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International Council for the
Exploration of the Sea

C.M.1977/H:2 - APPENDIX
Pelagic Fish (Northern) Committee
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PROVISIONAL INFORMATION AND DATA FOR ALLOCATION OF RESOURCES UNDER THE NEW EXTENDED NATIONAL FISHERIES JURISDICTION REGIME

prepared by

The ICES Mackerel Working Group

This Report has not yet been approved by the International Council for the Exploration of the Sea; it has therfore at present the status of an internal document and does not represent advice given on behalf of the Council. The proviso that it shall not be cited without the consent of the Council should be strictly observed.

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MACKEREL - NORTH SEA

1. General Biology

1.1 Stock Identification

There are generally considered to be two stocks of mackerel, the North Sea stock (Anon., 1974) and the Western Stock, which spawn and overwinter in the North Sea and the Celtic Sea area, respectively. North Sea mackerel are mainly found in ICES Sub-areas III and IV. Tagging has shown that a considerable amount of mackerel from the Western stock migrate into these areas during summer (Hamre, 1975; Anon., 1976 and 1977); there is also some emigration of North Sea mackerel into Sub-area VI.

1.2 Spawning

The main spawning area for North Sea mackerel is in the central North Sea (54° - 58°N, 0° - 7°E) during June and July (Iversen, 1973; Johnson and Dawson, 1975), but there is also some spawning in the Skagerrak (Lindquist and Hannerz, 1974). The main spawning area is indicated in Figure 1.

1.3 Distribution of larvae and juveniles

There is little information about the younger stages of mackerel. Larvae are mainly found in the central North Sea, particularly in July (Bainbridge, Cooper and Hart, 1974). The 0-group occurs in the same area while I- and II-group have a wider and more scattered distribution (Walsh, 1974). The coasts of the northern North Sea and the Skagerrak can be considered to be important nursery areas.

1.4 Distribution and migration of adults

North Sea mackerel overwinter in deep water in the Norwegian Trench, from about 62°N southwards into the Skagerrak (Hamre and Nakken, 1970; Postuma, 1972). In early summer, the mackerel appear in the upper water layer and after spawning are mainly found in the northern North Sea. The distribution by season of adults is shown in Figure 2.

2. Exploitation and management

2.1 The fishery

Until 1964 mackerel in the North Sea were caught mainly by trawl, gillnet and hook and line. The total annual catch was less than 100 000 tons. After 1964 landings increased rapidly due to the development of the Norwegian purse-seine fishery, and reached 934 000 tons in 1967. In the following years catches were reduced, partly due to regulation of the purse-seine fishery. The main fishing season is July-October. In Figure 3 the total catch of mackerel taken in the North Sea, Skagerrak and Kattegat in the last 10 years is shown. As indicated above, part of this catch is derived from the Western stock of mackerel. In 1972, 1973, 1975 and 1976 the contribution of the Western stock is estimated to have been about 25% of the total catch of mackerel from the North Sea shown in Figure 3. In 1974 it is estimated to have been about 40% because of the high proportion of the total North Sea catch taken during that year from the Shetland summer fishery.

2.2 Stock fluctuations

The changes in stock size of North Sea mackerel are indicated in Figure 4. The stock size at the beginning of each year has been estimated from tagging data. The decline in stock size up to 1970 is mainly a result of the fishery; after 1973 the decline has been due to the poor recruitment after the 1969 year class.

The average long-term annual yield is estimated to be about 300 000 tons at an exploited stock size of 1.2 - 1.5 million tons.

2.3 Fisheries regulations

The fishery of mackerel in the North Sea has not been subject to effective international management, although a NEAFC recommendation prohibits fishing of mackerel smaller than 30 cm for industrial purposes, and also with some excemptions, prohibits a fishery for this purpose in the first half of the year.

The Norwegian catch of mackerel in the North Sea has annually accounted for about 80% of the total catch. National regulation of the Norwegian fishery has, therefore, been of major importance. The regulations have been in force since 1970 and include : minimum legal size, prohibition of fishing for industrial purposes November-July, total catch quota and closed areas. As a result of these restrictions, the stock of mackerel increased from 1970 to 1973. Later it declined due to poor recruitment, although the rate of decline has been reduced by the quota limitations.

3. Catch statistics

3.1 The last 10-year period

Catch statistics of mackerel have not been reported with reference to areas comparable to the new economic zones in the North Sea. Estimates of the catch proportions within each zone must therefore be based to a large extent on general information about the mackerel fishery of each country.

The very large catches of mackerel taken during the period 1966-1969 were a result of the introduction of the purse-seine fishery by the Norwegians. A large part of the catch was taken in autumn along the southern and western slope of the Norwegian Trench. The Swedish catch was taken in the same area. After this period, because of national regulations, which reduced the fishing effort south of 59-60°N, the Norwegian fishery took place further north and west. Consequently, a large part of the total international catch was then taken in the Shetland area, and a considerable proportion of this mackerel originated from the Western stock. In the most recent years, the Norwegian and Faroe catches have accounted for most of the total, and these fisheries have resulted in larger proportions being taken on the eastern side of the northern North Sea.

In order to relate catches to economic zones, it seems to be necessary to restrict considerations to the Norwegian and the EEC zone within the North Sea.

In the Skagerrak the position of zones is obscure.

In the following table an attempt is made to estimate the proportion of the total catch taken within the zones of Norway and the EEC in the North Sea.

	Norway	EEC
1966-1969	75	25
1970-1974	40	60
1974-1976	60	40

3.2 Present state:

The catches of mackerel within each of the zones in the North Sea in 1975 are shown in Figure 5. The data are based on estimates made by Working Group members.

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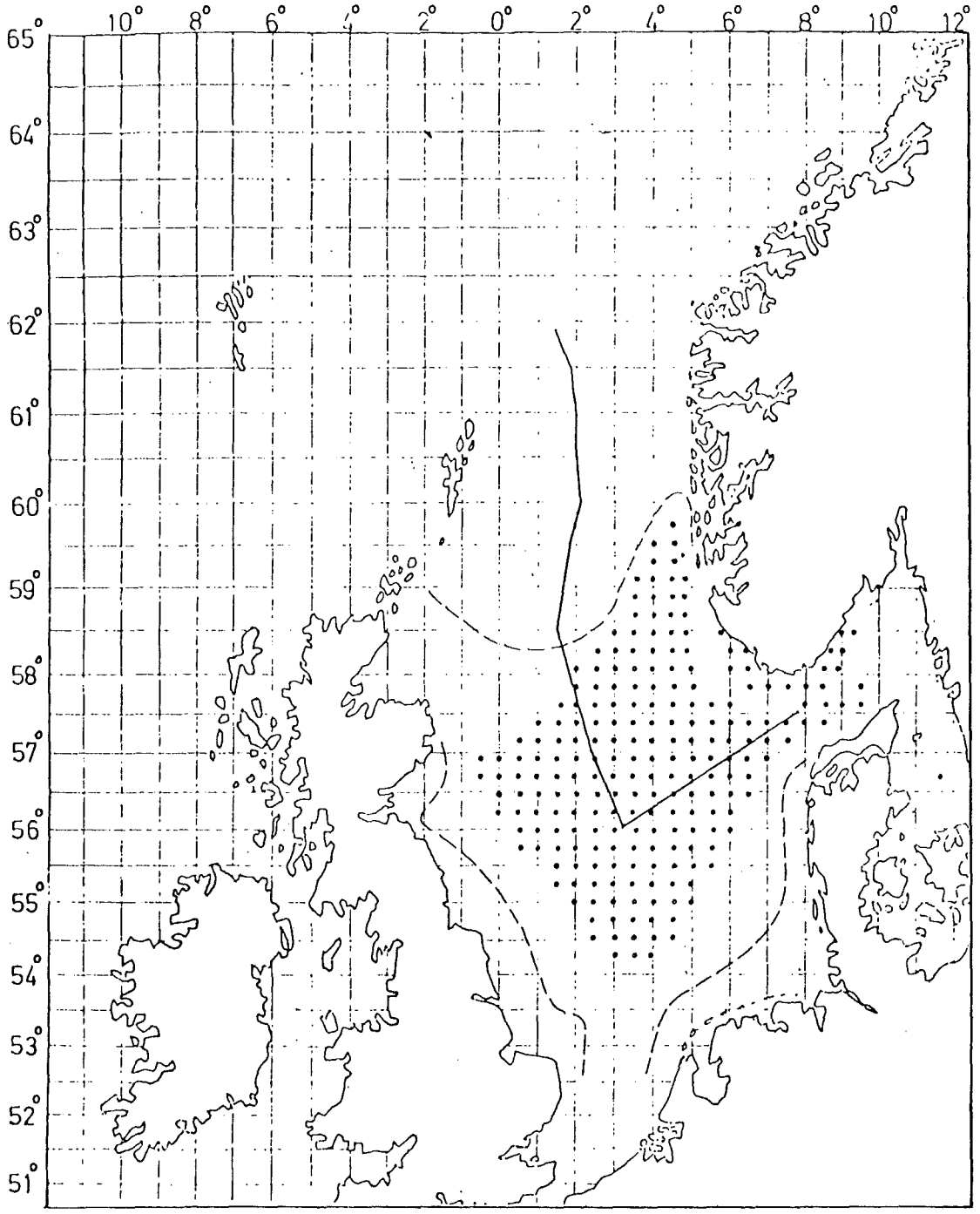

Figure 1 North Sea mackerel. Main spawning area (<100 eggs per m^2) and general total range of spawning.

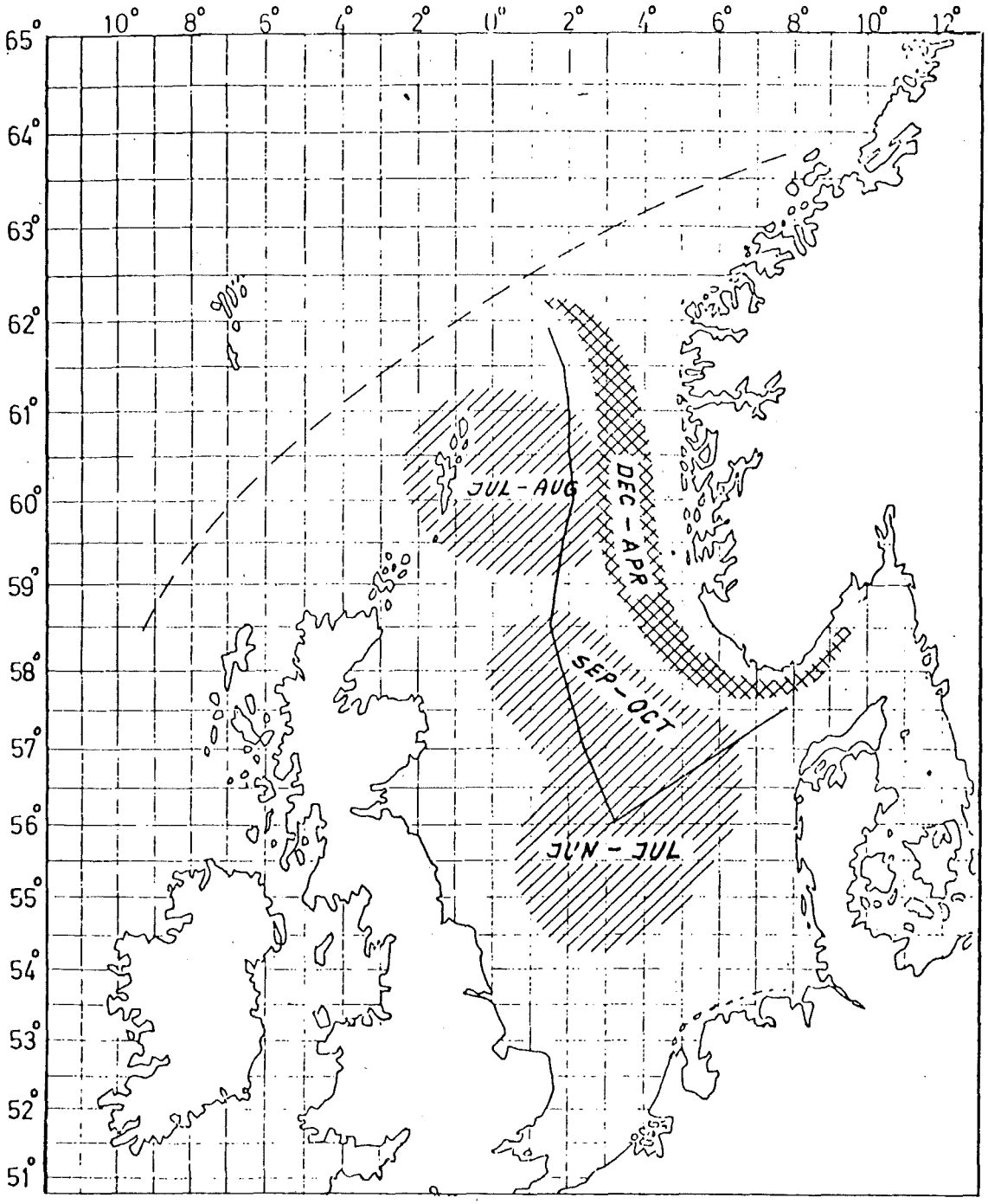

Figure 2 North Sea mackerel. Areas of main concentrations in summer-autumn and the overwintering area (cross-hatched). Range of distribution indicated.

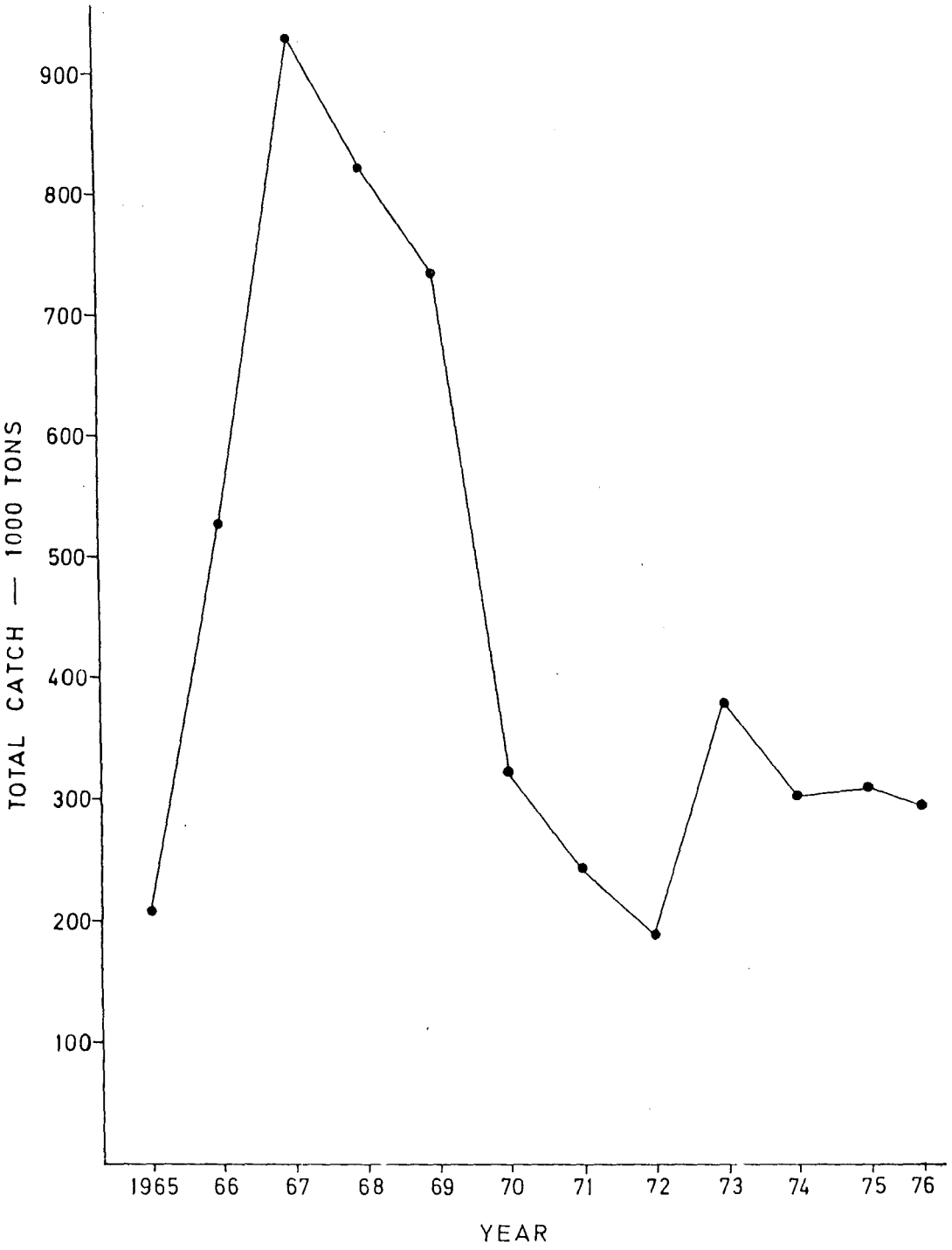

Figure 3 Mackerel. Total catch in the North Sea, Skagerrak and Kattegat 1966-1976.

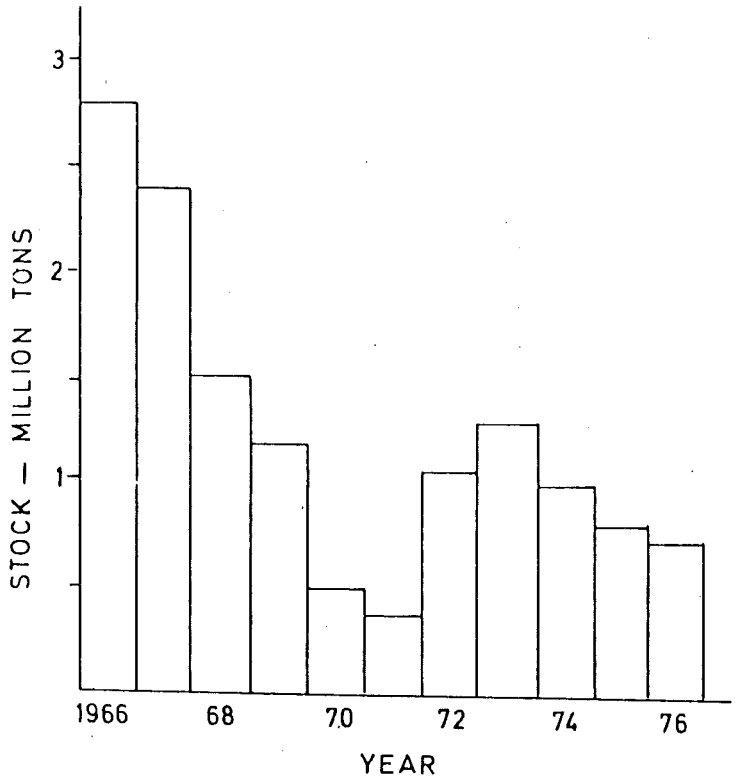

Figure 4 North Sea mackerel. Estimates of stock size (adults, ≥2 years) at the beginning of the year; from Norwegian tagging experiments.

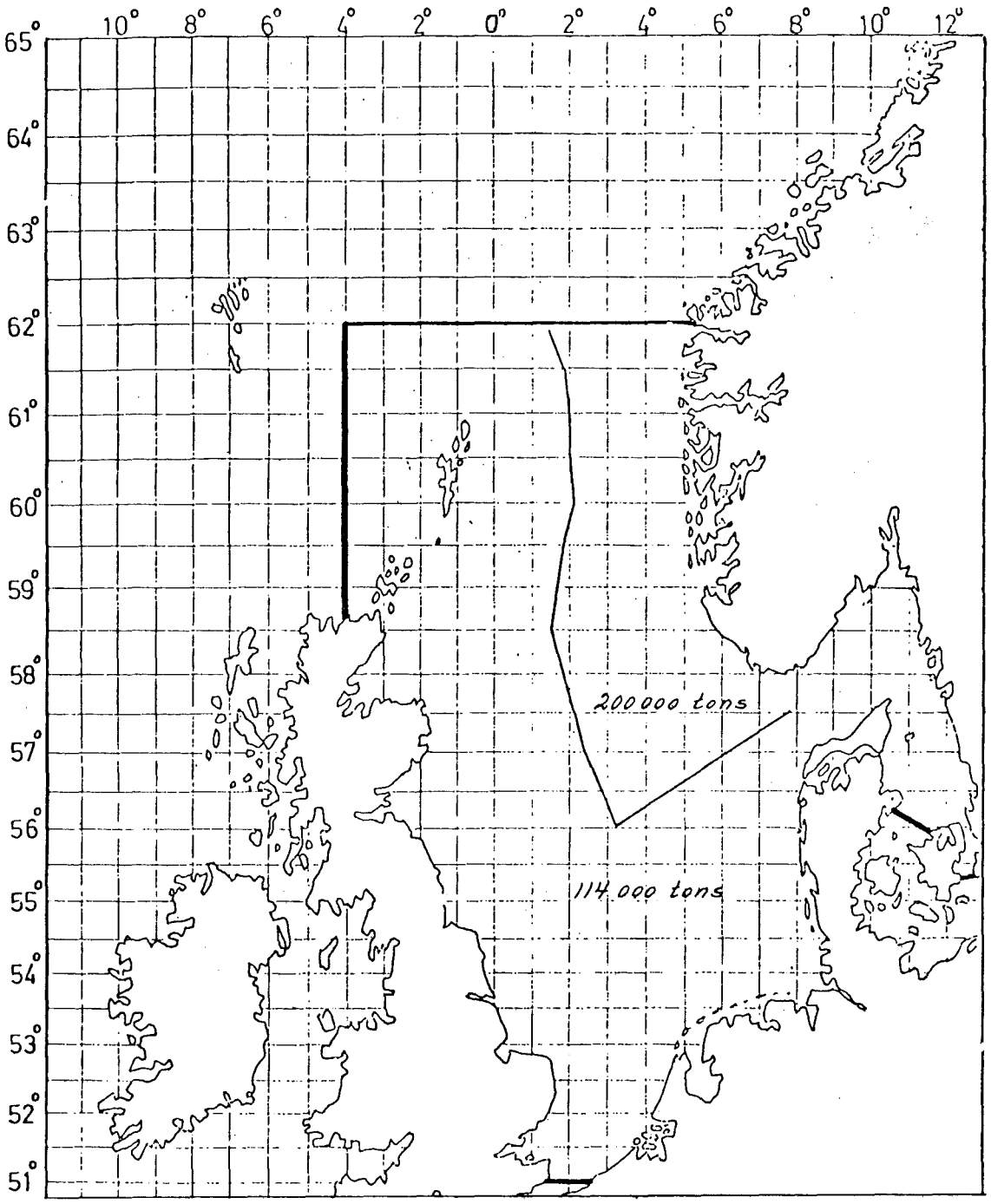

Figure 5 Mackerel. Estimated catch by economic zones in 1975.

MACKEREL, WESTERN AREA

1. General Biology

1.1 Spawning (see Figure 1)

Two spawning areas have been identified for the western stock :

1. In Biscay, spawing starts along the continental shelf at the end of February with a maximum in March; closer to the French coast spawning takes place in May and June.

2. On the Celtic Shelf the spawning season continues from March to July.

2. Distribution

2.1 Juveniles

Not much is known about the distribution of young stages. 0-group fish (≃ 18 cm) appear to the south of Cornwall (Div. VIIe) in October-December and overwinter in this zone. They do not seem to shoal with older fish.

2.2 Adults

The range of distribution of Western stock mackerel and its overwintering areas are shown in Figure 2. Fish spawning in Biscay migrate northwards to the Celtic Sea, the Shetland area and the northern North Sea. Some of them, however, remain in Biscay along the shore in summer.

As shown by English and Norwegian tagging experiments, after spawning in the Celtic Sea, adult mackerel tend to migrate northwards. Migration routes are known : one along the western coast of Ireland to Shetland, another through the Irish Sea and the third through the English Cahnnel into the North Sea. In autumn a reverse movement occurs.

3. Exploitation

3.1 The fishery

Between 1966 and 1969 the total catch from Sub-areas VI, VII and VIII remained at a rather constant level of around 70 000 tons. Then an increase took place which brought the total reported catch to 103 000 tons in 1970 and around 500 000 tons in 1975. Although provisional, the figure for 1976 does not seem to be appreciably different from that of 1975. (see Figure 3).

At the end of the 1960's, both Sub-area VII and Sub-area VIII contributed about 40% of the catch, but in the 1970s, the bulk of the catch has come from the Celtic Sea, where a directed fishery has been operating on over-wintering and spawning concentrations. The most recent assessment of this stock suggests that the exploitation rate in 1976 was appreciably above the optimum.

4. Stock fluctuations

Up to recent years, no stock estimate was available. In 1977, the ICES Mackerel Working Group estimated the stock size at 2 000 000 tons at the beginning of 1975 and noted a decline since 1973. Some echo surveys and egg and larval sampling are now being undertaken to provide estimates of stock size which are independent of commercial fisheries data.

As in the North Sea, large fluctuations in the abundance of year classes occur, Both in 1968 and 1971 year classes were abundant and have made major contributions to the fishery.

5. Fisheries regulations

To date, no international regulation has been applied to the Western stock. Limited national, commercial restrictions have been introduced on occasions in recent years by France.

6. Catch statistics

During the last 5 years about 90% of the catch in Sub-areas VI, VII and VIII have been taken inside the EEC 200-mile fisheries jurisdiction, the remaining 10% being caught in Sub-area VIII adjacent to the Spanish coast.

In 1972, the USSR catch accounted for 42% of the total. In 1975, this proportion increased to 63%. At the same time, the share of EEC member countries declined from 32 to 21 %.

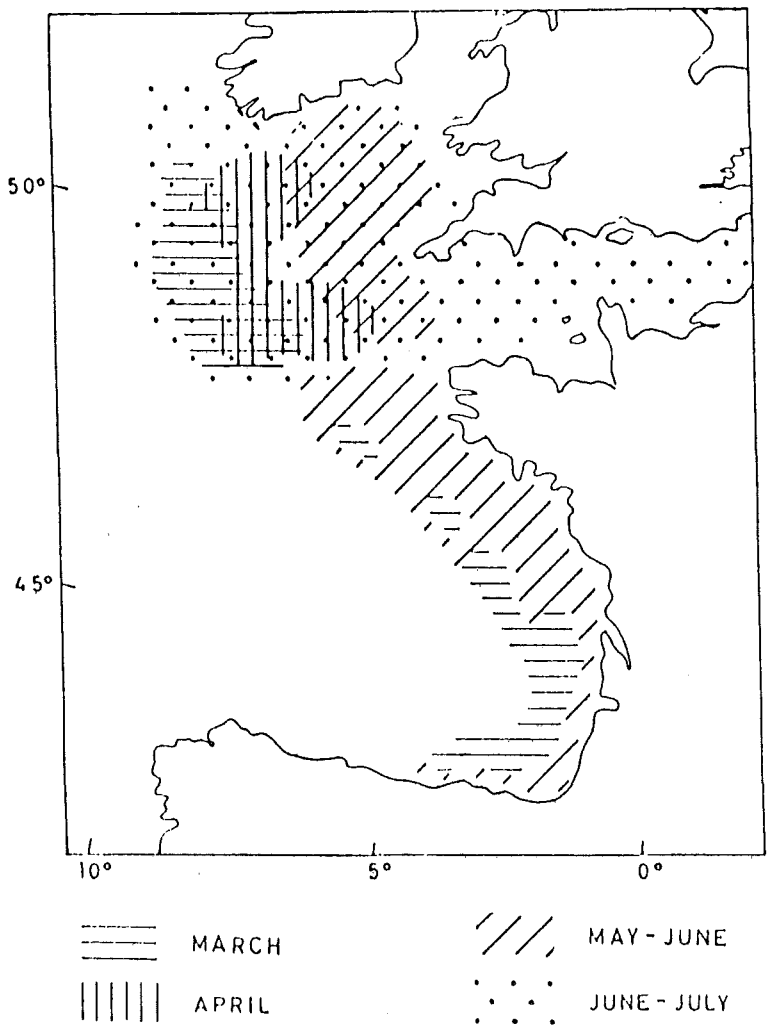

Figure 1 Mackerel, Western stock. Spawning areas (from egg distribution).

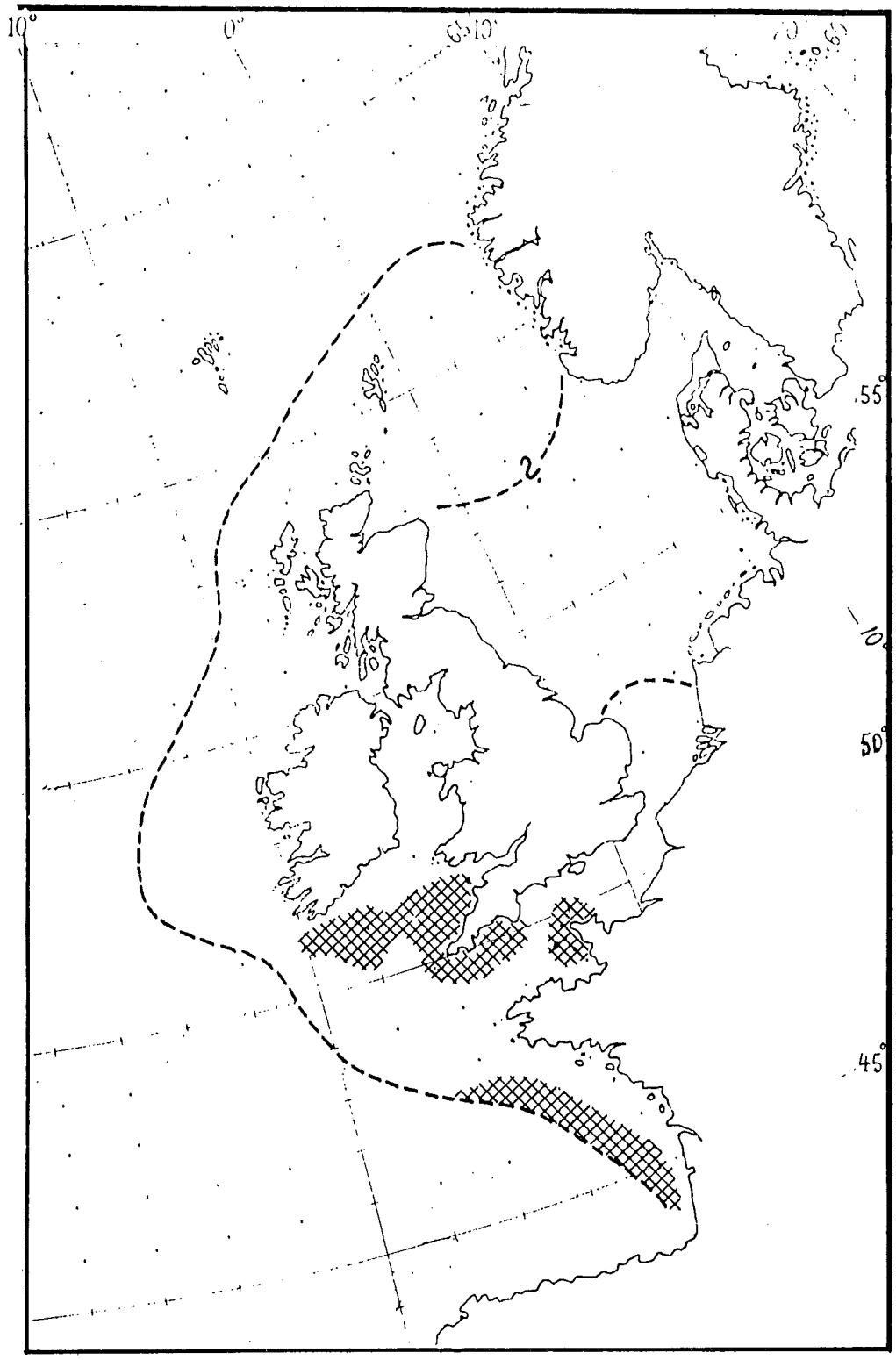

Figure 2 Mackerel, Western stock. Total range of distribution and overwintering areas (hatched).

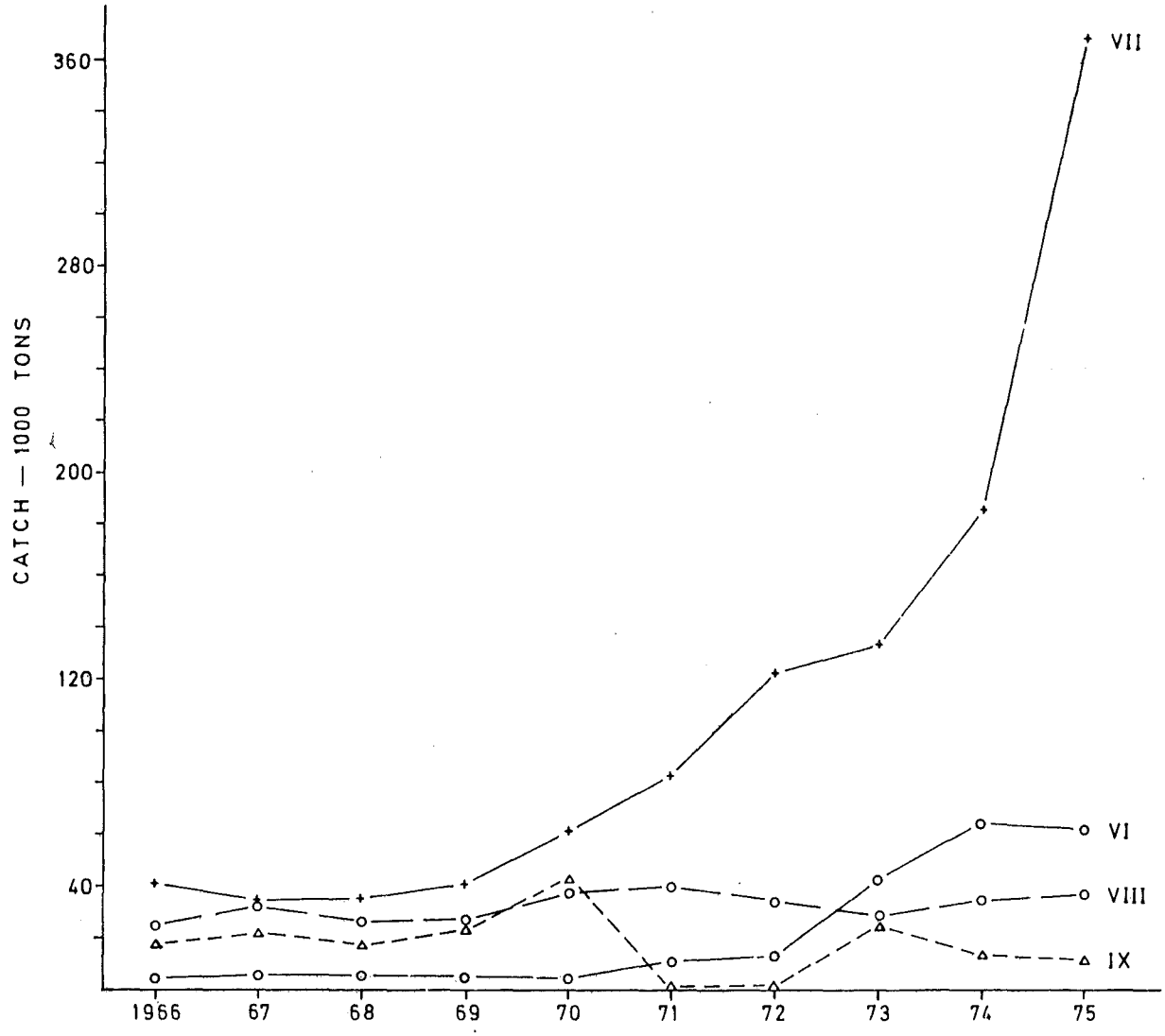

Figure 3 Mackerel, Western area. Catches in Sub-areas VI, VII and IX 1966 - 1975.

PILCHARD (Sardina pilchardus)

1. General biology

1.1 Stock identification

In the ICES region the pilchard is widely distributed all over the area between the North Sea and Azores (Figure 1). The main fisheries take place in Divisions VIId-e, Sub-area VIII and coastal parts of Sub-area IX.

From meristic and morphometric characters, two races have been described :

- the Iberian race or southern european Atlantic race, with a distribution from Gibraltar to the Cantabrian coast.

- the northern european Atlantic, distributed between northern Spain and the North Sea.

1.2 Spawning areas and periods

The pilchard is a serial spawner. Regular plankton surveys undertaken by British, French and Spanish laboratories have given the information on the spawning areas and periods shown in Figure 2.

1.3 Distribution and migrations of young stages

The youngest individuals have very seldom been caught and on these occasions only in shallow water along beaches or in ports.

The "0-group" appears in commercial catches in the second half of July between 46° and 47°N at a length of about 8 cm. In August, this age group is fished at the mouth of the Loire and in September and October off south Finistère.

In winter the majority of these young fish migrate southwards to the Landes coast where they are fished in February and March; the length is then 15 to 16 cm and they have a winter ring on the scales. In no other areas have 0-group fish been detected in commercial quantities despite research vessel fishing. In the spring and summer fisheries occur along the coast of Brittany on fish with a modal size of 18-19 cm. These fish are believed to migrate to the spawning areas in the Celtic Sea, the English Channel and along the edge of the French continental shelf.

Figure 3 shows the distribution of the juveniles, 0- and 1-group in the southern area.

1.4 Distribution and migration of adults

After spawning, one component of the adults (Figure 4) migrates towards the area north of the Loire. For the northern component of the population, little is known about the migration pattern. However, it is known that the fish withdraw westwards from the North Sea at the onset of winter.

2. Stock estimates

The size of the spawning stock in the English Channel was estimated by Cushing (1957), using Andreu's (1950) fecundity rate to be 10^{10} fish in 1950 (i.e., 800 000 tons). More recent data (Macer, 1975), give a fecundity rate twice as high as that used by Cushing and this would reduce his figure by one half. In Sub-area VIII relevant data concerning stock size are not available.

Borrmann and Holzlöhner estimated the size of the Western Channel stock from a cohort analysis. They obtained estimates of 100-200 thousand tons depending on the parameters used. It must be pointed out that the figures they used for the 1975 catch is 31% lower than the actual catch reported.

3. Exploitation

3.1 Catches

Table 1 shows catches from 1965 to 1975. In Sub-area IX following a period of high catches in 1965-67 of about 170 000 tons, the catch declined to about 100 000 tons in 1973-75. No detailed breakdown of the distribution of Spanish and Portuguese catches within the Sub-area was available.

Catches in Sub-area VIII have fluctuated around 38 000 tons annually. Spain took 90% of the total catch from this Sub-area in this period, probably mostly from its own waters.

3.2 Fishing gear

In Sub-areas VIII and IX the only gear used up to the early 1970's was the purse-seine. In later years in France, pelagic trawling has been developed using small boats (below 21 m). The number of French fishing vessels has decreased from 338 in 1962 to 80 in 1975.

In Sub-area VII, after the decline of the British drift netters, pelagic trawling by single or pair trawlers was the main gear used. No detailed data are available on fishing effort.

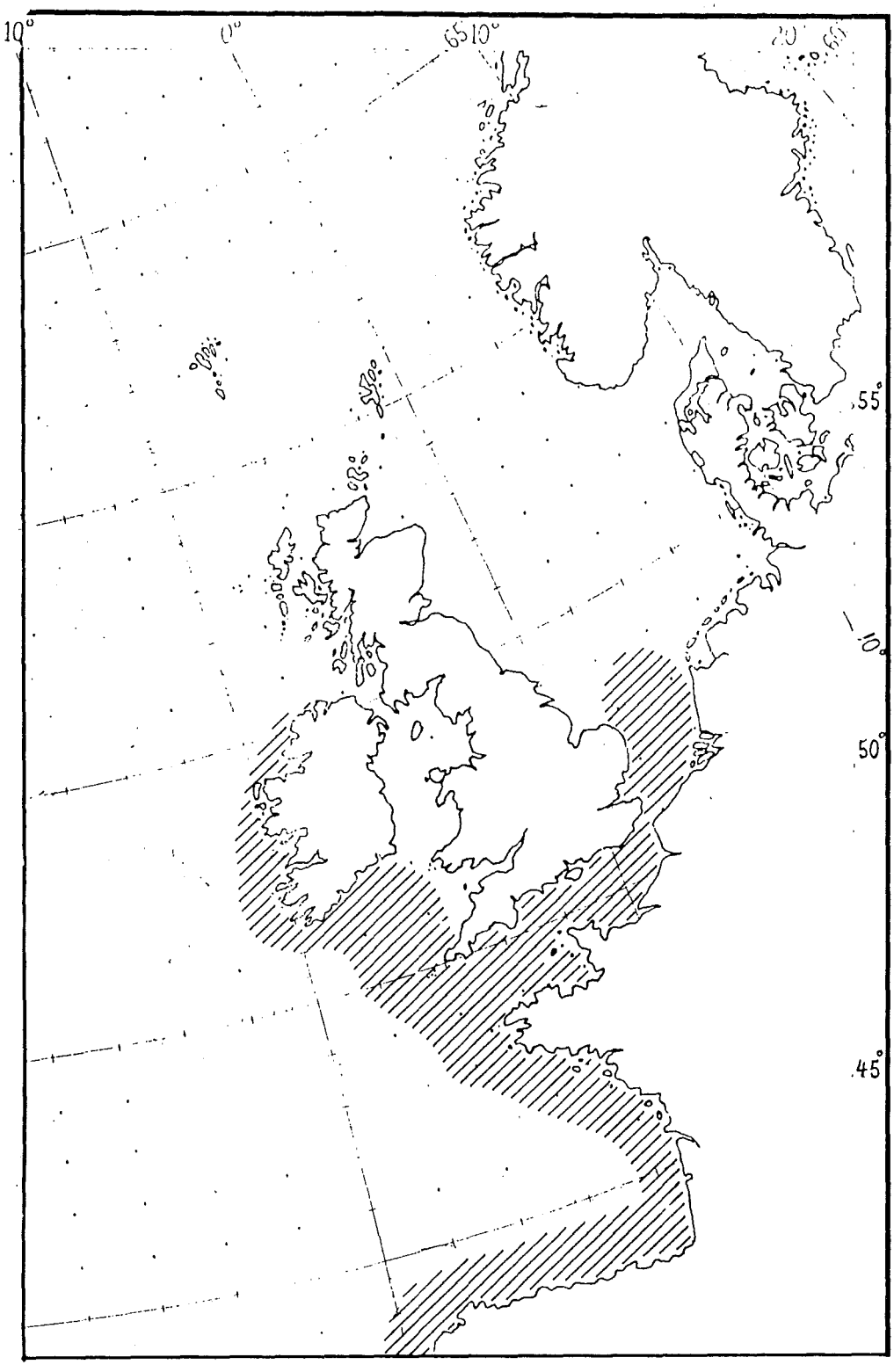

Figure 1 Pilchard. Distribution of adults

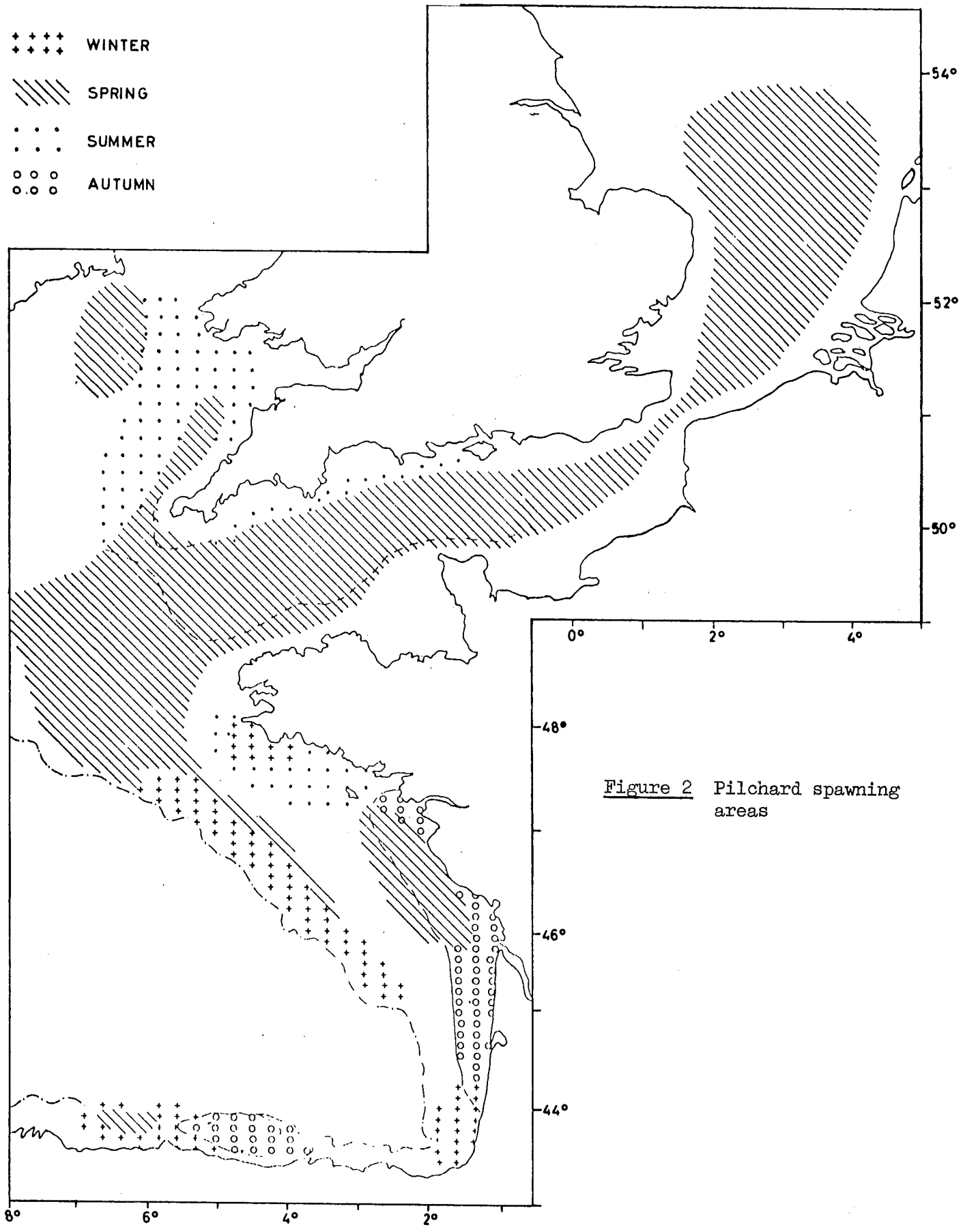

Figure 2 Pilchard spawning areas

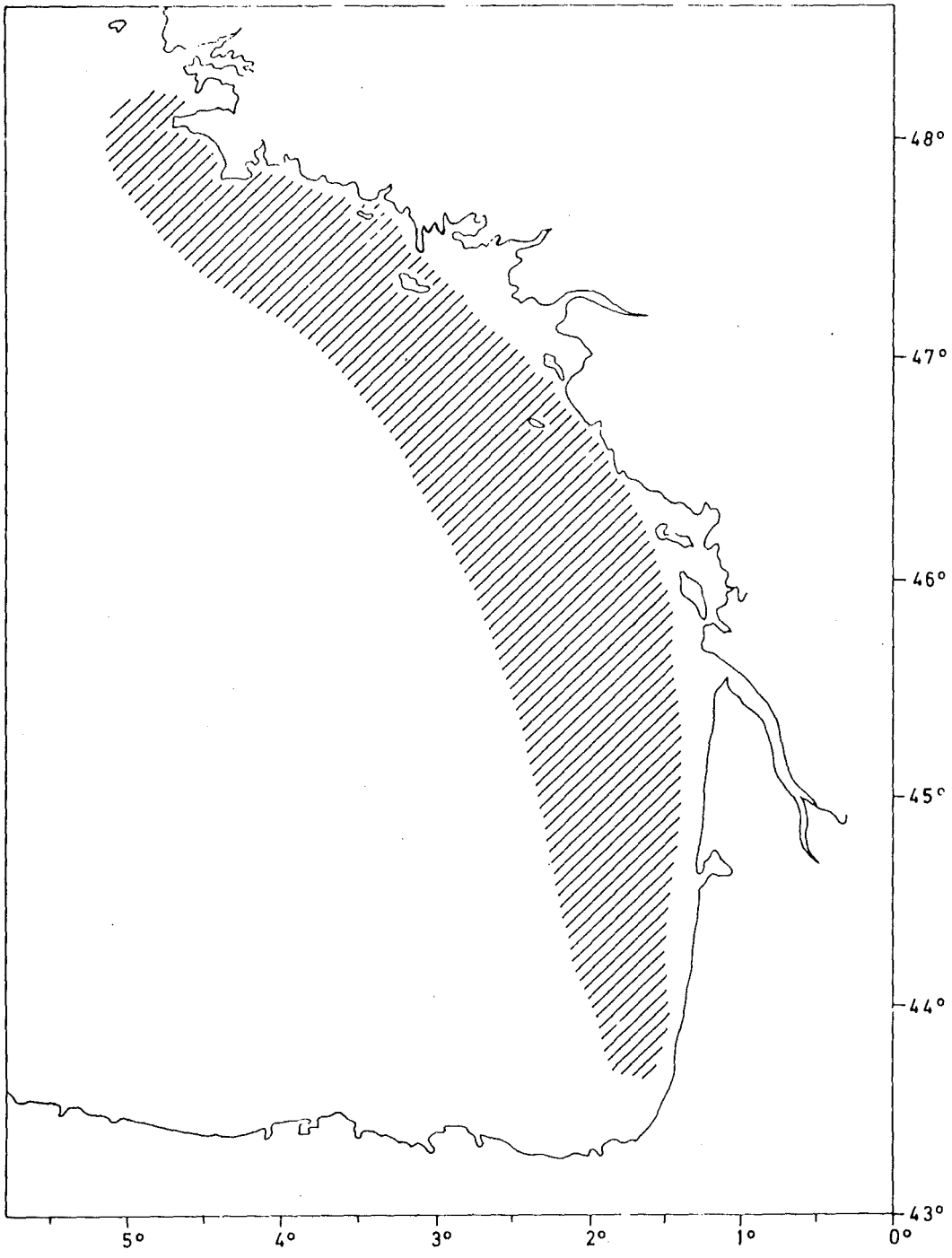

Figure 3 Pilchard. Southern population component.
Distribution of 0- and 1-group.

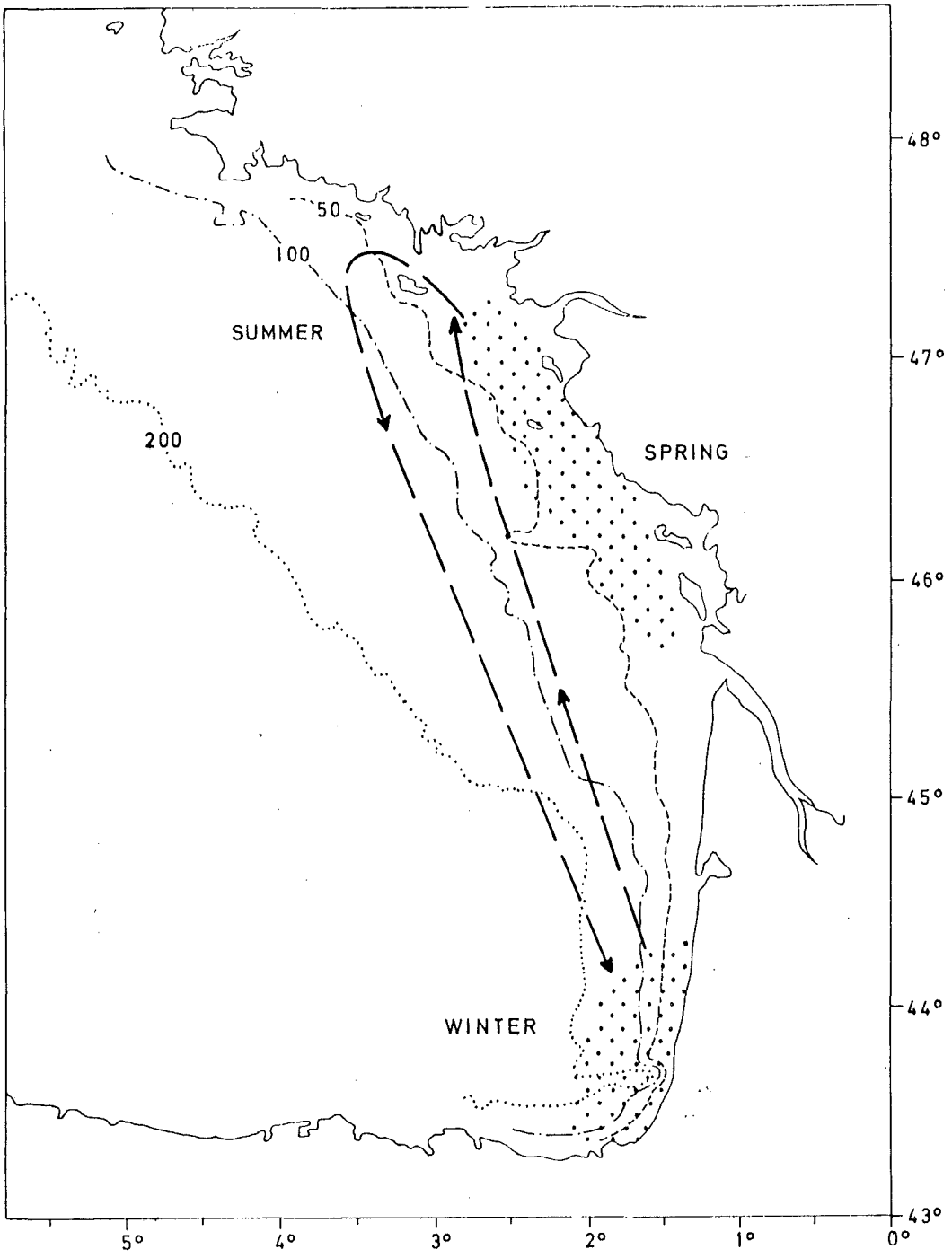

Figure 4 Pilchard. Southern population component.
Migration pattern of adults and spawning areas.

Table 1. Total catch of Pilchard per statistical area (ICES Bulletin Statistique)

Year / Area	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
IVa	5	11						7			2
IVb			1	6	1			4	12		
IVc	120	33	55	6	5	50	169	152	128	3 064	1 554
VIa		4	29	1	1	1	3	287	15	36	11
VIIa	139		35	521	387	27	61			287	149
VIIf								281	595	22	307
VIIb,c		18	1		3						102
VIId,e	3 802	1 197	1 345	965	1 020	1 853	2 111	7 839	5 852	4 636	7 231
VII g,K	280	601	228	227	168	83	873	604	286	657	2 311
VIII	39 543	37 566	38 536	32 205	45 709	34 546	50 493	39 603	50 708	38 002	55 211
IX	184 798	168 985	160 291	131 354	104 835	101 464	133 045	132 803	119 348	88 916	108 402
X	189	(8 851[x])	121	119	30	56	115	128	346	189	-
TOTAL	228 876	217 266	200 642	165 404	152 159	138 080	186 870	181 708	177 290	135 809	175 280

[x] of which 8 732 tonnes have been declared by France but actually originate from Sub-area VIII.

HORSE MACKEREL (Trachurus trachurus (L.))

1. General biology

1.1 Distribution

The horse mackerel (Trachurus trachurus (L.)) has an extensive distribution. In the ICES area, the range extends from off Portugal and Spain as far west as ICES Sub-area X, north around the British Isles and into the North Sea extending eastwards into the Kattegat and western Baltic (Figure 1).

1.2 Spawning

Only two major spawning areas are known. In the 'southern area' (Spain-Portugal), spawning occurs from Feburary to May, while in the 'northern area' (English Channel-North Sea) spawning occurs from May to August. During these periods temperatures in the surface waters range from 11°C to 16°C. Horse mackerel spawn for the first time at age 3 or 4. The eggs are pelagic.

1.3 Distribution of larvae and juveniles

The distribution of larvae and juveniles are not well documented. Juveniles have been found off Portugal and Spain, in Biscay, English Channel, the southern North Sea and in fjords of western Norway.

1.4 Growth

The growth pattern of horse mackerel is similar to that of mackerel with a rapid rate during the first 3 years of life, then dropping off sharply after maturity is reached.

1.5 Distribution and migration of adults

No data are available to show the migration patterns or permit a degree of stock discrimination. Some general ideas regarding distribution can be proposed based on catch distribution, limited sampling and general observation. The known horse mackerel overwintering areas are in the western English Channel, and to the south and west. During the spring and summer there is some movement northwards along the west coast of the British Isles into the North Sea. It is not known if the population in Sub-areas VIII and IX take part in this migration.

2. Exploitation and management

Horse mackerel fisheries occur throughout the year within the ICES area, but vary seasonally from Sub-area to Sub-area. A wide variety of gears is used. These include trawls, purse seines, gillnets and hook and line. The horse mackerel is used for human consumption, fish meal and oil. No regulation has been applied to these fisheries.

3. Stock size

No information is available as to the stock size.

4. Catch statistics

Catch statistics are given for the ICES areas for 1966-1975 in Tables 1 and 2. In this period, catches have increased from 100 000 tons in 1966 to a peak of 350 000 tons in 1973, declining to 265 000 tons in 1975. Figure 2 shows the distribution of catches in 1973-75 on the smallest statistical areas available. In the absence of any detailed information on catch distribution from those countries with a major share in the fisheries, the Working Group was unable to allocate the catches between economic zones.

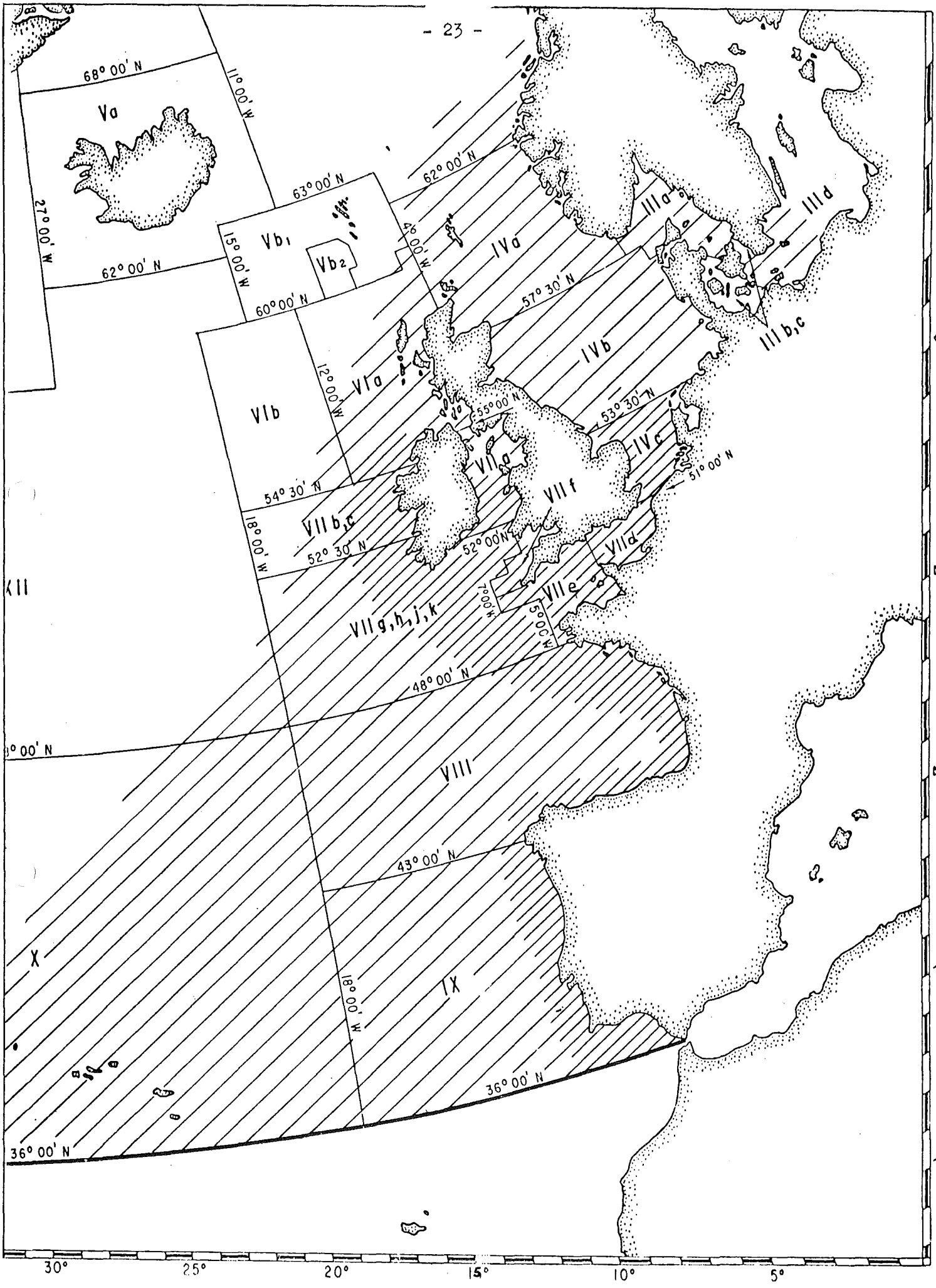

Fig. 1 Horse mackerel. Total range and main distribution area in the ICES region.

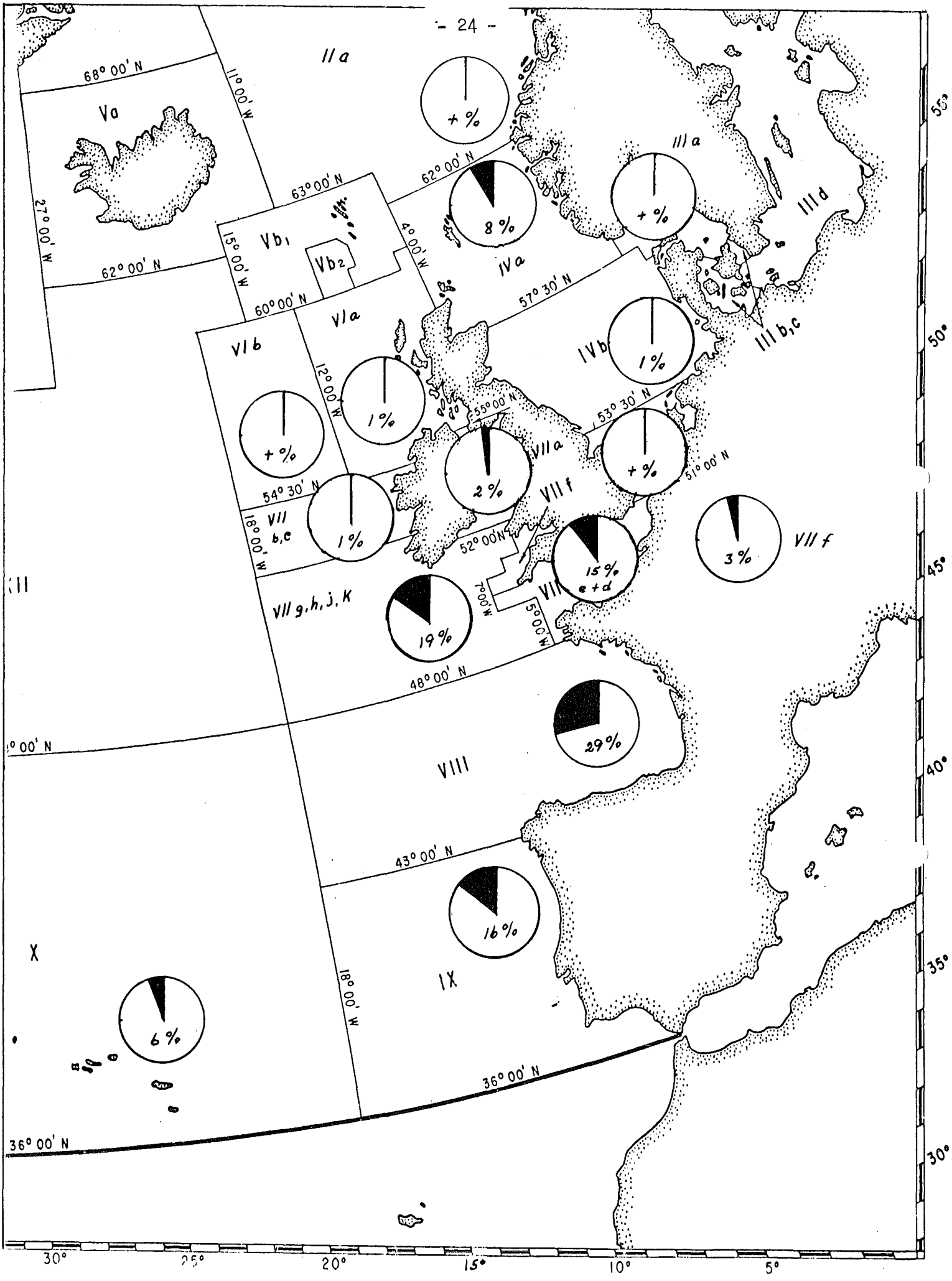

Fig. 2 Horse mackerel. Percentage of total annual catch within ICES statistical Sub-areas and Divisions (3 year average, 1973-1975).

Table 1. Catch of horse mackerel by countries 1966-1978 (tons). ICES Sub-areas and Divisions IIa, IIIa, IV, VI, VII, VIII, IX and X. (Data as officially reported to ICES).

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1974	1976[1]
Belgium	4	10	36	37	33	41	75	72	37	27	
Denmark	-	-	4	-	-	-	-	-	-	-	
Faroe Islands	-	-	-	-	-	-	-	5 370	1 114	158	
France	-	-	1 830	2 479	2 768	3 039	3 603	6 549	5 525	4 969	8 000
German Dem.Rep.	-	-	-	-	-	-	-	-	49	107	
Germany Fed.Rep.	1 532	96	1 238	1 096	966	395	175	2 891	1 720	1 480	
Iceland	-	-	-	-	-	-	-	379	203	-	
Netherlands	7	7	37	24	190	186	175	149	576	320	
Norway	-	-	-	-	7 404	23 173	6 381	20 760	21 393	3 194	5 300
Poland	164	73	2 330	420	1 192	627	2 081	3 921	5 772	2 348	3 026
Portugal	53 453	62 998	74 894	48 677	62 767	57 414	63 054	45 192	50 634	45 972	
Spain	47 000	53 352	62 326	85 781	98 418	26 167	82 247	113 361	70 733	83 849	
Sweden	-	-	-	-	-	-	-	2	2	1	
U.K.	214	107	104	111	121	146	221	265	1 957	636	
U.S.S.R.	279	-	-	13 320	74 952	57 049	107 753	154 254	120 264	122 014	
Total	102 653	116 643	142 799	151 945	248 811	168 237	265 765	353 165	279 979	265 075	

1) Provisional

Table 2. Catch of horse mackerel by Sub-areas and Divisions 1966-1976 (tons).
(Data as officially reported to ICES).

Year	IIa	IIIa	IVa	IVb	IVc	VIa	VIb	VIIa	VIIb, c	VIId, e	VII f	VIIg-k	VIII	IX	X
1966	-	-	430	1 620	45	69	-	7	7	17	-	4	43 035	53 475	3 943
1967	-	-	16	117	10	38	-	7	1	39	-	64	48 439	63 851	4 060
1968	-	4	33	1 367	131	88	-	64	-	570	-	2 209	56 393	78 502	3 434
1969	-	-	18	1 063	137	111	-	136	34	1 399	-	13 290	80 565	51 685	3 504
1970	76	-	10 705	1 079	202	100	1	310	1 478	554	-	70 712	95 169	64 714	2 710
1971	-	-	31 395	414	241	2 532	1	18	765	610	-	46 901	26 390	55 203	3 767
1972	1	-	7 590	22	543	1 680	196	4 012	2 104	33 844	4 000	56 276	80 507	63 811	11 187
1973	86	40	39 839	1 720	426	6 497	-	6	205	62 159	6 129	46 108	116 519	43 712	29 708
1974	-	4	25 411	1 790	3 550	3 351	170	16 555	3 875	32 842	3	62 101	59 985	50 771	19 538
1975	141	11	2 408	4 018	3 505	3 332	47	348	635	35 002	22 674	58 687	85 046	45 734	3 435