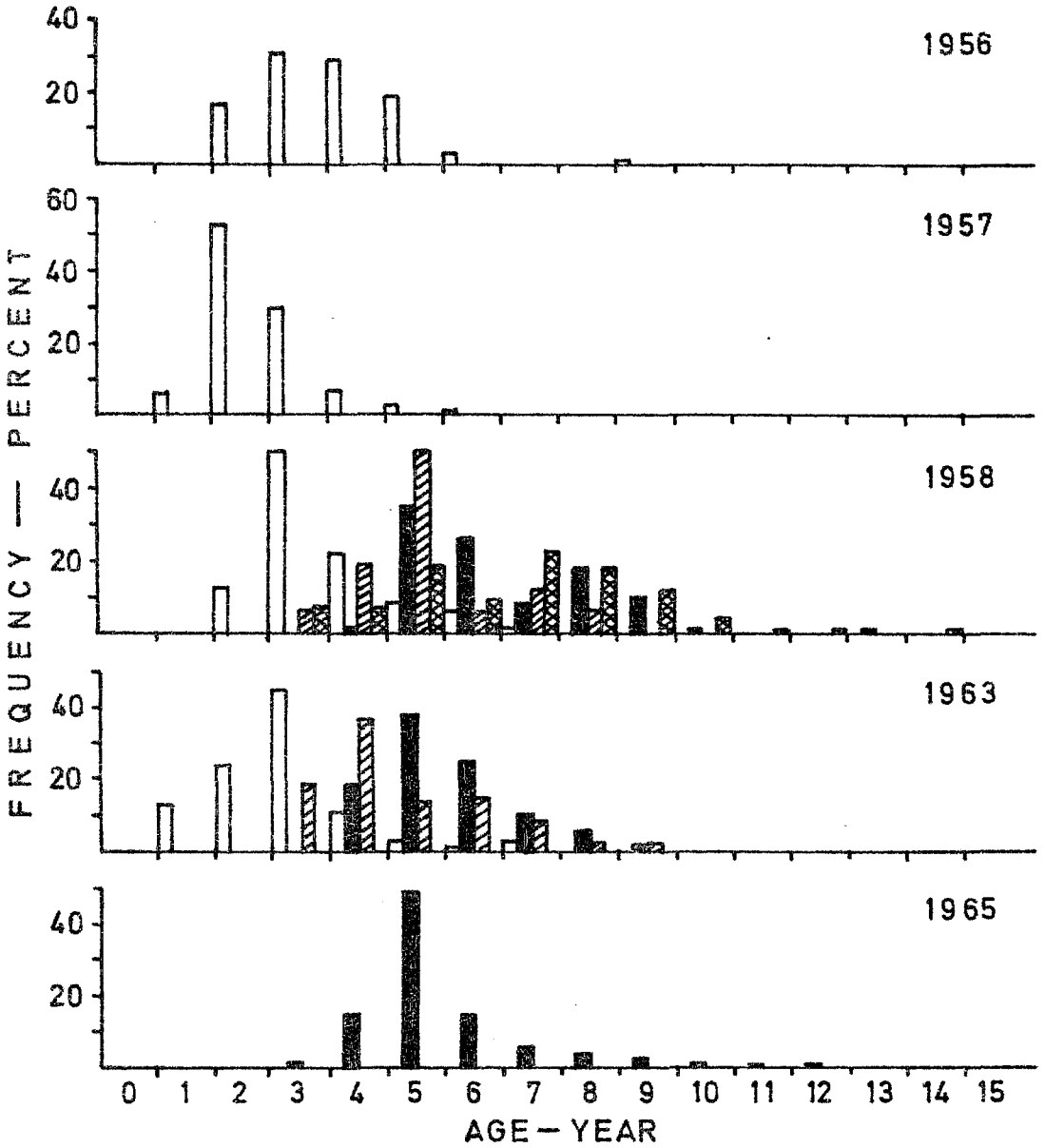

Figure 5. Age-distributions of Coastal and Arctic Cod landed by commercial vessels in the area limited by 62° and 64° N.

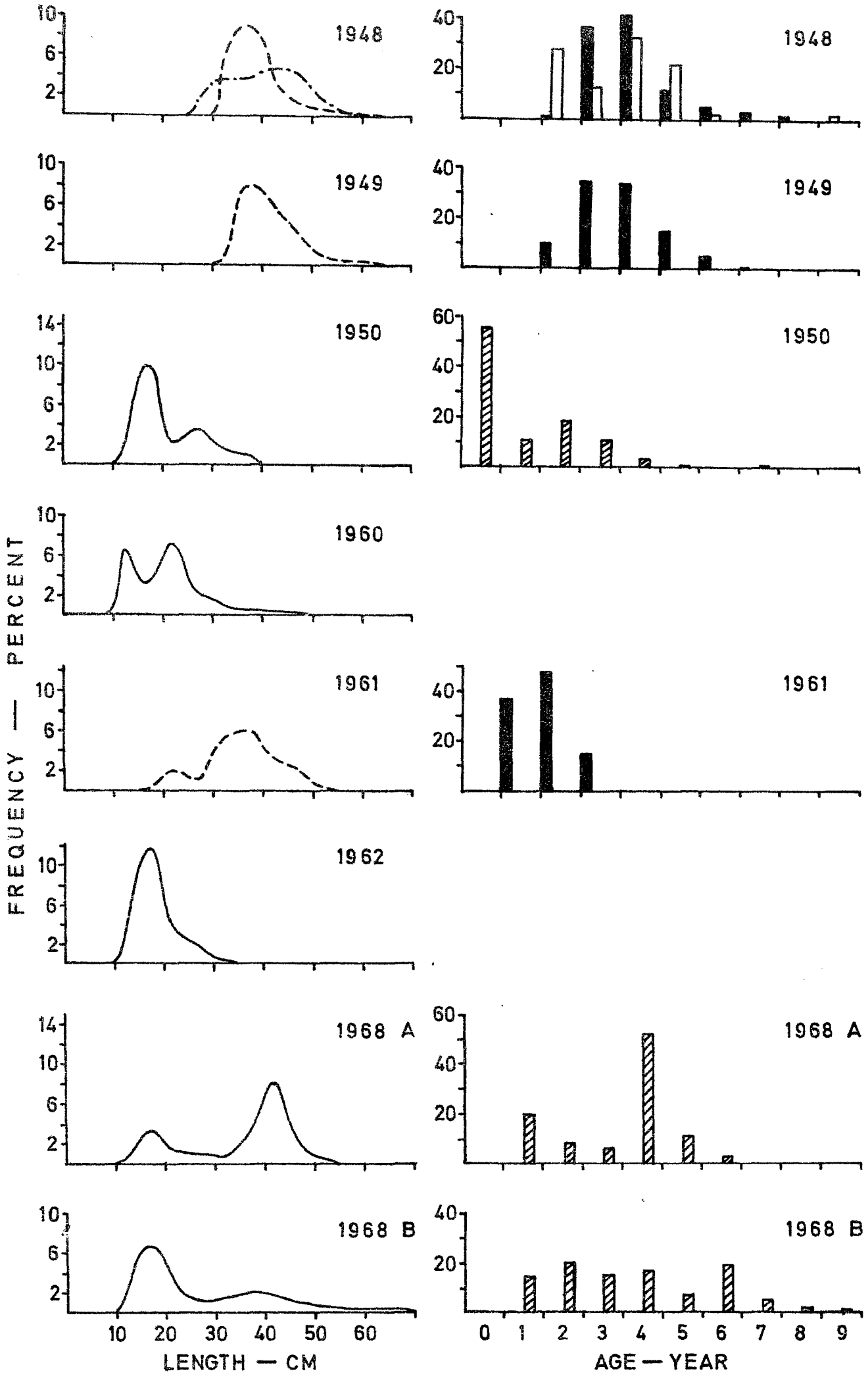

Figure 6. Length- and age-distributions of haddock caught in the area limited by 62° and 64° N.

——— Industrial trawl 1960 and 1962. Research vessel, otter trawl with a cover of small meshes 1950, 1968 A (on the edge) and 1968 B (on the shelf)

----- Danish seine. Commercial landings 1948 and 1949. Research vessel catch 1961

-.-.- Prawn trawl. Commercial landing