International Council for the
Exploration of the Sea

C.M.1969/H:6
Pelagic Fish (Northern) Committee
Ref.: Pel. Fish (S) Cttee.

The Norwegian Mackerel Fisheries in the Skagerak and the Northern North Sea

by
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INTRODUCTION

Fishing for mackerel in shore waters has been carried out by the Norwegians at least since the beginning of the 14th century, according to the information in hand. A first change in this old traditional fishery took place around 1830 when the Norwegians started to fish mackerel by gill net off the Norwegian Skagerak coast. In the early 19th century also the hook and line fishery was extended and has later developed into a more offshore than inshore fishery. Beside these two main gears the mackerel has been fished in inshore waters by beach seines and small purse seines, and by trawlers in the North Sea.

After the second world war, the conventional catching methods improved gradually as a result of better boats and equipment. But no substantial change in the fishing intensity was obtained before the power block was introduced to the traditional herring purse seiners in the early sixties. The power block caused a revolution in the purse seining technique which not only increased the fishing power of the fleet, but also created new fisheries. One of these is the purse seining for mackerel in the North Sea.

The present paper is a description of the Norwegian mackerel fishery with respect to gears, catch and effort.

THE FISHERY

Table 1 illustrates the importance of the various gears before and after the introduction of the power block. It may be noted that although the large purse seiners now completely dominate the landings, the conventional gears are still in use and contribute with a yearly catch of the same magnitude as in previous years. The reason why the "old gears" are still able to compete with the modern one is, however, a matter of marketing policy.

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Table 1 Norwegian mackerel landings by gears (in %) before (1959-63) and after (1964-68) the introduction of the power block.

$\bar{C}$ = average yearly catch in 1000 tons.

Year-periods	$\bar{C}$	Purse Seine	Gill nets	Hook and line	Trawl	Inshore
1959-1963	18,7		25,3	46,7	4,6	23,4
1964-1968	468,2	95,6	1,5	1,9	0,04	0,6

Gill nets

Apart from the catch of some stationary nets used in coastal waters, the gill net catch is taken by drifters in offshore waters, from off Hordaland to the Skagerak and the Outer Oslofjord. (See chart).

The drifters are about 50 to 70 feet long with a crew of 3-5 men. The nets are 17 fm long and $3\frac{1}{2}$ - 4 fm deep. 60 to 120 nets are used in each set, depending on size of boat and crew. The nets are set with floats on the surface and are used during dark hours only.

The gill net season last from April to September, with the peak season in June, i.e. during the spawning period. (Fig. 1).

Hook and line

The hook and line is the most important of the traditional mackerel gears and counts for nearly half the "pre power block" catches. The gear may either be used for trolling (in Norwegian called dorg) or jigging (in Norwegian called harp) according to the distribution and behavior of the fish.

Dorg

The main localities for mackerel trolling are off the coast from Rogaland to Skagerak and the Outer Oslofjord. This fishery is mostly carried out from small open motor boats 22-30 feet long, and with a crew of 1 to 3 men. In later years some larger and decked boats have participated.

Both construction and handling of the troll vary considerable and have often a personal character. Outriggers are common, one on each side of the boat and with lines containing up to 25 hooks. A piece of coloured rubber tube which covers the leg of the hook serves as artificial bait. The season starts in June and lasts to August - September when the boats gradually change to harp due to the change in the behavior of the fish.

Harp

The jigging method was used by the Norwegians for years, but it was first in the late fifties that the harp technique developed into a regular fishery.

In autumn the mackerel start to withdraw from the coastal waters and congregate in larger shoals in the Norwegian Channel and its slope towards the North Sea plateau, "The Reef". These shoals have a deeper distribution than the scattered

summer shoals and under this condition it is more efficient to use the harp method. This fishery is performed by the larger ships only, because the smaller ones cannot operate so far off the coast during late autumn. In addition, some decked boats from 50 to 70 feet and with a crew of some 4 - 7 men take part. The boats fish with several lines arranged on each side, the length of which varies according to the depth of the shoal. The changing over from troll to jig takes place in August - September and the different methods may at the beginning be used alternately according to the conditions on the grounds.

The hook and line fishery starts in June, the peak in catch is reached in September and the season may last to November. (Fig. 1).

Trawling

The trawl has been of secondary importance to the Norwegian mackerel fishery. Trawling for mackerel started in 1949, but combined with trawling for other species. The fishery has no peak season and takes place more or less throughout the year. The boats are small, some 100 feet or less, and the number varies considerably from year to year. Bottom trawl, midwater trawl and pair trawl have been used. At present very few boats are left in this fishery because most of them are now operating as "helpers" for the purse seiners.

The inshore fishery

During summer the mackerel also occurs in inshore waters. From Hordaland to the Oslofjord, the fish is frequently caught with a variety of gears in the fjords. The occurence of mackerel to the North of Hordaland is unusual, but in some years considerable quantities may be caught also in that part of the country.

The main gear used in inshore waters are various types of seines, beach seines and small purse seines, in addition some stationary gill nets are used. The catch varies from year to year. In the early sixities it was substantial, but has declined considerably in the later years. (Table 1).

Purse seine

Before 1964 small purse seines were used for catching mackerel in inshore waters, and some of the largest boats had also operated on the "Reef" (Danish side) during late summer and autumn.

The larger herring seiners equipped with power blocks started to fish mackerel in the North Sea and the Skagerak in the autumn of 1964. It was soon realized that the mackerel stock in the North Sea was far bigger than earlier expected and that it could be a very valuable resource for exploitation by the new gear. In the course of some few years practically all Norwegian herring seiners and small trawlers were converted into stern-seiners equipped with power blocks. Many new boats were also built and the size and catching power of the purse seining fleet increased considerably. Another new technical devise was the fish pump. This was successfully introduced in the middle of the sixties and has also contributed to the present high efficiency of the fleet.

A standard Norwegian purse seiner does not exist. The seiners may vary in size from 100 to 180 feet. The largest seiner is 184 feet long and has a loading capasity of 900 tons. The crew consist of 9 - 14 men depending on the size of the vessel.

The purse seines have also gradually increased in size and dimension, and are still increasing. The largest nets may now be near to 400 fm long and some

120 fm deep. Various hydraulic hauling devises have to a large extent replaced the original power block, and a system of three rollers is now very common.

The area of operation for the seiners is the Skagerak, the Norwegian Channel, the "Reef" and the fishing banks of the North-Eastern North Sea. During winter and early spring the seiners operate in the northern part of this area mainly from the Utsira Hole to the Old Viking Bank, some years around the south-eastern edge of the Viking Bank. In July this year the seiners encountered for a few days great concentration of mackerel north of Tampen, but this is regarded as extraordinary.

The variation in catch by season is shown in Figure 1 A. In winter the availability of mackerel is low. This is due to submersion of the fish in order to avoid the winter cooled surface layer. It is therefore only occasionally that the fishermen will reach the top of the shoals with their net. But the shoals are extraordinary dense so that when the shots are successful they often surround too much fish. The mackerel oppose strongly to be lifted up into cold upper layers, and this causes much breakage of nets during winter and early spring. Another reason for the low catch during February - March 1967 and 1968, (the years on which Figure 1A is based), is due to reduced effort because most of the boats have participated in the winter herring fishery.

The submersion of the mackerel shoals during winter also change the relative availability of the various size groups (Fig. 2). The catch during winter is dominated by the smallest individuals of the catchable stock. This indicates a segregation by size in the stock, with the smaller individuals consentrated on the top.

In April, when the surface temperature has increased to some 6 to 7 centigrades the mackerel shoals rise to the surface for feeding. The catch increases and the larger size groups do again appear in the landings. The peak of the spring catch is reached in May. In June the catch drops considerably and reach a minimum in July. This is caused by a spreading of the shoals during the spawning. This unfavourable change in the behaviour with respect to the seiners does, however, favour the gill net fishery (Fig. 1B).

In early autumn the mackerel begin to concentrate in large shoals in the Norwegian Channel and on the "Reef". This is the best season for the purse seiners and the peak of catch is reached in October.

EFFORT STATISTICS

Effort statistics of the mackerel fishery are available on a yearly basis only. For the gill net and hook and line fishery the yearly catch per man has been calculated and shown in Table 2. Although a slight decrease in the indices of both the gears is observed in 1968, the Table does not reflect any essential variation in availability of fish during the last four years.

Table 2 Catch per man (in tons).

Year	1962	1965	1966	1967	1968
Gill net	7,9	6,9	10,3	9,9	8,8
Hook and line	2,3	3,3	3,7	4,4	3,9

In Table 3 is shown the yearly catch per boat for the purse seine fleet during the years 1965-68. The index has increased up to 1967. This increase does no doubt reflect an increasing average efficiency of the seiners. But another factor which has contributed to the rise is an increase in the effective time spent in mackerel

fishery because of decreasing availability of herring in the same area.

In 1968 the catch per boat was somewhat lower than in 1967. But the difference in the availability of fish of the two years was considerable larger than the present data illustrate because the fishing in 1967 was stopped several times due to marketing difficulties.

Table 3 Catch and effort of the purse seine fishery.
C = total catch (in tons)
f = number of purse seiners

Year	1965	1966	1967	1968
C	137614	464026	845370	760000
f	367	399	416	401
C/f	374,9	1163,0	2032,1	1895,3

SUMMARY and CONCLUSIONS

1. The introduction of the power block revolutionized the purse seining techniques and created a new mackerel fishery in the North-Eastern North Sea and the Skagerak. The Norwegian mackerel catch rose from about 20 thousand tons in early 1960 to some 900 thousand tons in 1967. The mackerel catch taken by the other countries in the North Sea and Skagerak has on average dropped from 70,6 thousand tons in 1959-63 to 53,9 thousand tons in 1964-68.

2. The catch of the conventional gears in the Norwegian coastal waters has not essentially been influenced by the new catching techniques. The availability of fish to these gears has also more or less remained unchanged.

3. The yearly catch per boat index of the purse seine fleet reached a maximum in 1967. In 1968 the availability of mackerel to the purse seiners was considerably lower than the year before.

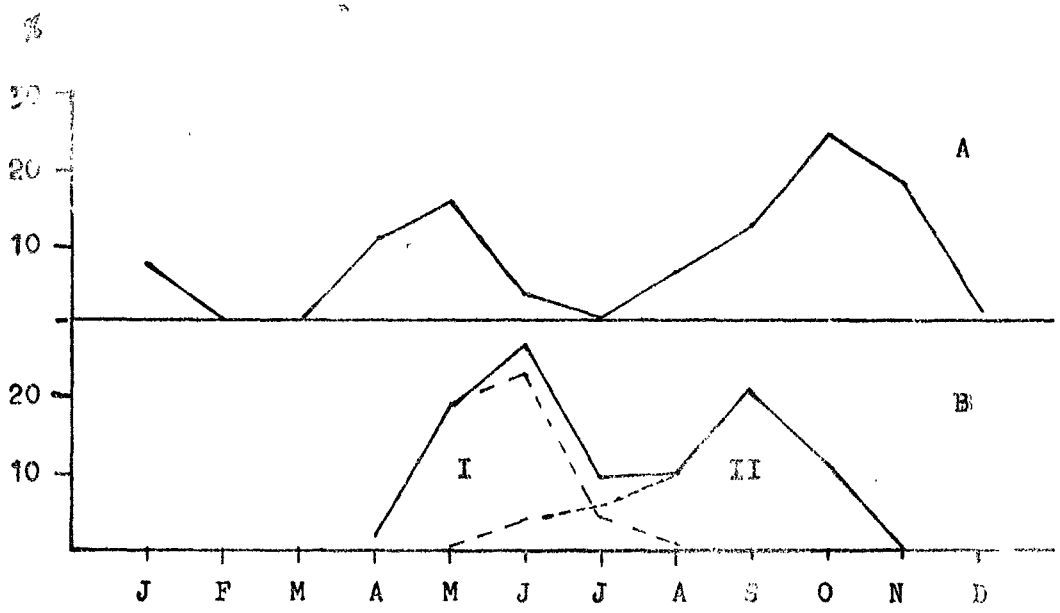


Fig. 1. Average mackerel catch by months (1967 - 68) in % of total.

A: Purse seine.

B: I = gill nets, II = hook and line.

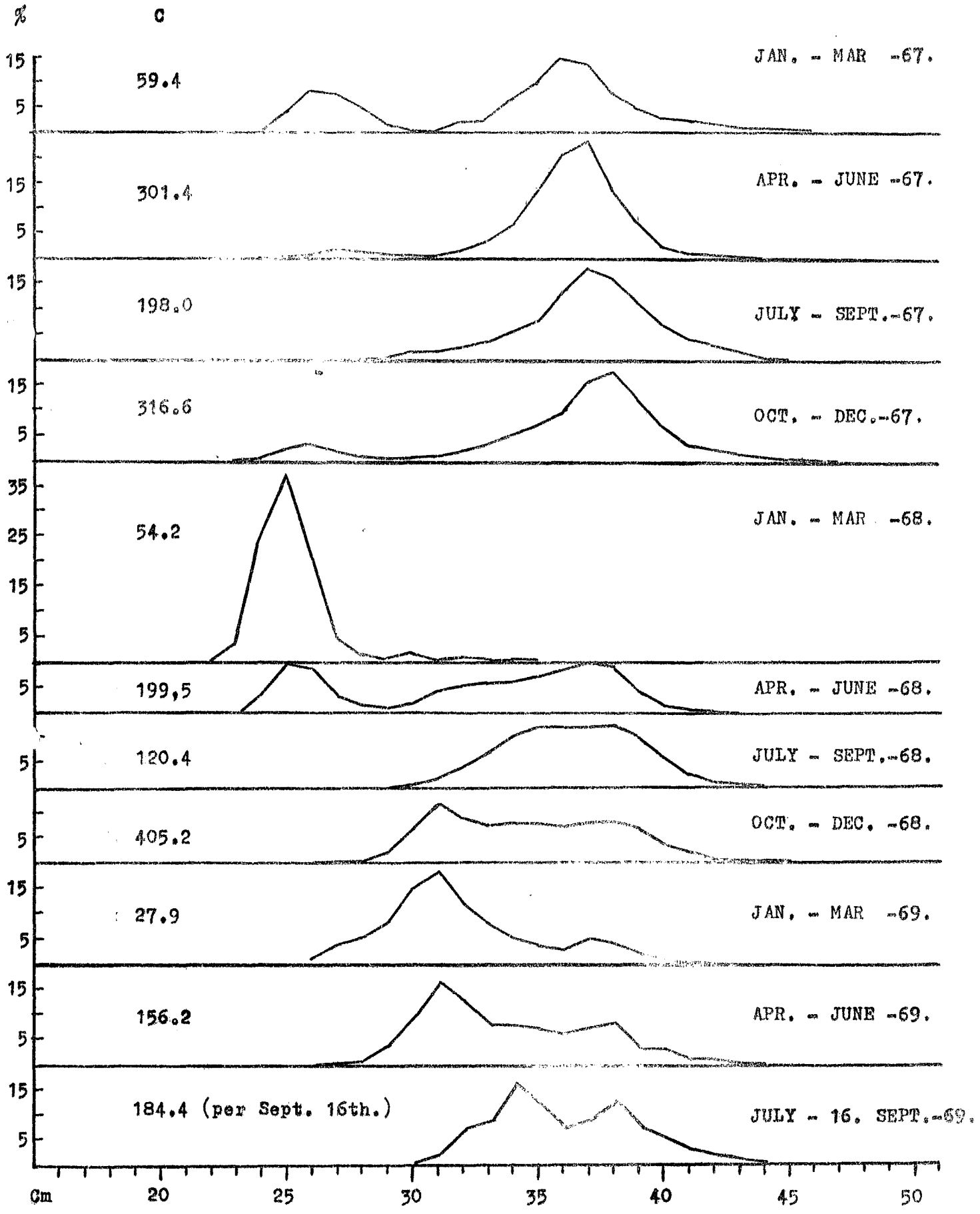
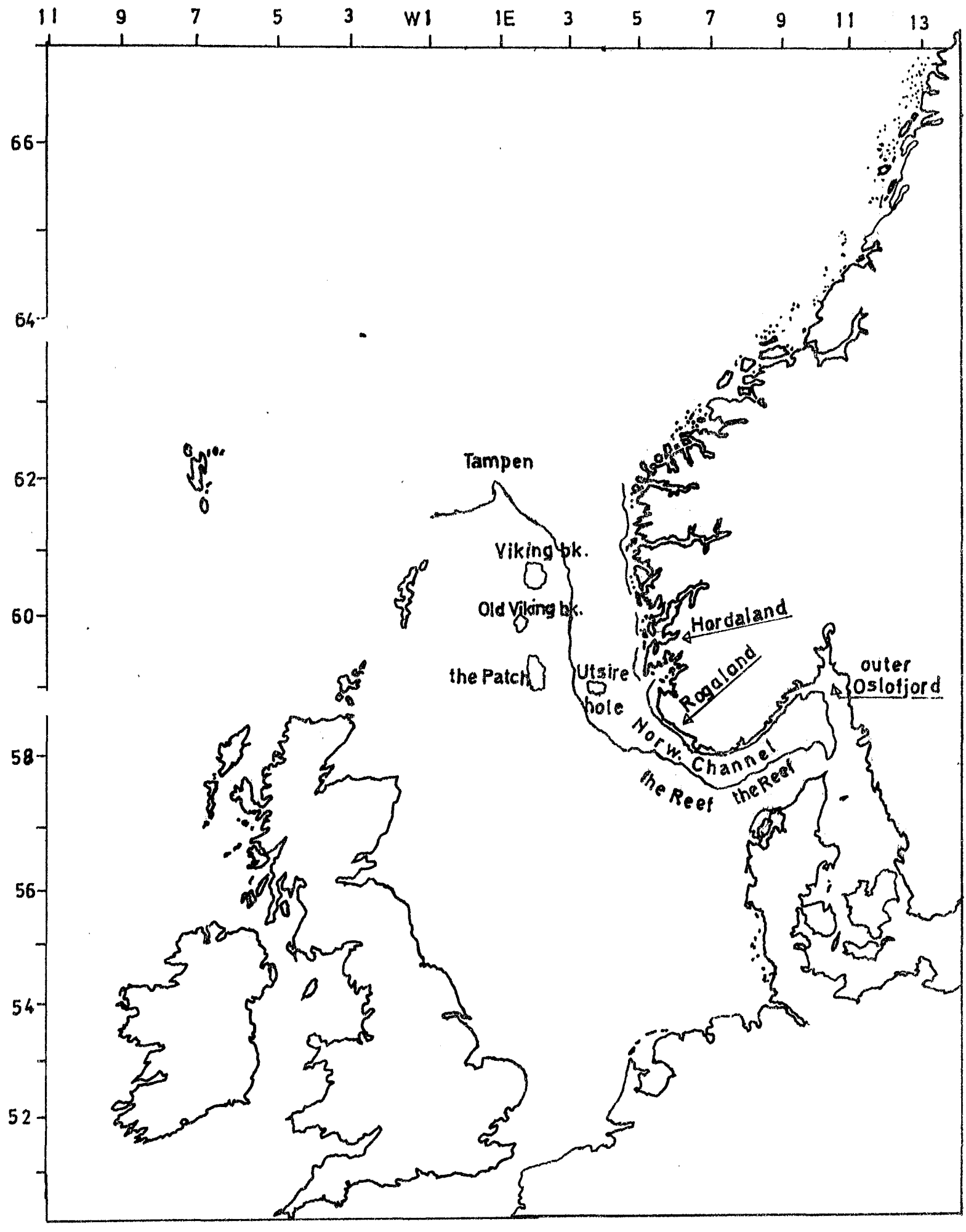


Fig. 2. Quarterly frequency distributions of mackerel caught by purse seine in the North Sea and the Skagerack.
C = total catch in 1000 tons.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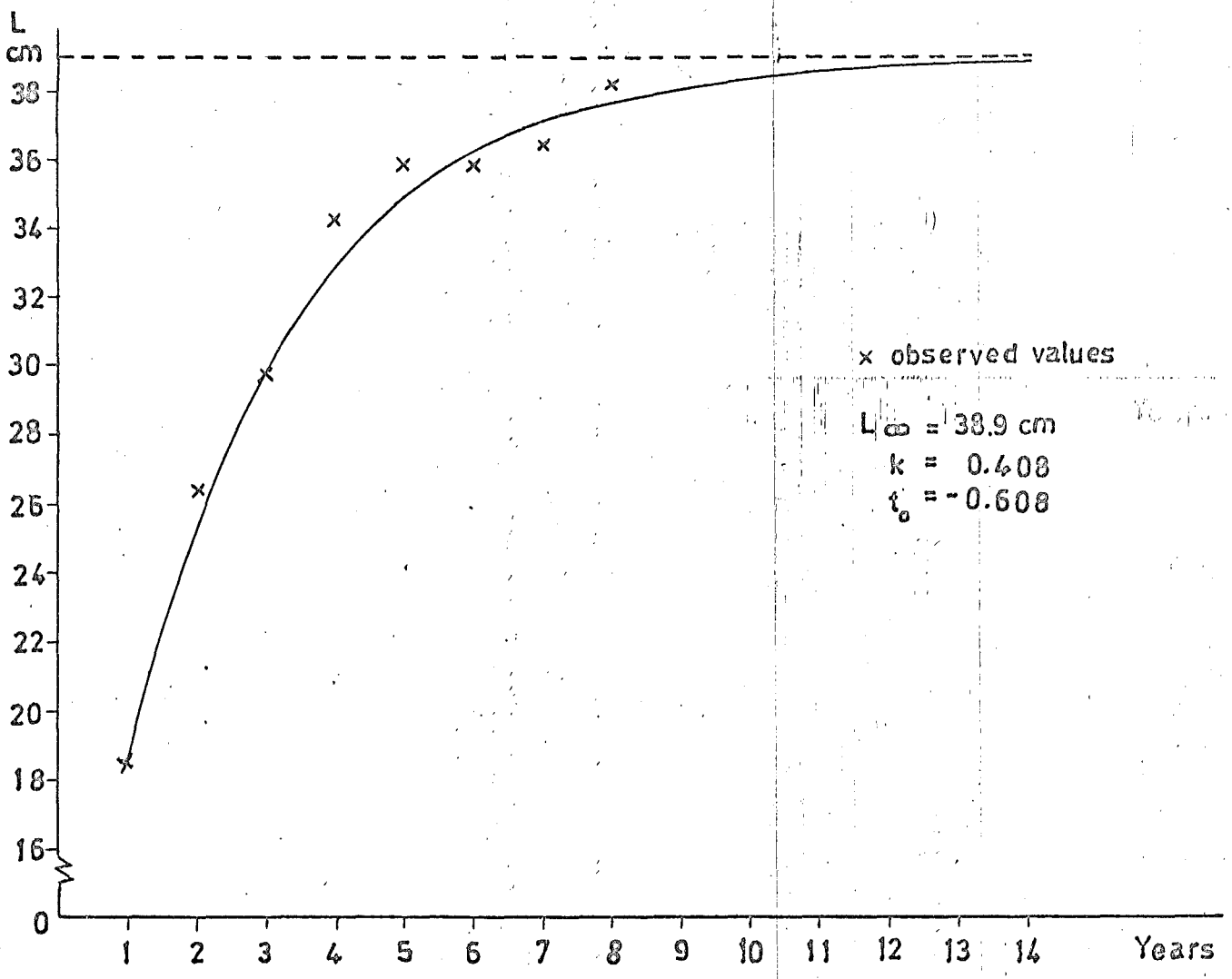

Fig. 4 Theoretical growth curve.