



International Council for
the Exploration of the Sea

1994/L:16, Ref. G, H.
Biological Oceanography
Committee

STUDY OF THE ICHTHYOPLANKTON OF COMMERCIAL SPECIES OFF PORTUGUESE CONTINENTAL COAST

Maria Hortense Afonso and Plácida do Carmo Lopes

Instituto Português de Investigação Marítima
Avenida de Brasília, 1400 Lisboa, Portugal

ABSTRACT

This study presents the results obtained from two cruises carried out along the Portuguese continental coast in summer (6 to 31 July) and autumn (27 October to 3 December) 1990.

Distribution and abundance of fish eggs and larvae and their relation with some environmental parameters were undertaken.

Twenty six and fourteen families were identified in samples collected, respectively, in the summer and autumn surveys.

In both seasons sardine, *Sardina pilchardus* (Walbaum, 1792), larvae were the most abundant with percentages of 28.6 and 78.0, respectively. Horse mackerel, *Trachurus trachurus* (Linnaeus, 1758), larvae were identified in samples from both cruises corresponding to 4.1% and 0.3%. Hake, *Merluccius merluccius* (Linnaeus, 1758), larvae appeared exclusively in the summer cruise with a small percentage of 0.06. Other larvae of families of economic interest as Bothidae, Pleuronectidae and Soleidae were also collected in the samples.

INTRODUCTION

Since 1981 several cruises were undertaken off the Portuguese continental coast in order to study the ichthyoplankton, specially sardine, *Sardina pilchardus*, eggs and larvae.

In 1990, two surveys were carried out included in the EEC Research Programme in the Fisheries Sector, in the FAR Project n° M A. 1.

203 "Estimation of the abundance and study of the distribution pattern of hake, horse mackerel, mackerel, monkfish and megrim in ICES div. IXa (Portuguese waters)".

During the groundfish survey ichthyoplankton sampling was conducted to estimate spawning areas and eggs and larvae distribution and abundance which was related with some environmental parameters.

MATERIAL AND METHODS

Samples were collected with a Bongo net (60cm of mouth diameter and 335 and 505 μ m mesh size), from RV "Noruega", along the Portuguese continental coast, in two surveys carried out in summer (6 to 31 July) and autumn (27 October to 3 December) 1990.

The survey area was covered by a grid of 92 sampling stations (Fig.1). At each station, double oblique tows from the surface to a maximum depth of 200m, were undertaken.

For the determination of the filtered water volume, calculated using the expressions of Smith and Richardson (1977), a digital flowmeter "Hydro-Bios" was used.

The oblique hauls were carried out at a constant speed of 3 Knots and the samples were fixed with 4% formalin, neutralized with sodium bicarbonate.

Plankton volumes were measured by displacement and all fish eggs and larvae were sorted, from the samples collected with the 505 μ m net, with the aid of a stereoscopic microscope.

The total number of eggs and larvae were calculated by 10m². Fish eggs and larvae were identified and their number are presented by 100m² of water filtered by the net.

RESULTS

In the Table 1 is presented the abundance of fish eggs and larvae in number per 10m² in the summer and autumn cruises.

Twenty six and fourteen families were identified in summer and autumn samples, respectively. In summer, seven of the families recorded are commercially important in the studied area while in autumn only four families have economic interest.

Sardina pilchardus larvae were dominant in the summer survey with

28.6% (Fig. 2). The two other most abundant families in summer were Gobiidae and Blenniidae. *Trachurus trachurus* was represented by 4.1%. Under the designation of "Others" are included families with percentages inferior to 3.0 such as Merlucciidae, Sparidae and Pleuronectidae with economic interest.

In autumn, *Sardina pilchardus* was, as registered in summer, the most abundant species (78.0%). Gobiidae and Myctophidae were the two other most important families (Fig. 2). *Trachurus trachurus* and families of commercial interest as Sparidae and Soleidae attained percentages inferior to 1.0 and were included in "Others".

Sardina pilchardus

Sardine eggs were only registered in four stations in summer (total number 52) while in autumn the distribution was more widespread (total number 2352). The highest concentration in summer (4.0 eggs/100m²) was recorded in the bathymetric of 44m. In autumn sardine eggs were more abundant off the south coast of Portugal with the maximum abundance (182.2 eggs/100m²) found in the bathymetric of 22m. Most of sardine eggs were found between the bathymetrics of 20 and 100m.

In summer the surface temperature in the stations where eggs were caught ranged from 17.9 to 21.3°C while in autumn those values varied between 14.8 and 18.8°C.

Sardine larvae were the most abundant in the studied area represented by 28.6 and 78.0%, respectively, in the summer and autumn samples. Larvae distribution and abundance per 100m² is indicated in Figure 3. The maximum number of larvae in both seasons occurred in the north coast off Portugal near the bathymetric of 100m.

In summer, sardine larvae were only registered off the west coast of the studied area with higher concentrations between the bathymetrics of 20 and 100m and in that area surface temperature and salinity range from 18.2 to 21.3°C and 35.75 to 35.93 S, respectively. The maximum abundance (54.36 larvae/100m²) was recorded in the bathymetric of 100m and the surface temperature and salinity were, respectively, 20.9°C and 35.88 S.

In autumn, the maximum concentration of sardine larvae (102.05 larvae/100m²) occurred also in the bathymetric of 100m. Sardine larvae were widely distributed along the west and south coast off Portugal. Highest abundances of larvae were registered between the bathymetrics of 20 and 100m and in that area values of surface temperature and salinity varied, respectively, from 14.8 to 16.9°C and 35.78 to 36.14 S.

The total annual landing of sardine in 1990 for the Portuguese coast was 92 404 tonnes (ICES, 1993). As catches are of great amounts, sardine is commercially the most important species for Portugal even with a relatively low market value.

Trachurus trachurus

Horse mackerel larvae concentrations were considerably low represented by 4.1% and 0.3%, respectively, in the summer and autumn surveys (Fig.2). The geographical distribution is represented in Figure 4 and we observed that the larvae were found between the bathymetrics of 20 and 1000m. The surface temperature in the areas where horse mackerel larvae were collected ranged from 16.5 to 20.9°C. The highest abundances were registered in summer with a maximum concentration of 7.23 larvae/100m² in the bathymetric of 45m and the surface temperature was 20.7°C.

In autumn, larvae abundances were lower than those recorded in summer with the maximum concentration (1.84 larvae/100m²) in the bathymetric of 45m and the surface temperature was 16.8°C. Horse mackerel larvae were registered in waters which surface temperature varied between 14.8 and 18.1°C.

For horse mackerel the total landing for 1990 in the Portuguese coast was 19 958 tonnes (ICES, 1993). This species is the second in commercial value for Portugal.

Merluccius merluccius

Hake larva (a single specimens only) was recorded in the summer survey at station 19, at a concentration of 0.06 larvae/100m² in the bathymetric of 104m and the surface temperature registered was 20.9°C.

The total landing of hake for the Portuguese continental coast in 1990 was 3400 tonnes (ICES, 1994). Even with low annual catches *Merluccius merluccius* is an important commercial species in Portugal considering that it has a high market value.

Flatfishes

This designation includes three families, Bothidae, Pleuronectidae and Soleidae which gather commercially important species off the Portuguese coast. Specimens of those families were registered in summer with percentages, respectively, of 3.8, 0.4 and 4.0 whilst

in autumn only Soleidae larvae occurred with 0.2%.

Sparidae

Larvae of this family are also of economic interest for Portugal and were identified in the summer and autumn surveys with percentages of 1.8 and 0.1, respectively.

DISCUSSION

Several works are published concerning sardine eggs and larvae studies in the Portuguese waters: Sobral (1975), Ré (1979, 1981, and 1986), Ré et al. (1982, 1988 and 1990) and Afonso (1991). All authors agree that spring is the most important season for sardine spawning, specially in the south west coast off Portugal.

In the Cantabrian and Galician coasts off Spain, spring is also indicated as the main sardine spawning season (Dicenta et al., 1977, Dicenta, 1984, Solá and Franco, 1985, Franco and Solá, 1985, Solá, 1987, Franco and Solá, 1988, Lago de Lanzós et al., 1988, García et al., 1988, Santiago et al., 1988, Solá et al., 1990 and García et al., 1991).

According to our results sardine spawning in summer is very low which agrees with Sobral (1975) indicating that sardine spawning off the Portuguese coast is minimum in summer.

In our samples sardine eggs were collected between the bathymetrics of 20 and 100m, results according with other studies carried on off Portugal and Spain (Cantabrian and Galician coasts) (Ré, 1986, Ré et al., 1988, Afonso, 1991, Solá and Franco, 1985 and Franco and Solá, 1985).

Regarding our data, when surface temperature were higher in summer (July) egg abundance was low whilst in autumn (November) with the decrease of surface temperature higher egg concentrations occurred. Off the Spain coast, Solá et al. (1990) observed that when "temperature rise in summer, sardine egg and larval abundance was at its weakest" and that in autumn and winter, as surface temperature cools, sardine abundance increased.

The distribution of sardine larvae in our samples was dispersed over all the studied area including occurrences at oceanic stations, with higher abundances in summer and autumn samples, between the bathymetrics of 20 and 100m. These results are in accordance with Afonso (1991) for the Portuguese coast and with Solá and Franco (1985) and Franco and Solá (1985) for the Cantabrian and Galician coasts.

Concerning horse mackerel larvae highest abundances were recorded in summer in our samples between the bathymetrics of 20 and 1000m. In both surveys larvae were collected in areas where surface temperature ranged from 14.8 to 20.9°C.

Ré (1979) and Ré et al. (1982) collected horse mackerel larvae off the Portuguese coast, between 20 and 200m depth. Off Spain (Galician and Cantabrian coasts) Dicenta (1984), Solá and Franco (1985), Solá (1987), Franco and Solá (1988) and Solá et al. (1990) registered the occurrence of horse mackerel larvae from May to August. Solá et al. (op. cit.) indicate that a peak of larval abundance appeared in July in three years of sampling in waters surrounding 18°C and that a weaker peak was registered in fall.

Only a single hake larva was collected in the summer survey in the bathymetric of 104m. Ré et al. (1982) registered six hake larvae in December, March and July 1979/80, in a northwest area off the Portuguese coast. Off Spain (Galician and Cantabrian coasts), Dicenta (1984), Franco and Solá (1985), Solá and Franco (1985) and Franco and Solá (1988) recorded the occurrence of some hake larvae between the bathymetrics of 20 and 250m.

ACKNOWLEDGMENTS

The authors are grateful to M. Etelvina Mergulhão for providing information concerning environmental parameters and M. Teresa Rodrigues for the sorting of the plankton samples.

REFERENCES

- Afonso, M. H., 1991. Estudo de uma área de postura de sardinha, *Sardina pilchardus* (Walbaum, 1792) na costa continental portuguesa. Bol. Inst. Nac. Inv. Pescas, 16 : 23-52.
- Dicenta, A., 1984. Aportación al conocimiento del ictioplancton de la costa vasca. Bol. Inst. Esp. Oceanog., 1(2) : 94-105.
- Dicenta, A., Cendrero, O. and Cort, J. L., 1977. Distribucion y abundancia de huevos y larvas de sardina ("*Sardina pilchardus*" Walb.) en el Cantabrico, en Abril de 1975. Bol. Inst. Esp. Oceanog., III, 236 : 65-80.
- Franco, C. and Solá, A., 1985. Contribución al estudio del Ictioplancton de especies de interés comercial de la plataforma gallega. Bol. Inst. Esp. Oceanog., 2(3) : 15-26.

- Franco, C. and Solá, A., 1988. Contribution to the study of the ichthyoplankton of commercial species on the continental shelf off Spain. ICES C. M. 1988/H:74.
- García, A., Franco, C., Solá, A., Alonso, M. and Rodriguez, J. M., 1988. Distribution of sardine (*Sardina pilchardus*, Walb.) egg and larval abundances off the Spanish North Atlantic coasts (Galician and Cantabrian areas) in April, 1987. ICES C. M. 1988/H:21.
- García, A., Franco, C., Solá, A. and Lago de Lanzós, A., 1991. Sardine (*Sardina pilchardus*, Walb.) daily egg production off the Galician, Cantabrian and Bay of Biscay waters, in April-May, 1990. ICES C. M. 1991/H:37.
- ICES, 1993. Report of the Working Group on the assessment of mackerel, horse mackerel, sardine and anchovy. ICES C. M. 1993/Assess:19.
- ICES, 1994. Report of the Working Group of assessment of southern shelf demersal stocks. ICES C. M. 1994/Assess:3.
- Lago de Lanzós, A., Franco, C. and Solá, A., 1988. Comparative study of the annual variation in the spawning intensity of sardine - *Sardina pilchardus* (Walbaum, 1792) - of the Cantabrian and NW Spain. ICES C. M. 1988/H:73.
- Ré, P., 1979. The eggs and planktonic stages of Portuguese marine fishes. I- Ichthyoplankton from the coast of Algarve (May, 1977). Arq. Mus. Boc. (2ª série), 7(3) : 23-51.
- Ré, P., 1981. Seasonal occurrence, mortality and dimensions of sardine eggs (*Sardina pilchardus* (Walbaum)) off Portugal. Cybium, 3ª série, 5(4) : 41-48.
- Ré, P., 1986. Ecologia da postura e da fase planctónica de *Sardina pilchardus* (Walbaum, 1792) na região central da costa portuguesa. Bolm Soc. Port. Ciênc. Nat., XXIII, 2ª série : 5-81.
- Ré, P., Farinha, A. and Meneses, I., 1982. Ichthyoplankton from the coast of Peniche (Portugal) (1979/80). Arq. Mus. Boc. (Série A), I, 16 : 369-402.
- Ré, P., Farinha, A. and Meneses, I. 1988. Diel spawning time of sardine, *Sardina pilchardus* (Walbaum, 1792) (Teleostei, Clupeidae) off Portugal. Inv. Pesq., 52(2) : 207-213.
- Ré, P., Cabral e Silva, R., Cunha, E., Farinha, A., Meneses, I. and Moita, T., 1990. Sardine spawning off Portugal. Bol. Inst. Nac. Inv. Pescas, 15 : 31-44.

- Santiago, J., Artetxe, I. and Zamakona, A., 1988. Distribution and abundance of mackerel, horse mackerel and pilchard eggs in the southern Bay of Biscay in 1987. ICES C. M. 1988/H:10.
- Smith, P. E. and Richardson, S. L., 1977. Standard techniques for pelagic fish egg and larva surveys. FAO Fish. Tech., 175, 100 p.
- Sobral, M. C., 1975. Contribution à l'étude du plancton et reproduction de la sardine et anchois dans la côte portugaise. ICES C. M. 1975/J:11.
- Solá, A., 1987. Yearly variation of the ichthyoplankton of commercial interest species in the Santander coast (North of Spain). ICES C. M. 1987/L:32.
- Solá, A. and Franco, C., 1985. Contribución al estudio del Ictioplancton de especies de interés comercial de la plataforma cantábrica. Bol. Inst. Esp. Oceanog., 2(3) : 1-14.
- Solá, A., Motos, L., Franco, C. and Lago de Lanzós, A., 1990. Seasonal occurrence of pelagic fish eggs and larvae in the Cantabrian Sea (VIIIc) and Galicia (IXa) from 1987 to 1989. ICES C. M. 1990/H:25.

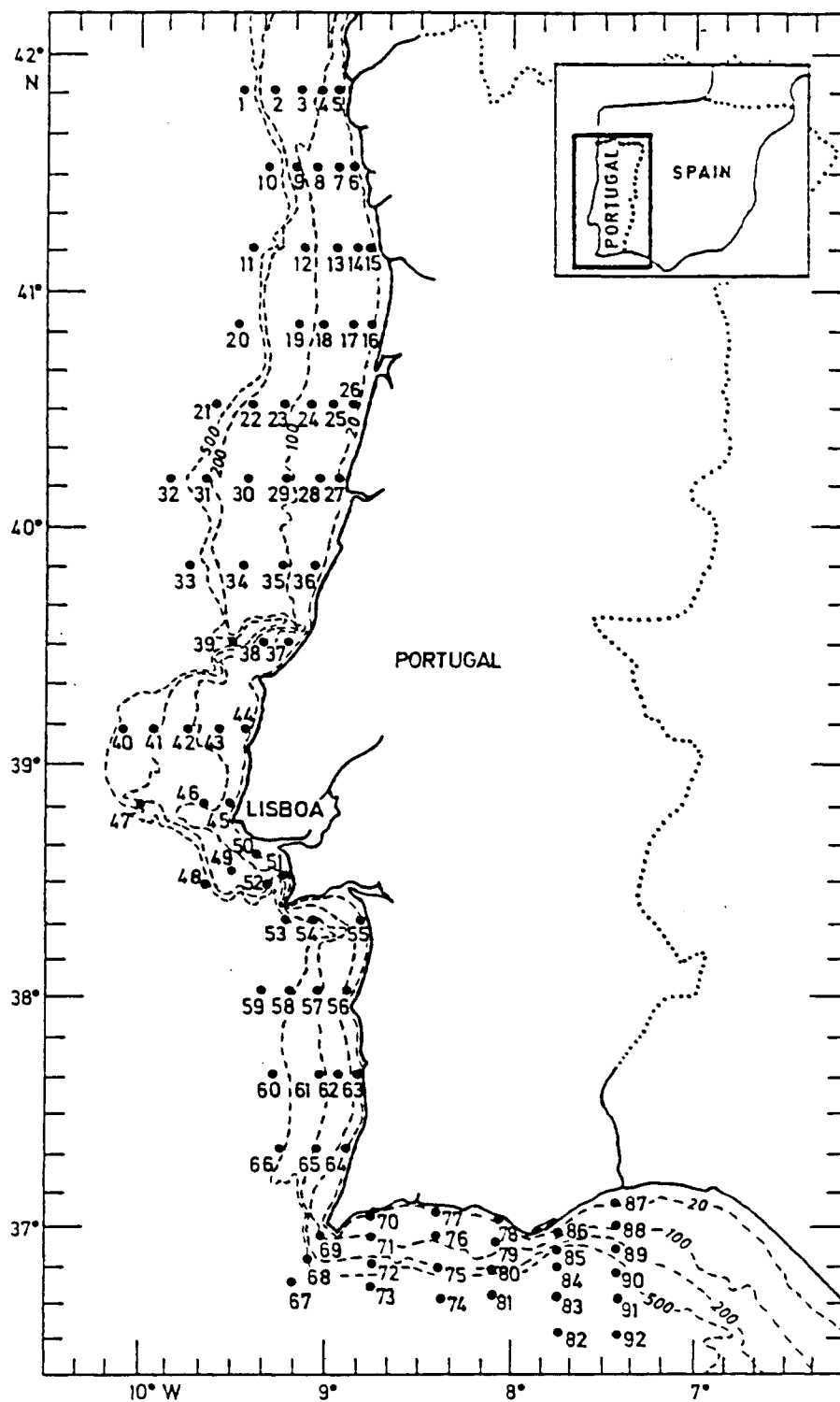


Figure 1 - Sampling area and grid of oceanographic stations.

Table 1 - Abundance of fish eggs and larvae per 10m².

Stations No.	SUMMER		AUTUMN	
	Eggs/10m2	Larvae/10m2	Eggs/10m2	Larvae/10m2
1		6.64		
2	131.37	238.86		49.27
3		59.53	118.43	83.38
4	50.86	158.94	40.81	48.09
5	44.72	35.78	69.62	
6	8.85	39.84	95.59	47.23
7	15.45	108.13	211.50	
8	4.84	77.40	750.01	
9		149.47		
10				161.18
11			16.40	709.19
12	27.17	6.79	11.27	68.17
13	165.44	98.04	397.39	49.79
14			82.23	332.50
15	40.51	33.14	24.85	241.39
16	34.65	76.24	240.69	841.65
17	11.09	177.37	980.05	600.94
18	5.24	230.70		
19	168.54	667.67		
20				
21			46.96	176.74
22				975.14
23	24.08	325.05	1620.61	54435.57
24	273.29	378.77	166.62	4250.54
25		201.06	11.97	1477.31
26	9.17	24.47		347.60
27	124.16	6.06		274.94
28	7.98	67.85	15.73	2691.50
29	133.37	316.13	32.79	9755.23
30	780.78	39.60	5.38	6981.73
31	69.26	79.91	7.00	301.84
32		10.23	28.58	
33	87.42	238.95	66.82	160.28
34	14.49	202.87	39.83	1153.74
35	16.69	186.98	177.07	1672.07
36	74.76	3.11	5.50	196.64
37	2.18	121.89	3.82	40.08
38	44.43	382.12	42.77	1795.13
39	203.38	6.36	710.02	4274.25
40	13.25	59.63		
41	401.26			
42	1239.40	339.90		
43	98.40	30.16		
44	48.11	134.38		
45	293.98	146.99		
46	52.24	470.20	33.62	1072.54

Table 1 (cont.)

Stations No.	SUMMER		AUTUMN	
	Eggs/10m2	Larvae/10m2	Eggs/10m2	Larvae/10m2
47	1703.36	282.85	173.08	1254.49
48	31.04	55.87	282.67	893.14
49		79.30	68.46	573.69
50	128.24	16.37	5.05	12.84
51	540.74	196.15	7.78	489.91
52	667.74	150.39	175.50	
53	502.51	44.67	565.86	
54	900.89	94.21	110.20	2651.32
55	348.60	34.86	339.78	1313.88
56	818.60	16.71	155.36	174.33
57	23.95	23.95	1875.87	3024.96
58		33.68		
59		20.85		
60	42.94	24.54		223.71
61	5381.49		26.29	2752.00
62	591.96	72.60	308.88	5089.94
63	641.34	34.30	270.77	2017.14
64	1826.17	78.08	117.71	5576.22
65	106.37	27.99	260.79	13565.89
66	5280.17	14.39	738.82	10215.00
67	183.88	15.99	198.15	39.63
68	1623.58	128.38	8596.04	200.08
69	157.63	41.12	89.16	761.29
70	45.13		3054.01	4.13
71	136.49	8.53	414.83	316.63
72	154.01	9.06	189.59	169.82
73	77.11	6.43		
74		375.62	16.88	50.64
75	48.79	8.13	134.95	347.00
76	229.04	37.14	152.71	322.39
77			11523.08	59.43
78		5.87	364.36	323.42
79	15.47		11496.32	152.12
80	7.57	7.57		178.61
81	29.93	89.80	6.53	137.17
82			4.99	9.97
83	41.46	82.93	8.30	19.12
84				
85			155.01	368.14
86			373.41	263.88
87			347.80	43.93
88			506.51	149.65
89			4009.29	37.35
90				7.91
91	16.16	177.80		10.64
92	509.97	79.48	27.48	36.64

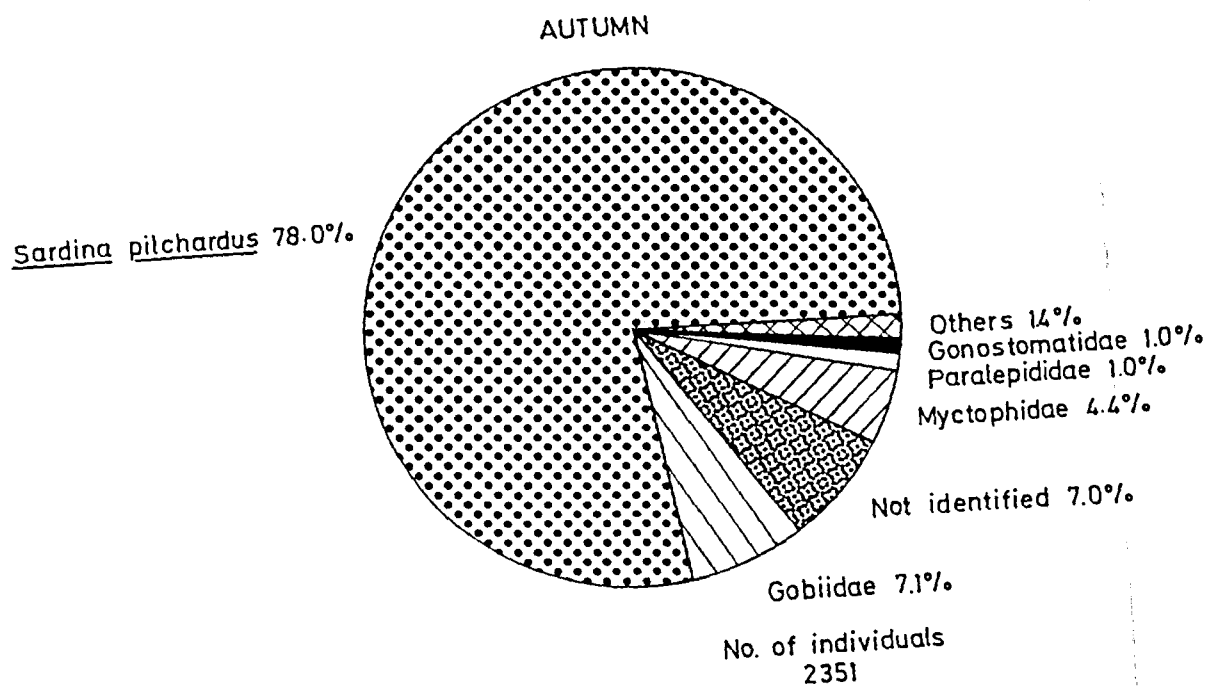
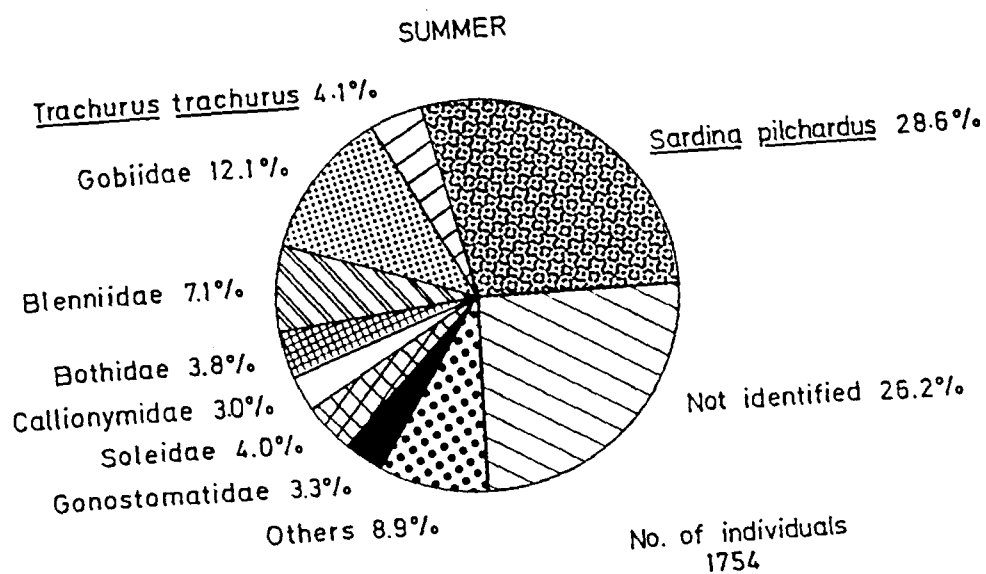


Figure 2 - Percentual abundance of fish larvae.

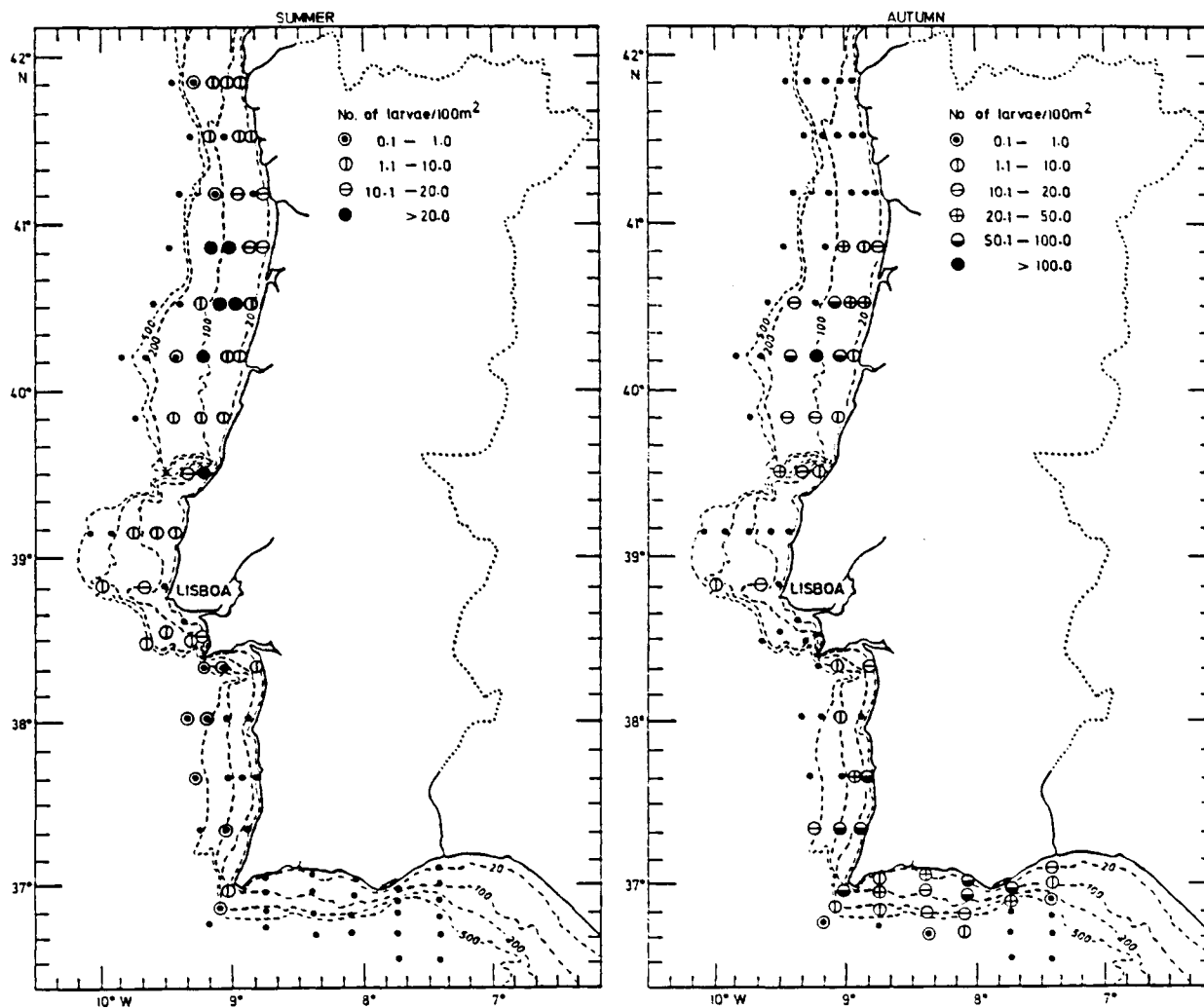


Figure 3 - Geographical distribution and abundance of sardine larvae/100m².

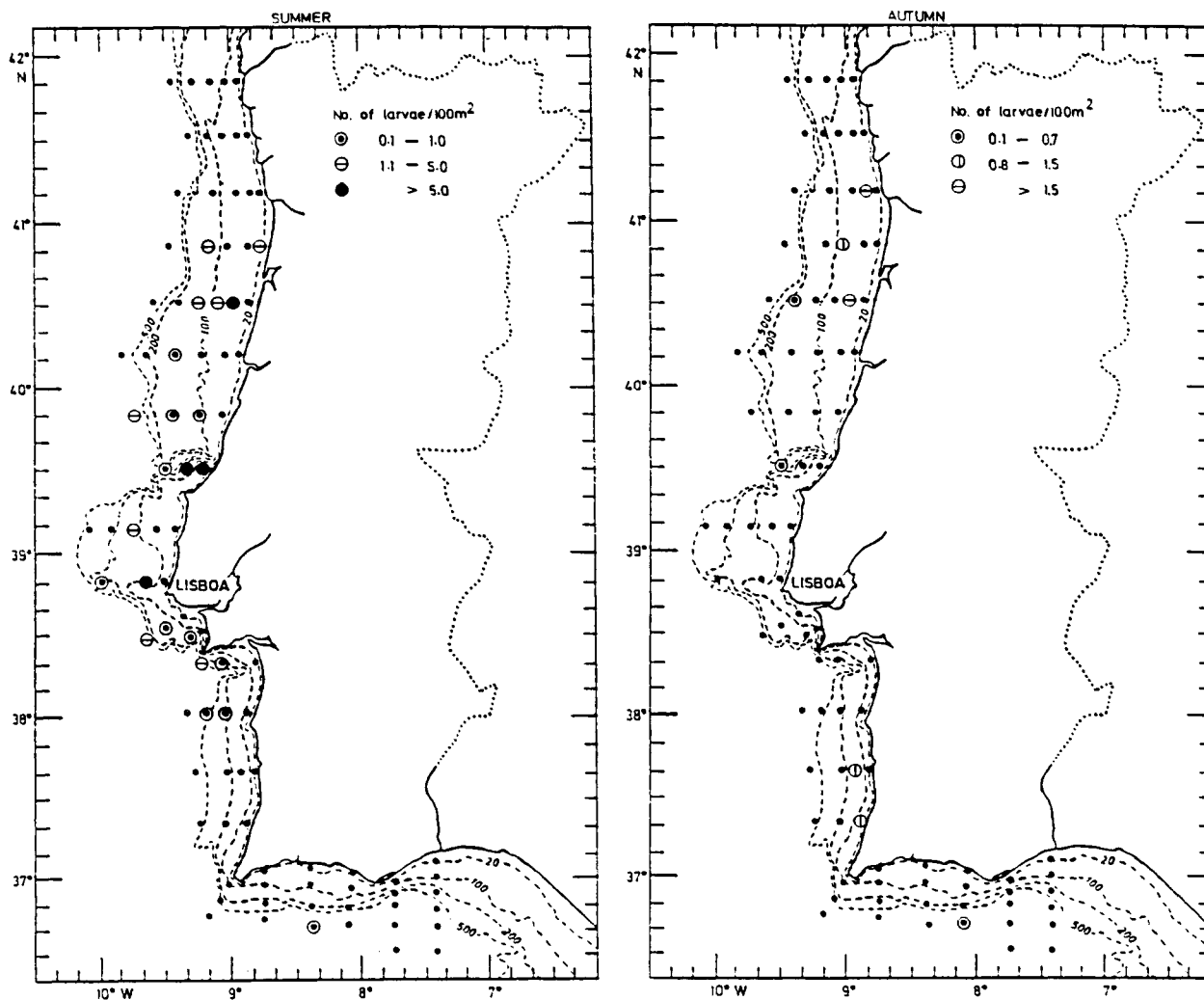


Figure 4 - Geographical distribution and abundance of horse mackerel larvae/100m².