

fol. 41 H

Fiskeridirektoratet
Biblioteket

International Council for
the Exploration of the Sea

ICES C.M.1989/H:20
Pelagic Fish Committee

Fiskeridirektoratet
Biblioteket

MIGRATION OF WESTERN MACKEREL TO THE NORTH SEA 1973 - 1988

by

Svein A. Iversen and Dankert W. Skagen

Institute of Marine Research
P.O.Box 1870
5024 Bergen-Nordnes, Norway

Abstract

The latest years, it is evident that most of the mackerel present in the North Sea belongs to the Western stock, since the yearly catches by far exceed the presumed size of the North Sea stock.

The Norwegian tagging data have been revised to obtain estimates of the percentage of Western mackerel in the catches in the North Sea. By combining these data with the distribution of catches, a reasonable estimate of the migration of the Western mackerel to the North Sea may be obtained.

Distribution of catches

The main fishing areas for mackerel have shifted over the last 25 years. In the 60's and early 70's the main catches were taken in the northern part of the North Sea (Division IVa), Fig.1. During this period the fishery in the western areas was rather low. The North Sea stock was big in the 60's, but declined in the 70's and 80's to a minimum of 37000 tons in 1988 (Iversen et. al. 1989). Unfortunately, there are little information about the size of the western stock prior to 1972. When the stock and the catches declined in the North Sea, the catches in the south western area (Sub-areas VII and VIII) increased considerably to a maximum in the late 70's. Then the fishery moved northwards into Division VIa and further into Division IVa in the later years. The shift in the main fishery from Division VIa to IVa might not have been as abrupt as shown in Fig.1.

There has been regulatory measures in both these areas which have been more or less successfully enforced. This may have camouflaged a shift in distribution pattern (Anon.1989). The northern and eastern distribution of the western stock over the last years is also reflected in the development of the catch rates in Division IIa (Fig.1).

The shift in migration and distribution of fishing areas from south to north in the western area and into Divisions IIa and IVa are also described by Walsh and Martin (1986). These authors put forward a hypothesis that when the North Atlantic drift is strong to the North west of Scotland more of the water and mackerel finds its way into the Norwegian Sea, while in times of weak flow most finds its way into the North Sea.

3113 / b 4888

Tagging data

The Norwegian tagging programme has been conducted since 1970. In most years, 5000-20000 internal tags have been released in each of two series, one off southwest Ireland in May, the other along the coast of southern Norway in August. The western series probably includes only Western mackerel. The eastern tags were assumed to be on North Sea mackerel, it is doubtful whether this is true for the later years (Bakken and Westgård, 1986). Recapture has been by magnets in meal and oil factories, the latest years also in selected fileting plants.

The recapture rate was satisfactory up to 1978, but then fell considerably, presumably because a decreasing part of the landings were used for industrial purposes.

To compute the mixing of Western mackerel into North Sea catches, the following procedure was used: Let N be the stock size in number at release time, T the number of tags released, R the number of tags recovered. Then

$$C = R \cdot \frac{N}{T}$$

is the number of fish represented by the recovered tags in a catch. Using the suffixes W and E for western and North Sea (eastern) tags respectively, and assuming that the western tags are in Western mackerel and the eastern in North Sea mackerel, the percentage of Western mackerel in the catch becomes

$$W\% = C_W / (C_E + C_W) \cdot 100$$

In each year of catch (j), the percentage of Western mackerel was computed as the mean over all relevant releases (i) using $C = \sum_i C(ij)$. Tags returned

the same year as released were not considered. The numbers N for the stock sizes were taken from the latest available VPA-tables in the Mackerel Working Group reports, including age groups from 1 and upwards. For the North Sea stock these numbers have not been computed since 1985. For the later years the stock size from egg estimates was used, interpolated as necessary and raised to stock size in numbers by assuming the age composition as in 1985. The data for N should be interpreted with some caution, since they to some extent are based on tag return rates. Discrepancies between age composition in the stock and in the tagged sub-population have not been taken into account.

Using this procedure the percentage of Western mackerel was obtained as shown in fig. 1.

In the 3rd. quarter most of the catches in Division IVa were of Western stock, except in 1976 -78. In the 4th quarter, Western dominance appeared in Division IVa somewhere between 1978 and 1980. In Divisions IVb and c a similar shift (in 3rd. quarter) may have taken place in 1979. These trends are probably realistic, since they are apparent in all releases, and the trend within each release is independent of the presumed stock size. In the years after 1980, Western mackerel seems to dominate the catches in all areas and seasons where tag return data are available. It is possible that some or all of the fish tagged in the eastern area in this period may have been of Western origin. The percentages of North Sea mackerel in the catches would only be underestimated if the fraction of North Sea mackerel was higher in the catches than in the tagged population, which seems unlikely.

If it is further assumed that the ratio between Western and North Sea mackerel in the catches equals the ratio in the area, and that the total North Sea stock is confined to the North Sea, a rough estimate of the fraction of the Western stock being present in the North Sea may be expressed as

$$\frac{N_E}{\%E} \cdot \frac{\%W}{N_W} \cdot 100$$

The results, computed under the assumption that the percentages %W and %E for Division IVa are representative for the North Sea, are tabulated below. This approach is unreliable when one stock dominates totally, as in the 1980's. Therefore, the results are only given up to 1981.

Table 1. Percentage of the Western stock being present in the North Sea, from tagging data.

	3rd q	4th q
1973	64	9
1974	31	5
1975	68	10
1976	17	4
1977	7	3
1978	8	-
1979	24	-
1980	42	-
1981	47	37

Discussion

The analysis of the tags are based on catches in Division IVa. The percentages of western fish given in table 1 are based on data from Division IVa and the assumption that the mixing ratio is the same throughout the whole North Sea.

Considerable quantities of immature mackerel have been observed in the central part of the North Sea (Division IVb) and Skagerrak in late summer and autumn the later years (Degnbol et al., 1988, Kirkegaard 1986, 1989, Kirkegaard et al., 1987, Iversen and Westgård, 1986).

In October 1985 rather large quantities of 1 year old mackerel were observed in these areas (Iversen and Westgård, 1986). This yearclass (1984) has since been caught in considerable quantities in the North Sea. However, this year class has not contributed to the North Sea spawning stock (Iversen et al., 1989). Therefore the rich 1984 yearclass observed in the North Sea since 1985 has recruited the Western spawning stock.

Therefore, it seems that the central and southern part of the North Sea is becoming important as a nursery area for juvenile Western mackerel. Both acoustic and catch per unit volume data indicated that 3-4 billion one year old mackerel were present in the central North Sea in July-August 1988 (Kirkegaard, 1989).

The calculated proportions of Western and North Sea mackerel in the North Sea based on the tagging data for the last years are rather dubious due to

the low stock size of North Sea mackerel and the fact that probably a lot of Western mackerel has been tagged in the North Sea. Therefore the percentages given in Anon (1987, 1988 and 1989) are suggested to be applicable for the late 80's. These percentages are not based on actual calculations, but are the Mackerel Working Group's interpretation of the catch distribution, tagging experiments and survey data. The Working Group assumes that 50 % and 70% of the Western stock is in the North Sea during the third and fourth quarter respectively.

However, the present analysis indicates a lower fraction of Western fish in the North Sea during the fourth quarter than in the third quarter for the period 1973 - 1981.

Further, the analysis demonstrates that the percentage of Western fish in the North Sea was rather low during the years 1976-1979 with a minimum in 1977 and 1978. This might be explained by a more western distribution of the Western fish in this period, indicating that rather large proportions of the North Sea stock were caught.

Table 2. gives suggested percentages of the Western stock being present in the North Sea. These values are rounded and based on table 1 for the years up to 1981. No data are available to calculate the percentage for 4th. quarter for the period 1978 to 1980. Here, a gradual increase has been assumed.

For 1982 to 1985 status quo has been assumed, since the distribution of catches was similar in this period. For the years 1986 to 1987, the values suggested by the Mackerel Working Group have been used. However, in 1988 the main fishery in the 3rd. quarter took place in Division IIa, while it moved into Division IVa in the 4th. quarter. Therefore, to indicate the more northern distribution in the 3rd. quarter this year, only 40% is suggested, and 70% in the 4th. quarter.

Table 2. Suggested percentages of Western mackerel in the North Sea

Year	3rd. q	4th q.
1973	65	10
1974	30	5
1975	70	10
1976	15	5
1977	5	5
1978	10	5
1979	25	10
1980	40	25
1981	45	35
1982	45	35
1983	45	35
1984	45	35
1985	45	35
1986	50	70
1987	50	70
1988	40	70

There are hardly any catches in the North Sea in 1st and 2nd quarter. The Working Group has assumed that about 10% and below 5% respectively of the Western stock are present in the North Sea in these quarters during the later years. The reason for these low values is that the 2nd quarter is the main spawning season. The main spawning area of this stock is off south-west of Ireland.

References

- Anon. 1987. Report of the Mackerel Working Group. ICES, C.M.1987/Assess:11.
- Anon. 1988. Report of the Mackerel Working Group. ICES, C.M. 1988/Assess:12.
- Anon. 1989. Report of the Mackerel Working Group. ICES, C.M. 1989/Assess:11.
- Bakken, E. and Westgård, T., 1986. Intermixture of the North Sea and Western mackerel stocks determined by analysis of Norwegian tagging data. ICES, C.M.1986/H:65.
- Degnbol, P., Iversen, S.A., Kirkegaard, E. and Lewy, P. 1988. Report on an acoustic survey for mackerel in the North Sea, Skagerrak and Kattegat in July-August 1987. ICES, C.M.1988/H:40.
- Iversen, S.A. and Westgård, T., 1986. The size and distribution of the 1984 yearclass of mackerel in the Skagerrak and the North Sea the autumn 1986. Working Document. The Mackerel Working Group 1986.
- Iversen, S.A., Eltink, A., Kirkegaard, E., and Skagen, D.W. 1989. The egg production and spawning stock size of the North Sea mackerel and horse mackerel stocks in 1988. Working Document. The Mackerel Working Group 1989.
- Kirkegaard, E., 1986. Report on the acoustic survey for herring of the west coast of Denmark in July 1985. ICES, C.M.1986/H:69.
- Kirkegaard, E., 1989. Some results from a Danish acoustic survey in the North Sea July-August 1988. Working Document. The Mackerel Working Group 1989.
- Kirkegaard, E., Lewy, P. and Sætre, K.J., 1987. The Danish acoustical survey in Div. IIIa and eastern North Sea August 1986. ICES, C.M.1987/H:42.

100 000 tons

10

5

63 65 70 75 80 85 88

- ▼-▼ Division IIa
- Division IVa
- △-△ Division VIa
- x-x Subareas VII & VIII

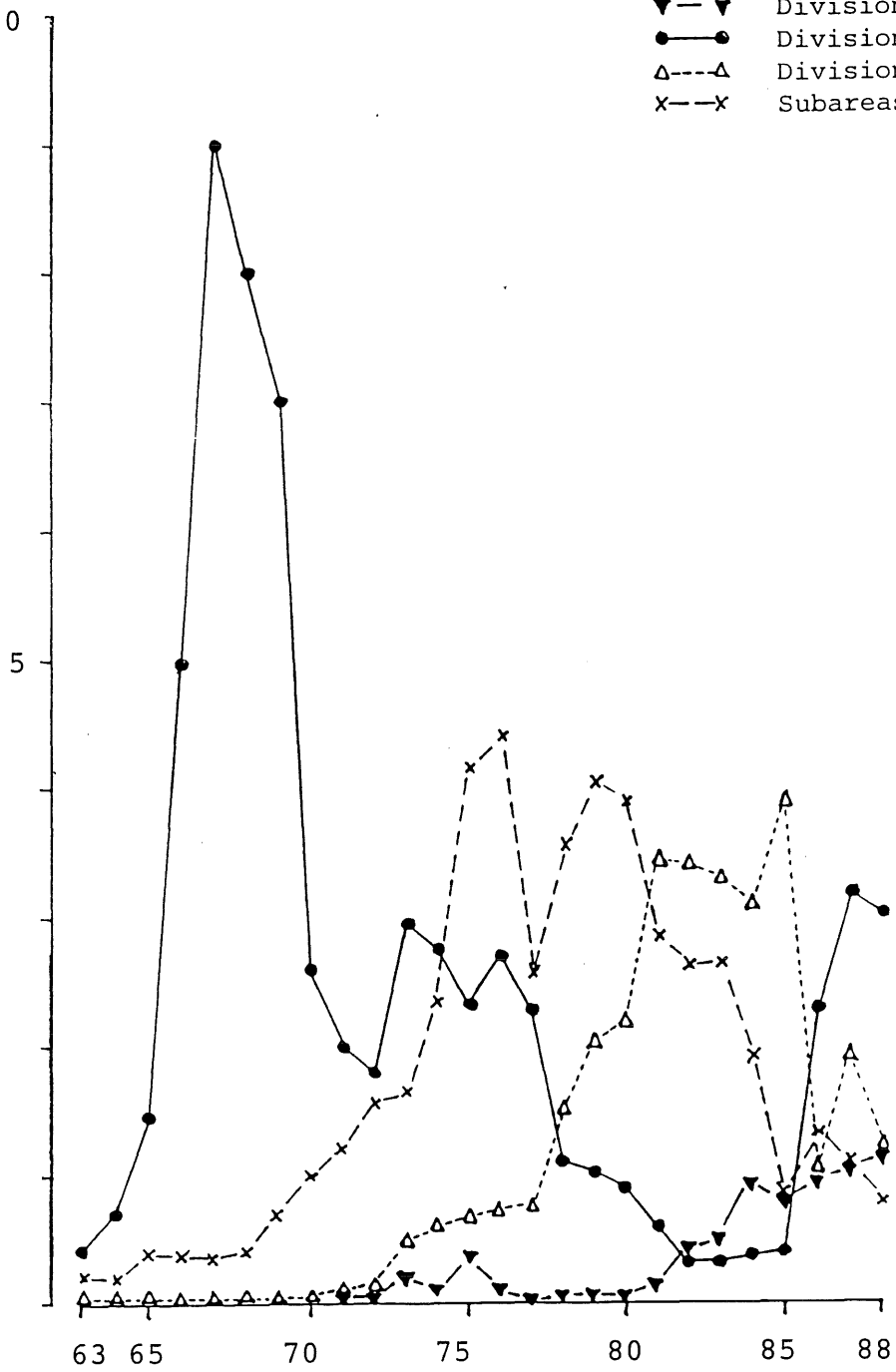


Fig.1 Yearly catches by area.

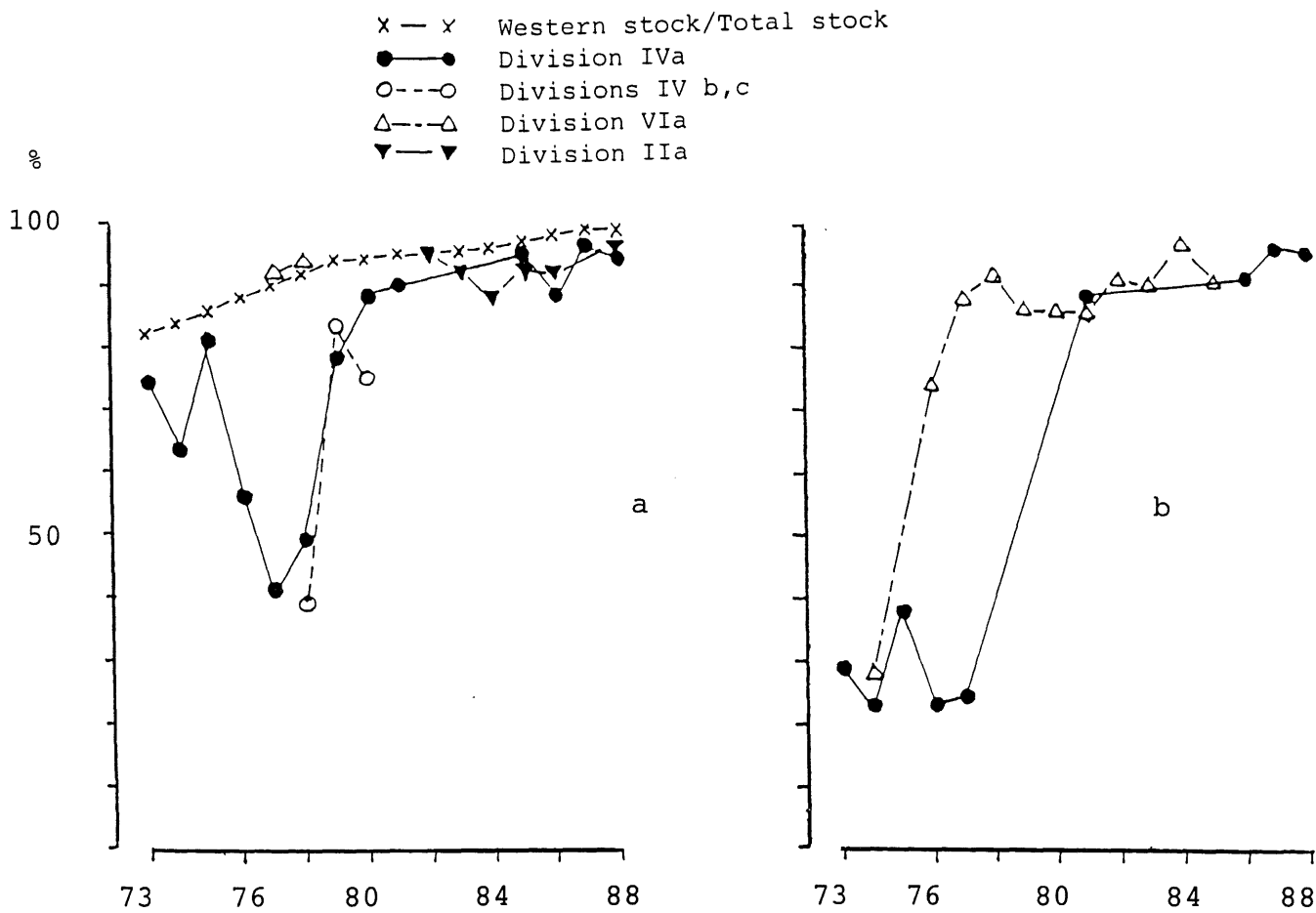


Fig. 2 Fraction of Western mackerel in catches and in the sea, third (a) and fourth (b) quarter.

Fischerdirektoratet
Biblioteket