INTERNATIONAL COUNCIL FOR THE
EXPLORATION OF THE SEA

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Pelagic Fish Committee.

DIFFERENT GROWTH PATTERNS IN MACKEREL WEST OF THE BRITISH ISLES.

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Introduction

Kästner (1977) has described two groups of mackerel with a different growth pattern in the waters west of Scotland. This was an indication that the so-called "Western Stock" of mackerel (ICES 1977) may not be a homogeneous population, but a combination of several subpopulations with different spawning and feeding areas.

A difference in growth pattern has been evident in mackerel sampled from the Dutch fishery in the Celtic Sea during different seasons. Mackerel caught during autumn and winter are generally larger for their age than mackerel caught during the following spring and summer. These differences are most conspicious in the weights per age group, and the Netherlands have in recent years always presented separate weight/age data for each quarter of the year to the ICES Mackerel Working Group.

Because the weight of the fish is not only determined by its annual growth, but also by the condition factor at the moment of capture, weight/age data are not the most suitable material to study differences in growth pattern. For this purpose, it is better to examine length/age data. In the present report, this type of data are presented for the Celtic Sea, and a comparison is made with the mackerel in other waters around Britain.

Material and Methods.

Samples of mackerel were obtained from the Dutch fishery in the various seas around Britain (figure 1). In most areas, mackerel is (or used to be) a by-catch in the fishery for herring (Hebrides, Celtic Sea) or for roundfish (North Sea). The length composition of the mackerel landed from the North Sea was dependant on the market price of small mackerel and the mesh size used in the cod end. In the herring fishery, many of the small mackerel used to be discarded and only the medium and large sized mackerel were landed normally. As these fishing and sorting practices may have caused a bias in the mean length per age of the younger age groups, only the fish of 4 years and older were considered for this report.

In the Dutch market sampling system, a large number of length measurements is taken in the fish market, and from these length data the age composition of the catch is calculated by means of a length/age key. This is done for each area and quarter of the year separately.

The mean length for age was derived from the total length/age composition of the catch, calculated as described above. Since the mean length for age was derived from transformed data, the variance of the mean could not be calculated in the usual way, but only by a complicated procedure. As the differences in mean length between various seasons were obvious, and followed a consistent pattern from year to year, it was considered unnecessary to test the differences statistically.

Because the growth pattern may differ between year-classes of the same sub-population, all data were grouped by year-class.

Results.

Figure 2 demonstrates the seasonal changes in mean length for age for a number of year-classes in the Celtic Sea. The same pattern emerges for all year-classes at all ages sampled, viz. a high mean length in the last quarter of the year and sometimes also in the first quarter of the next year, followed by a sharp drop in the 2nd and 3rd quarter.

Figure 3 shows length frequency distributions of a particular year-class during the various seasons in a number of successive years. This figure is given in order to indicate the spread of values around the mean, in the absence of a calculated variance. Year-class 1968 was taken for this purpose, as this was the most numerous year-class in the Dutch material from the Celtic Sea. It is seen that the largest fish in the samples from the winter fishery are absent during spring and summer. On the other hand, some of the smallest size categories found in the 2nd, and sometimes already in the 1st quarter, were not present in the catches made during the last quarter of the preceeding year.

The growth pattern of mackerel in the Celtic Sea is compared with that in other areas in figure 4 and 5 and in table I. Again year-class 1968 has been used because of the high number of observations on this year-class. An increase in mean length during the 4th quarter, similar to the one in the Celtic Sea can be detected in the material from west Scotland and the southern North Sea. The data for the central and northeastern North Sea show a more regular pattern, without a sudden increase during the winter.

The winter values for the Celtic Sea are comparable to those from west Scotland, and also to the ones from the southern and central North Sea (figure 4). The slow growing mackerel found in the Celtic Sea during spring and summer can only be compared to the southern North Sea mackerel in summer and autumn, and to the west Scottish mackerel in autumn.

Discussion

The different growth patterns found in mackerel of sub-area VII and division VIa are a strong indication that the mackerel of the so-called "Western Stock" do not constitute a homogeneous unit stock.

Dutch length/age data confirm the observation of Kästner (1977) that a group of slow growing mackerel is found west of Scotland during the 3rd quarter of the year. The differences in growth pattern, however, are even more pronounced in the Celtic Sea and the area off Cornwall, and they also occur in the southern North Sea.

Bolster and Burd (1972) have already attempted to split the mackerel of the western English Channel into two components; one that spawns in the Celtic Sea before June and also overwinters in this area, and one that spawns in the southern North Sea in June-July and overwinters off the coast of Cornwall.

The theory of Bolster and Burd was mainly based on differences in age composition and maturity stage, and they do not mention a difference in growth pattern. In some aspects the theory is difficult to reconcile with the age length data presented in this report. We have found no great differences in growth between mackerel overwintering off Cornwall, and those overwintering off the Irish south coast. If there are two distinct sub-populations present in the Celtic Sea in winter, one of them must be out of reach for the Dutch fishery in that area.

Secondly, the mackerel caught during summer in the southern North Sea are of the slow growing type, whereas the overwintering mackerel in the Celtic Sea are fast growers.

On the basis of the age/length data presented in this report we would like to formulate a new hypothesis concerning the stock composition and migration habits of the western mackerel. We assume that there is a northern, fast growing component of western mackerel and a southern, slow growing one (figure 6).

The northern component does not feed and spawn in the Celtic Sea, but in areas further north such as the Porcupine Bank, off northwest Ireland, and near Rona (Walsh 1976). Part of it may also penetrate into the North Sea via the English Channel. Only during wintertime it migrates south and is caught in the Celtic Sea.

The mackerel that actually spawn and feed in the Celtic Sea are the more southern, slow growing component of the western mackerel. Part of this stock would overwinter in areas even further south than the Celtic Sea, such as the Bay of Biscay. By the end of the winter when the fast growing mackerel are leaving the Celtic Sea, the slow growing mackerel move into this area to spawn and feed. Subsequently also a part of this slow growing group migrates north towards west Scotland, and another group migrates east through the English Channel into the North Sea.

The slow growing mackerel arrive in the west Scottish waters much later than the fast growing ones (Kästner 1977), and they also leave the area before the fast growing mackerel. Our length/age data show the presence of slow growing mackerel in division VIa only during the 3rd quarter of the year.

Part of the slow growing mackerel also enter the North Sea in summer and retreat again towards the Celtic Sea in autumn. The increased mean length of mackerel in the 4th quarter in the southern North Sea may indicate a small proportion of fast growing western mackerel which has also penetrated into the North Sea before the slow growing ones, and which is retreating only after the slow growing mackerel have left the area.

Of course this hypothesis does not assume a very sharp division between the slow growing component and the fast growing one. Tagging experiments have demonstrated a considerable mixing of mackerel from all areas, even between the North Sea and the western stock (Hamre, 1975). Still, the changes in growth type of mackerel in the Celtic Sea follow a consistent pattern, and point to a distinct heterogenity of the western mackerel stock.

Such a heterogenity of the western mackerel should be taken into consideration during the assessment of the stock. If our hypothesis about the migration of the fast growing mackerel is correct, this mackerel will generally spawn outside the Celtic Sea. Any stock assessment based on egg surveys in the Celtic Sea and the Bay of Biscay will therefore not include the fast growing component of the stock.

It will be very useful to test this hypothesis by means of a tagging experiment on mackerel caught during winter in the Celtic Sea.

TABLE I - Mean length of year-class 1968 per area and quarter for the period 1972-1977. Corresponding numbers of age readings are given as an indication of sampling effort.

		1972		1973		1974		1975		1976		1977	
		4 year		5 year		6 year		7 year		8 year		9 year	
		$\bar{L}$	N	$\bar{L}$	N	$\bar{L}$	N	$\bar{L}$	N	$\bar{L}$	N	$\bar{L}$	N
North eastern North Sea IVa	1st	-	-	-	-	-	-	-	-	37.10	4	-	-
	2nd	35.02	30	36.08	13	36.85	9	38.22	17	37.43	6	38.64	9
	3rd	-	-	35.35	17	36.14	15	38.76	4	36.10	3	38.48	11
	4th	35.19	10	35.87	27	36.03	10	38.16	9	37.47	7	40.09	6
Central North Sea IVb	1st	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	33.08	29	-	-	35.35	9	-	-	35.71	9	36.70	11
	3rd	-	-	-	-	34.42	17	35.22	25	35.24	39	36.14	18
	4th	-	-	-	-	-	-	35.82	19	35.25	18	36.39	20
West Scotland VI	1st	-	-	-	-	-	-	-	-	38.67	9	-	-
	2nd	-	-	33.42	43	35.92	13	-	-	-	-	-	-
	3rd	-	-	32.76	56	34.17	52	33.45	59	34.10	15	34.82	12
	4th	-	-	34.23	17	36.10	26	34.92	54	36.43	22	-	-
Southern North Sea IVc	1st	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	32.09	63	32.79	21	32.98	20	34.18	12	34.18	23	37.44	23
	3rd	-	-	32.54	20	33.36	29	34.25	24	35.39	13	37.18	16
	4th	32.73	41	34.74	15	34.71	24	35.17	19	36.70	11	37.35	12
South of Ireland VII	1st	-	-	-	-	34.52	16	33.41	35	35.34	40	34.58	38
	2nd	-	-	31.48	45	32.12	29	32.44	33	33.80	34	34.41	32
	3rd	-	-	32.48	23	-	-	33.25	27	33.34	1	33.25	7
	4th	32.48	32	34.23	41	36.02	34	34.39	6	37.19	30	36.51	14

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/MV

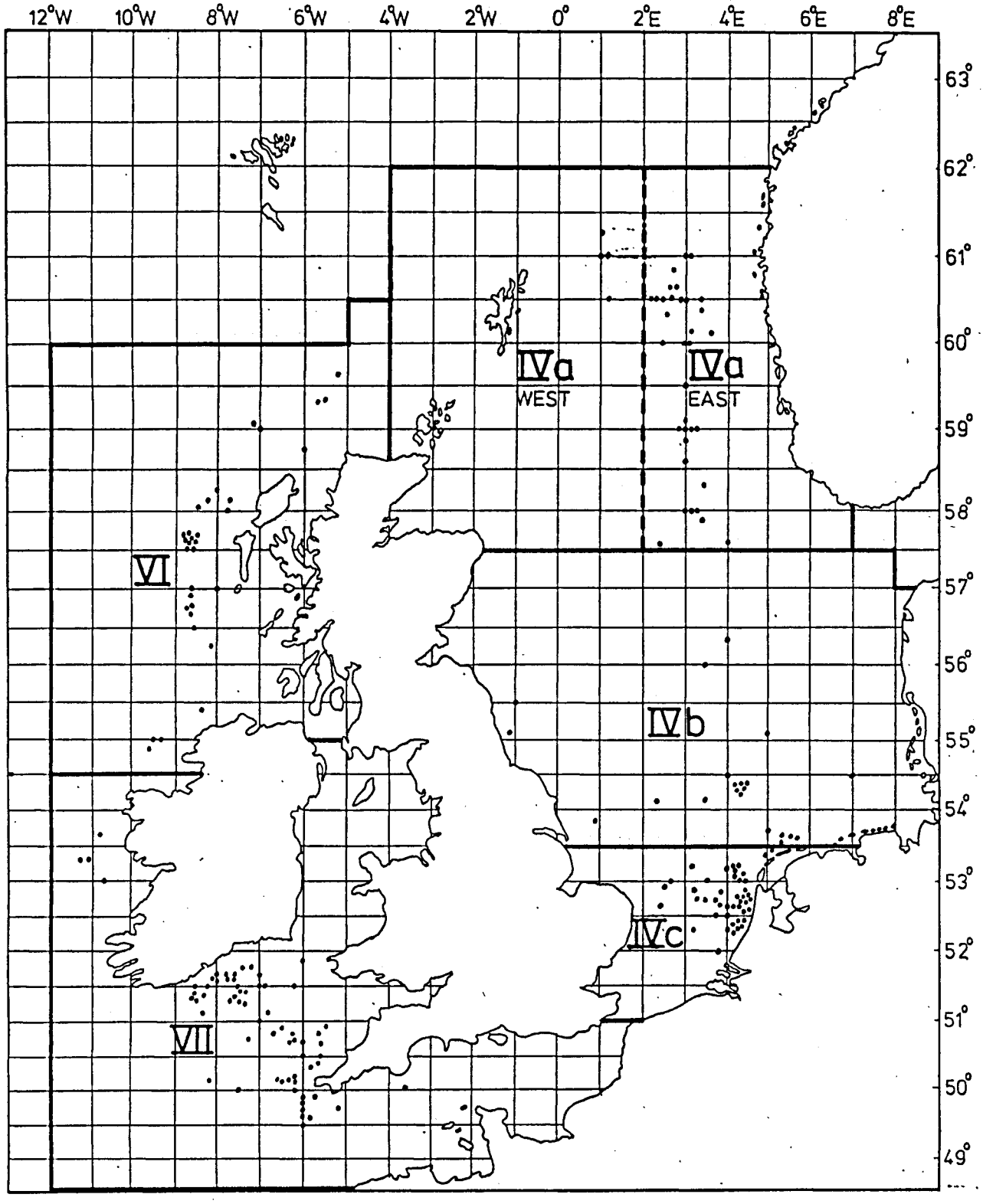


FIGURE 1.
Positions of age-samples from Dutch mackerel catches in the period 1972-1977 + area subdivision.

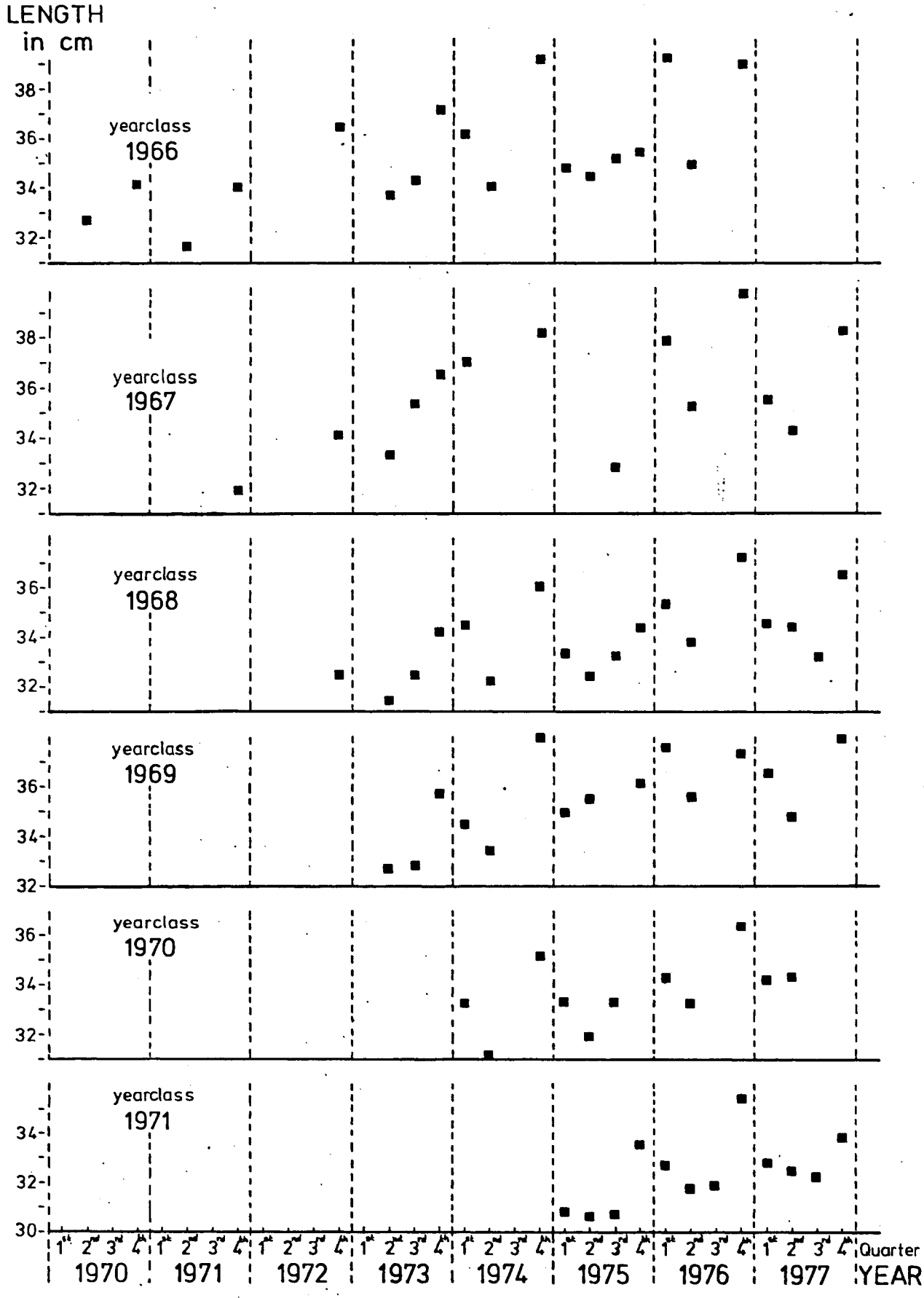


FIGURE 2.

Mean lengths of yearclasses 1966-1971 South of Ireland per quarter for the years 1970-1977. (only means of at least 5 observations)

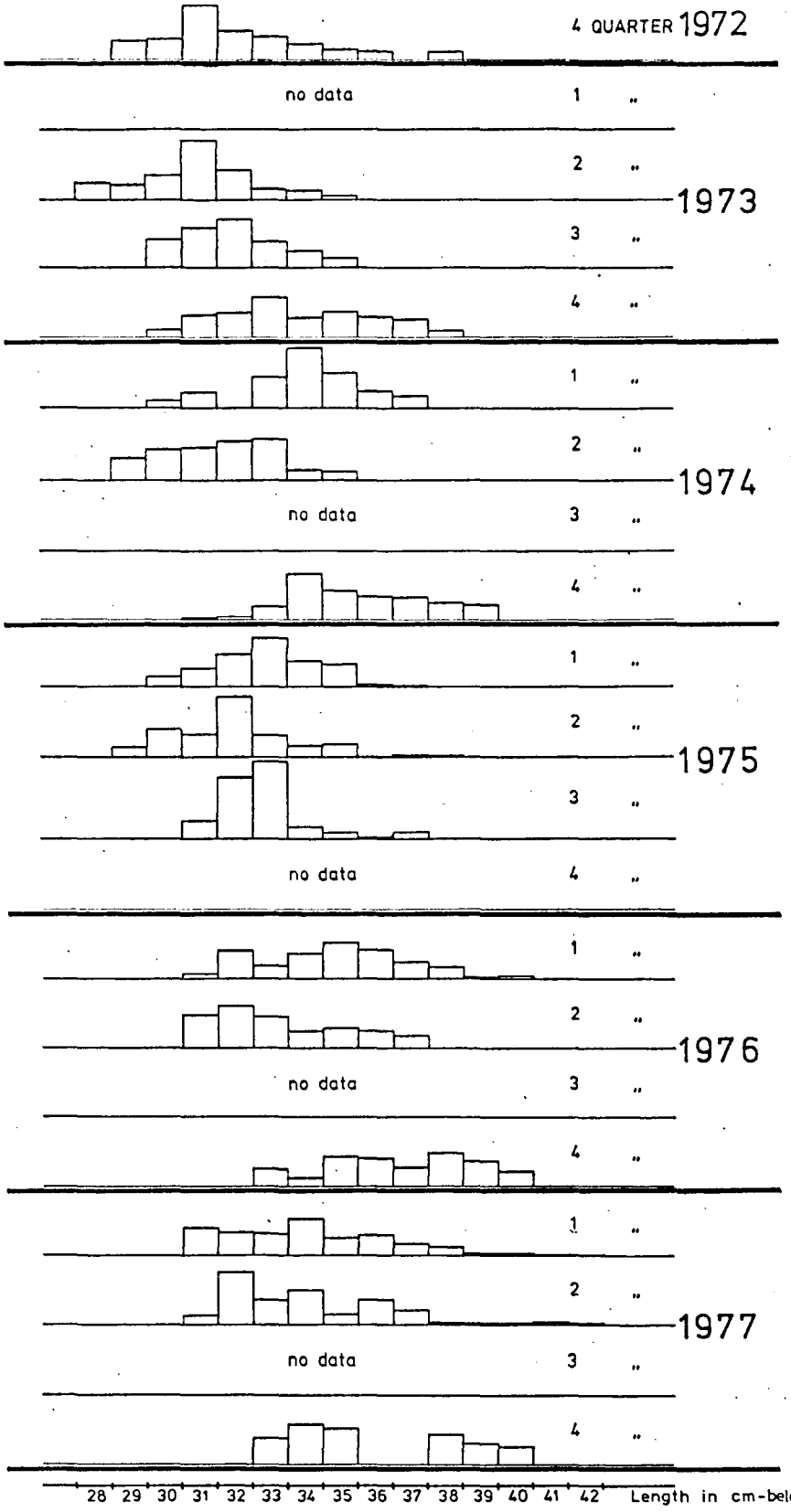


FIGURE 3
Percentage length distributions of yearclass 1968 in area VII (South of Ireland).

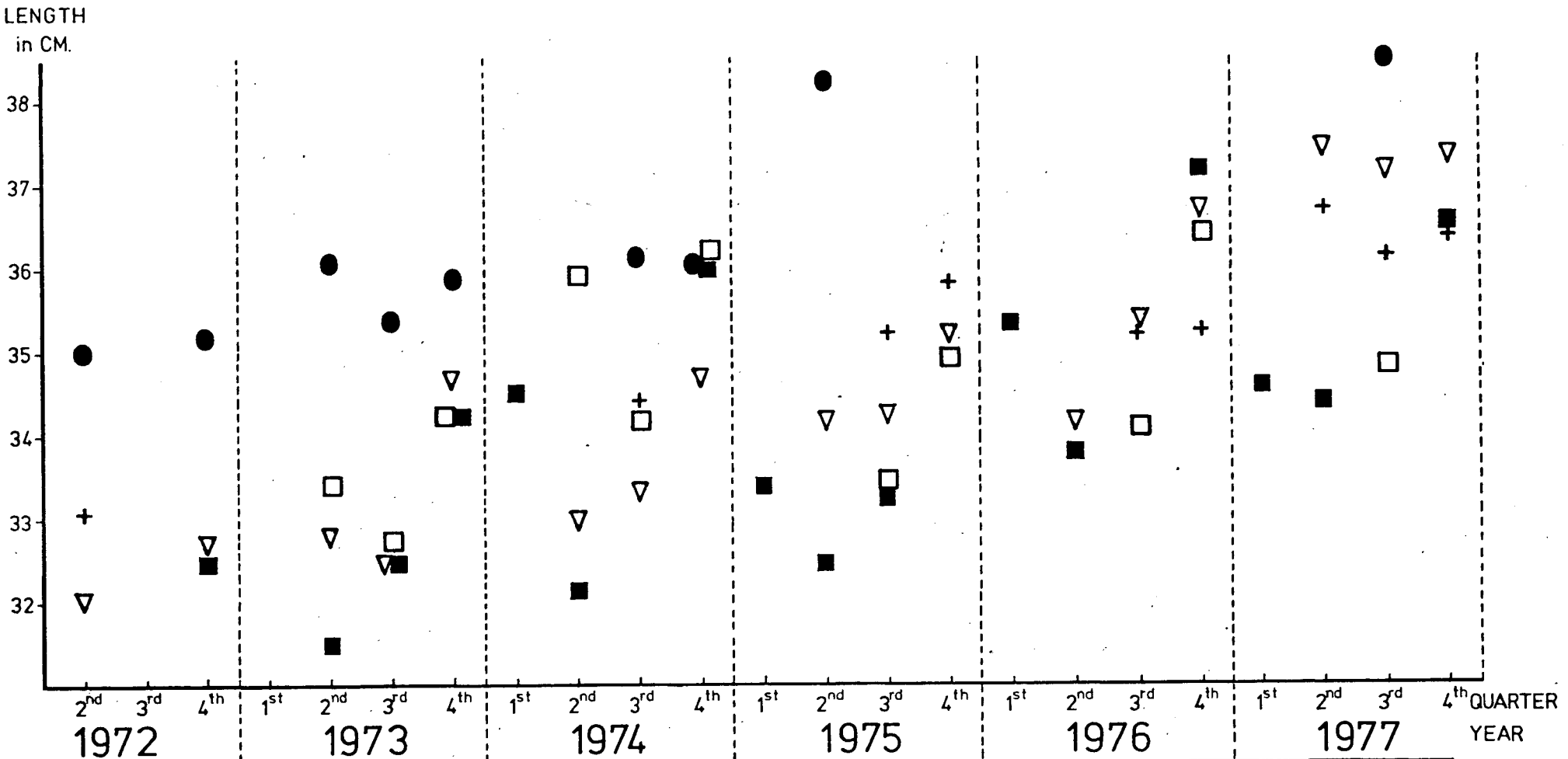
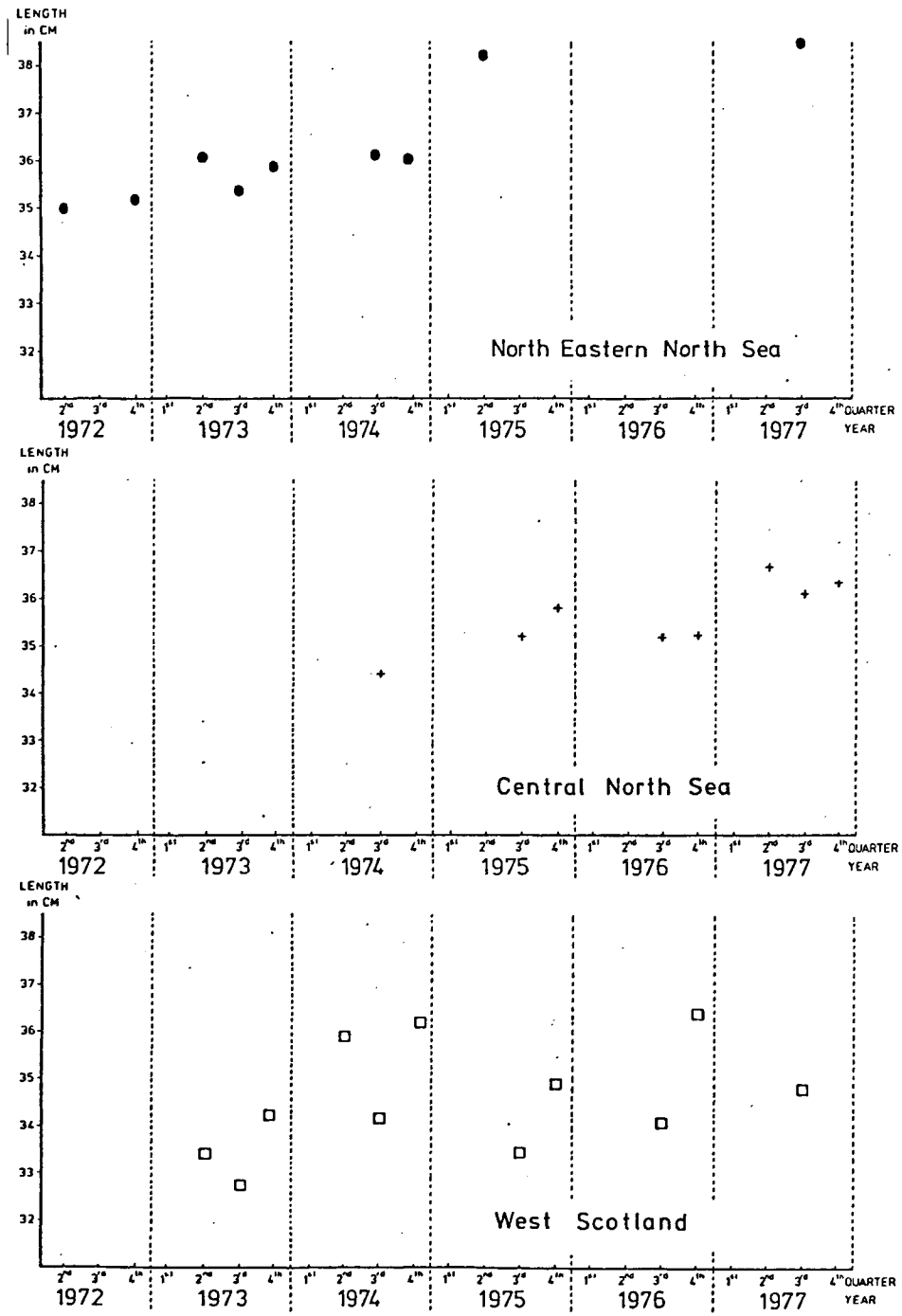


FIGURE 4.

Mean length of yearclass 1968 per area and quarter for the period 1972-1977.
(only means of at least 10 observations)



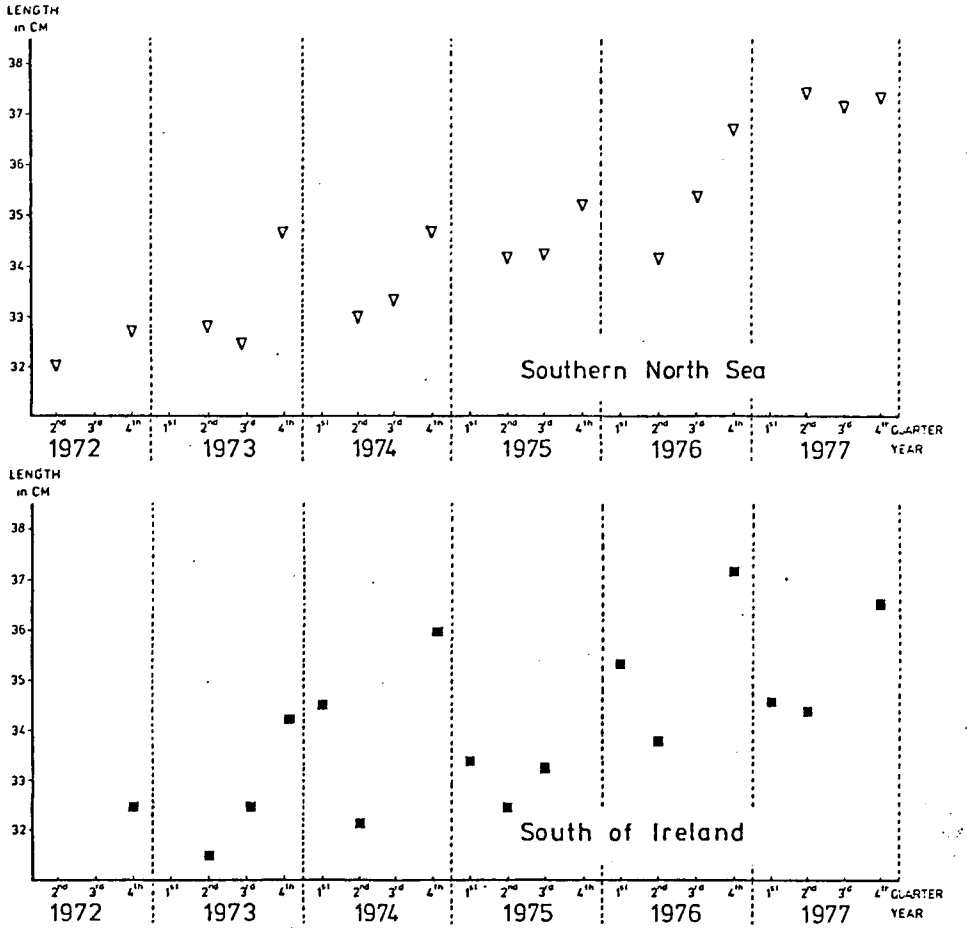


FIGURE 5.

Mean length of yearclass 1968 per quarter for the period 1972-1977 in different areas.

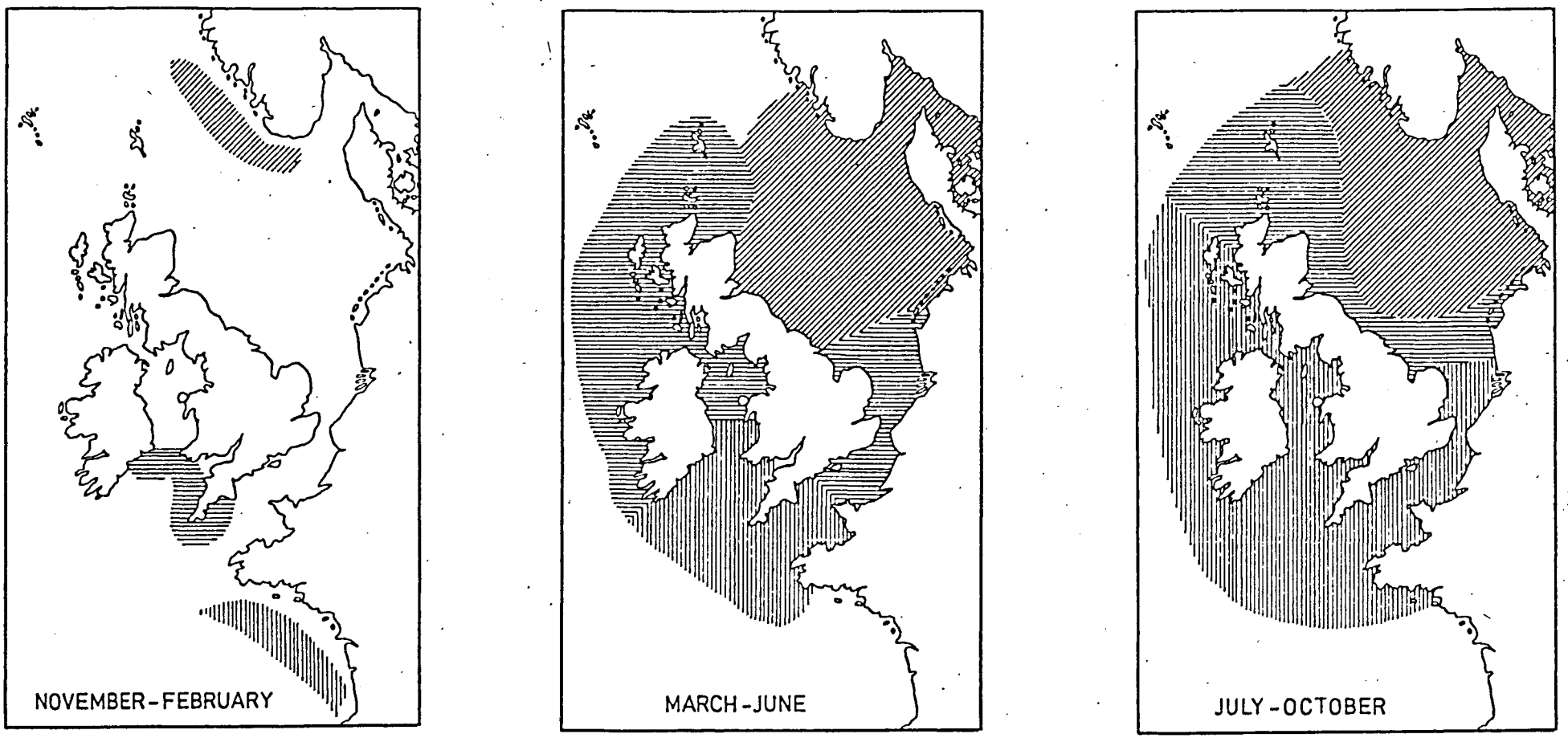


FIGURE 6.
Hypothetical distribution of mackerel subpopulations in various seasons.

Western mackerel (slow growing type).

Western mackerel (fast growing type).

North Sea mackerel.