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Distribution and abundance of teleostean eggs and larvae on the NW coast of Spain

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ABSTRACT: Monthly ichthyoplankton cruises were made over 3 annual cycles in the Ria of Vigo (Galician coasts, NW Spain). A total of 43395 teleostean eggs belonging to 14 families and 7058 larvae of 21 families were collected. The largest densities of eggs were found during winter and spring, whereas the greatest numbers of larvae were collected during spring and summer. Eggs and larvae were found all over the ria, although most of the species were most abundant in the outer area of the ria. The Ria of Vigo appears to be a major spawning ground for many of the species recorded.

INTRODUCTION

The abundance and composition of ichthyoplankton off the coasts and rias of Galicia (NW Spain) has received little attention. Lopez-Jamar (1977) described the annual cycle of ichthyoplankton in the Ria of Arosa, sampling every 3 mo. Lopez-Veiga (1977) reported data for *Sardina pilchardus* and *Sprattus sprattus* in the Ria of Vigo, but not for a full annual cycle, and Ferreiro & Labarta (1984) studied the annual cycles of 3 species – *S. pilchardus, S. sprattus* and *Engraulis encrasicholus* – in the Ria of Vigo. Data on the ichthyoplankton collected during a 1 mo cruise from the Galician plateau have also been published (Martin 1982, Sola & Franco 1984).

Extensive ichthyoplankton studies have been undertaken close to Galicia by Arbault & Lacroix-Boutin (1968, 1969, 1971, 1974) in the Bay of Biscay, Dicenta et al. (1977) and Villegas (1979) in the Cantabrian Sea (off the N coast of Spain), and by Re (1979a, b, 1981, 1984) and Re et al. (1982, 1983) off the Portuguese coasts.

In the present work the composition, spawning seasons, spatial distribution and annual abundances of the most important ichthyoplankton species in the Ria of Vigo were studied over 3 consecutive annual cycles.

SAMPLING AREA

The name 'Rias Bajas' is applied to a series of 4 estuaries situated on the west coast of Galicia, NW Spain (Fig. 1a).

The Ria of Vigo is the most southernly of these (Fig. 1b). It has a surface area of 176 km^2, a length of 33 km and a water volume of 3.117 $\times$ 10^6 m^3. The depth of the ria varies from 6 m in the inner part (San Simón Inlet) to a maximum of 50 m in the outer area. The mouth of the ria is partially obstructed by the Cies Islands; the northern channel is 2.5 km wide and 23 m deep and the southern channel 5 m wide and 67 m deep. The most important discharge of freshwater to the ria is from the Verdugo River in San Simón Inlet, with a flow rate of 13.6 m^3 s^{-1} (Fraga & Margaleff 1979).

The Galician Rias support an important fishery as well as an intense culture of molluscs. The high primary production in the rias is sustained mainly by the coastal upwelling of North Atlantic Central Water (NACW) which at certain times of year enters the rias (Fraga & Margaleff 1979).

METHODS

The ichthyoplankton of the Ria of Vigo was sampled monthly for 3 consecutive years. There were small variations in the sampling grid from one year to another. On all cruises the ria was divided in 3 areas: inner, central and outer; both northern and southern shores were sampled in each area. The sampling stations visited each year are shown in Fig. 2. During one year, 1983, 4 stations in San Simón Inlet were sampled (Fig. 2d).

The hauls were taken from the RV 'Lampadena' and

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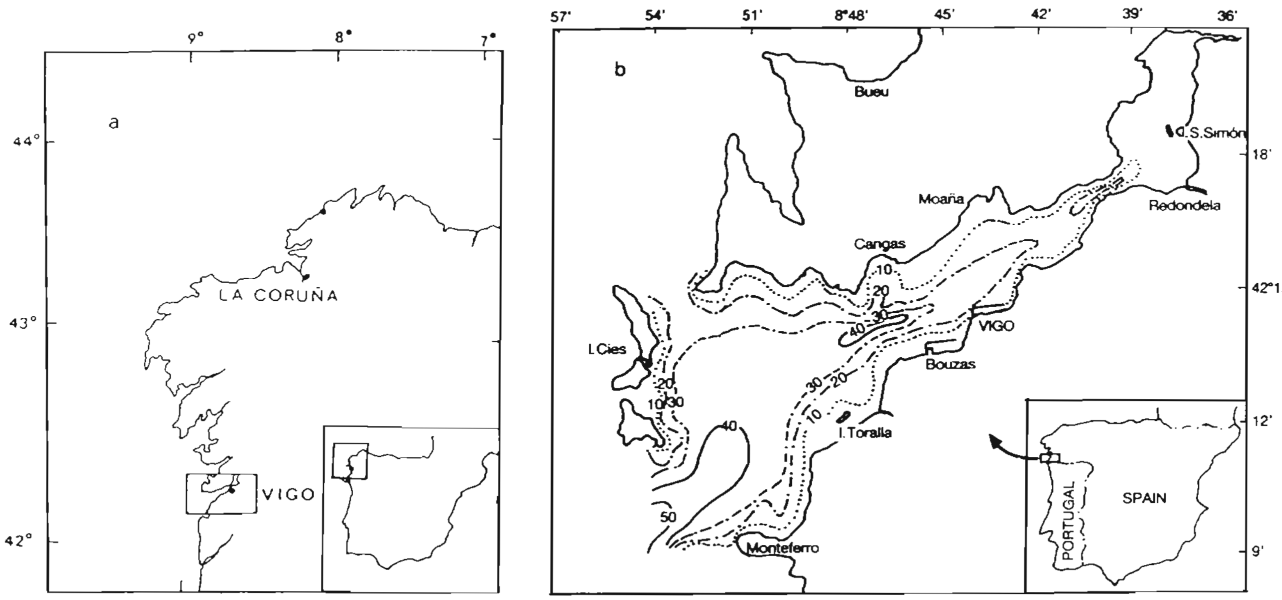


Fig. 1. Maps of the area studied. (a) Galician coasts; (b) Ria of Vigo

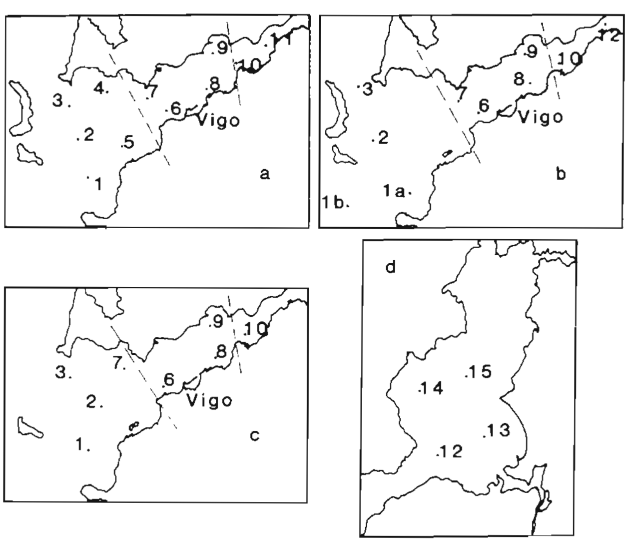


Fig. 2. Grid of stations sampled. (a) September 1979 to October 1980, (b) October 1981 to January 1983, (c) February 1983 to January 1984, (d) San Simón Inlet February 1983 to January 1984. The broken lines indicate the 3 areas (outer, middle and inner) considered

MV 'Zoea' during daylight with an ichthyoplankton Bongo net towed at slow speed (Smith & Richardson 1977, Posgay & Marak 1980). Samples taken in 1979–80 were sampled with a Bongo with a PVC frame, 20.3 cm mouth diameter, while a stainless steel frame with 24 cm mouth diameter was used in the next 2 yr; in both cases the net had 2 different mesh sizes, 0.30 and 0.50 mm. A 2-way analysis of variance (ANOVA) for paired data applied to the number of eggs and larvae collected monthly indicated that in the case of eggs there was no significant difference between the 2 size meshes ($p > 0.05$), except for the 1981–82 cruise ($0.05 > p > 0.01$, Table 1); consequently we decided to estimate the abundance of eggs in each haul as the mean of the number found with each mesh. The 0.30 mm mesh was used to estimate the larvae, as the 0.50 mm mesh significantly underestimated these ($p < 0.001$, Table 2).

The average volume of water filtered at each surveyed station was measured with a General Oceanics 2030 flowmeter provided with a standard rotor in the small Bongo and with a slow flux rotor in the large

Table 1. Results of ANOVA applied to pelagic fish eggs collected with 2 meshes (300 and 500 µm). * Significant at $p < 0.05$; ** significant at $p < 0.01$; *** significant at $p < 0.001$; ns: not significant

Source of variation	1979–80				1981–82				1983				1983 San Simón			
	df	SS	MS	F_s	df	SS	MS	F_s	df	SS	MS	F_s	df	SS	MS	F_s
Factor 1 (meshes)	1	0.61	0.61	2.17 ns	1	0.86	0.86	6.71*	1	0.10	0.10	1.25 ns	1	0.08	0.08	3.13 ns
Factor 2 (months)	54	83.74	1.55	5.55***	125	196.06	1.57	12.18**	88	264.82	3.01	39.19***	38	58.37	1.54	61.69***
Error	54	15.10	0.28		125	16.10	0.13		88	6.76	0.08		38	0.95	0.02	

Table 2. Results of ANOVA applied to fish larvae collected with 2 meshes (300 and 500 μm). * Significant at $p < 0.05$; ** significant at $p < 0.01$; *** significant at $p < 0.001$; ns: not significant

Source of variation	1979-80 df	SS	MS	F_s	1981-82 df	SS	MS	F_s	1983 df	SS	MS	F_s	1983 San Simón df	SS	MS	F_s
Factor 1 (meshes)	1	3.10	3.10	21.27***	1	5.88	5.88	19.86***	1	12.17	12.17	52.26***	1	4.65	4.65	38.30***
Factor 2 (months)	54	52.35	0.97	6.66***	125	107.57	0.86	2.90***	87	132.82	1.53	6.55***	38	18.52	0.49	4.02***
Error	54	7.86	0.15		125	37.05	0.30		87	20.27	0.23		38	4.61	0.12	

Bongo. The hauls were of 4 min duration and the net was towed obliquely at 2 kn from the bottom to the surface. In San Simón Inlet double oblique hauls could not be made because of the shallow water, and surface hauls were taken. The samples were preserved on board using 4 % formalin buffered with borax.

At each sampling station vertical profiles of temperature were measured with a Wallace and Tiernan bathythermograph, and salinity was analyzed in water samples taken at 0, 5, 10, 20, 30, 40 and 50 m depth. The transparency of the water was measured with a 30 cm diameter Secchi disk.

All fish eggs and larvae were removed from the samples, identified, and measured in the laboratory under a Nikon SMZ stereoscopic microscope provided with diascopic light. Numeric data were transformed to standard units, numbers per 10 m^2 of sea surface (Ahlstrom 1973, Tanaka 1973).

RESULTS

Ichthyoplankton species composition

A total of 43395 fish eggs belonging to 14 families (22 species) were collected over the 3 yr (Table 3). One family, Clupeidae, represented by 2 species, *Sprattus sprattus* (44.14 %) and *Sardina pilchardus* (11.8 %), dominated in all 3 yr. Flounder *Platichthys flesus* (13.96 %), and *Callionymus lyra* (7.47 %), followed in abundance. These 4 species represented 77.37 % of the captures. Because of problems in the identification of early developmental stages of eggs with similar characteristics of egg diameter, viteline structure and number and diameter of oil globules (Ferreiro 1986) the eggs of *Trachinus draco, Zeugopterus punctatus* and all members of the family Sparidae were grouped as 'Group 1 eggs', and those of rockling species (*Ciliata mustela, Gaidropsarus vulgaris* and *G. mediterraneus*) and *Trachurus trachurus* were grouped as 'Group 2 eggs'.

A total of 7058 fish larvae belonging to 21 families (49 species) were captured in the ria (Table 4). The Gobiidae contributed to 65.33 % of the larvae; 6 species of this family were found although only 3 of them were numerically important. We found difficulty in identifying Gobiidae larvae to species level because larvae of this family are very similar (Russell 1976), and those collected were quite small (Ferreiro 1986). All the larvae collected in the ria have already been described (Ferreiro 1986). *Gobius* sp. A can be assigned to *Leusuerogobius friessi* or *Deltentosteus quadrimaculatus; Gobius* sp. B may be *Gobius niger, Gobius flavescens* or *Pomatochistus minutus; Gobius* sp. C is similar to *Pomatochistus microps* larvae as described in the literature; *Gobius* sp. D could not be attributed to any of the larvae described in previous papers and are thought to be *L. friessi, D. quadrimaculatus* or *Gobius auratus* – 3 species present on the Galician coasts and whose larvae have not been described. *Gobius* sp. E and *Gobius* sp. F were very scarce and could not be identified. Other taxonomic groups included Clupeidae (10.66 %), Callionymidae (5.16 %), Pleuronectidae (4.16 %), Blenniidae (4.08 %), Labridae (4.52 %) and Ammodytidae (2.74 %). These families constituted 96.65 % of the total larvae captured in the ria. Larvae of the family Sparidae (0.23 % of the total number of larvae collected) are presented in Table 4 as Sparidae sp. A and Sparidae sp. B. It was not possible with the data available in the literature to identify these larvae more accurately.

Spawning season of the principal species

From Fig. 3 it can be seen that the largest densities of eggs were found between January and May. In the case of larvae (Fig. 4) the greatest densities appeared in summer. In 1983 the pattern of eggs and larvae abundance seems to be a little different from the pattern found in the 2 previous years; in these years egg density decreased sharply in April and larvae were most abundant from February to May. Fig. 3c shows that in 1983, unlike in previous years, there was a sudden decrease in salinity from 35.316 ‰ in March to 32.133 ‰ in April, and this decrease could be related to the low egg densities found in that year in April and the following months.

As many of the species collected were represented by a small number of eggs or larvae, and their abundances are thus very sensitive to sampling errors, we

Table 3. Numbers (N) of pelagic fish eggs collected in the Ría of Vigo from September 1979 to January 1984

Family, species	1979–80 (137 hauls)		1981–82 (128 hauls)		1983 (88 hauls)		San Simón 1983–1984 (44 hauls)		Total	
	N	%	N	%	N	%	N	%	N	%
CLUPEIDAE										
Sardina pilchardus	534	4.28	1335	9.24	3249	21.30	14	1.14	5 132	11.80
Sprattus sprattus	5228	41.91	6395	44.28	7356	48.23	177	14.46	19 156	44.14
ENGRAULIDAE										
Engraulis encrasicholus	384	3.08	420	2.91	19	0.12	2	0.16	825	1.90
CALLIONYMIDAE										
Callionymus lyra	1259	10.09	1130	7.82	784	5.14	68	5.56	3 241	7.47
GADIDAE										
Trisopterus luscus	172	1.38	211	1.46	393	2.58	2	0.16	778	1.79
Rockling (*Ciliata mustela, Gaidropsarus vulgaris, C. mediterraneus*)	462	3.70	737	5.10	1158	7.59	243	19.85	2 600	5.99
CARANGIDAE										
Trachurus trachurus	111	0.89	66	0.46	5	0.03	0	–	182	0.42
LABRIDAE										
Ctenolabrus rupestris	581	4.66	662	4.58	205	1.34	35	2.86	1 483	3.42
TRACHINIDAE										
Trachinus draco	9	0.07	9	0.06	6	0.14	0		24	0.06
Trachinus vipera	43	0.34	37	0.26	28	0.18	0		108	0.25
CARAPIDAE										
Echiodon drummondi	0		0		2		0		2	0.005
TRIGLIDAE	19	0.15	40	0.28	39	0.26	0		98	0.23
SCOPHTHALIMIDAE										
Zeugopterus punctatus	–		–		2		–		2	0.005
BOTHIDAE										
Arnoglossus laterna	400	3.21	684	4.77	279	1.83	7	0.57	1 370	3.16
PLEURONECTIDAE										
Platichthys flesus	2198	17.62	1860	12.88	1386	9.09	614	50.16	6 058	13.96
SOLEIDAE										
Solea senegalensis	10	0.8	7	0.05	10	0.07	0		27	0.06
Solea vulgaris	0		3	0.02	4	0.03	0		7	0.02
Buglossidium luteum	74	0.59	149	1.03	10	0.07	53	4.33	286	0.66
Solea lascaris	13	0.10	12	0.83	7	0.05	0		32	0.07
Microchirus variegatus	7	0.06	12	0.83	3	0.02	0		22	0.05
Soleido sp.	3	0.02	2	0.01	2	0.01	0		7	0.02
Group 1 (*Trachinus draco, Zeugopterus punctatus,* F. Sparidae)	249	2.00	426	2.95	185	1.21	6	0.49	866	2.00
Group 2 *Trachurus trachurus*	680	5.45	221	1.53	115	0.75	0		1 016	2.34
Not identified	40	0.32	21	0.15	10	0.06	3	0.25	74	0.17
Total	12 474		14 439		15 258		1224		43 395	

will analyse the spawning season only for the more abundant species.

Figs. 5 and 6 show the spawning seasons of these species. Spawning of most of them takes place during winter and spring, although it continues into summer for many species. During the autumn, eggs of sprat *Sprattus sprattus*, sardine *Sardina pilchardus* and rocklings *Ciliata mustela, Gaidropsarus vulgaris* and *G. mediterraneus* begin to appear in the plankton; these species, with the flounder *Platichthys flesus*, which does not begin to spawn until January, and the species of the family Ammodytidae, finish their spawning sea-

Table 4. Numbers of pelagic fish larvae collected in the Ria of Vigo from September 1979 to January 1984

Family, species	1979–80		1981–82		1983		San Simón 1983–1984		Total	
	N.	%	N	%	N	%	N	%	N	%
CLUPEIDAE										
Sardina pilchardus *Sprattus sprattus*	93	4.15	263	13.46	412	17.68	14	2.82	782	11.08
CALLIONYMIDAE										
Callionymus lyra	40	1.78	47	2.41	144	6.18	1	0.20	232	3.29
BELONIDAE										
Belone belone	0		0		0		1	0.20	1	0.01
SYNGNATHIDAE										
Enterulus aequoreus	3	0.13	9	0.46	3	0.13	1	0.20	16	0.23
Nerophris lumbriciformis	0		1	0.04	0	0.04	0		1	0.01
Syngnatus acus	0		0		1		1	0.20	2	0.03
Syngnatus rostellatus	0		0		0		1	0.20	1	0.01
GADIDAE										
Trisopterus luscus	0		0		2	0.09	0		2	0.03
Rockling (*Ciliata mustela, Gaidropsarus vulgaris, G. mediterraneus*)	0		8	0.41	4	0.17	0		12	0.17
Raniceps raninus	2	0.09	0		0		0		2	0.03
CARANGIDAE										
Trachurus trachurus	0		0		1		0		1	0.01
SPARIDAE										
Sparidae sp. A	1	0.04	2	0.10	2	0.09	0		5	0.07
Sparidae sp. B	4	0.18	0		1	0.04	0		5	0.07
Sparidae sp.	0		0		6	0.26	0		6	0.09
LABRIDAE										
Symphodus melops	71	3.17	179	9.16	17	0.73	29	5.84	296	4.19
Ctenolabrus rupestris	10	0.45	14	0.72	3	0.13	1	0.20	28	0.40
Labridae sp.	4	0.18	4	0.20	0		15	3.02	23	0.33
AMMODYTHIDAE										
Hyperoplus lanceolatus	6	0.27	0		7	0.30	0		13	0.18
Ammodytes tobianus	63	2.81	0		22	0.94	0		85	1.20
Gymnammodytes semi-squamatus	0		11	0.56	14	0.60	0		25	0.35
Ammodytidae sp.	27	1.20	52	2.66	18	0.77	0		97	1.37
TRACHINIDAE										
Trachinus draco	0	0.13	0		1	0.04	0		1	0.01
Trachinus vipera	3		0		1	0.04	0		4	0.06
GOBIIDAE										
Gobius sp. A	378	16.85	214	10.95	991	42.53	5	1.01	1588	22.50
Gobius sp. B	1161	51.76	648	33.16	118	5.06	109	21.93	2036	28.85
Gobius sp. C	90	4.01	185	9.47	338	14.51	292	28.75	905	12.82
Gobius sp. D	7	0.31	16	0.82	17	0.73	1	0.20	41	0.58
Gobius sp. E	0		0		0		2	0.40	2	0.03
Gobius sp. F	0		0		0		1	0.20	1	0.01
Gobius sp.	4	0.18	8	0.41	21	0.90	5	1.01	38	0.54
BLENNIIDAE										
Blennius gattorugine	152	6.78	66	3.38	24	1.03	6	1.21	248	3.51
Blennius ocellaris	11	0.49	15	0.77	6	0.26	0		32	0.45
Blennius pholis	1	0.04	6	0.31	2	0.09	0		9	0.13
Coryphoblennius galerita	3	0.13	5	0.26	2	0.09	0		10	0.14
Coryphoblennius sp.	7	0.31	16	0.81	10	0.43	0		33	0.47
Blennius sp. A	1	0.04	2	0.10	1	0.04	0		4	0.06
Blennius sp. B	11	0.49	11	0.56	6	0.26	3	0.60	31	0.44
Blennius sp. C	0		1	0.05	0		0		1	0.01

Table 4 (continued)

Family, species	1979–80		1981–82		1983		San Simón 1983–1984		Total	
	N	%	N	%	N	%	N	%	N	%
CARAPIDAE										
Echiodon drummondi	0		0		2	0.09	0		2	0.03
ATHERINIDAE										
Atherina presbyter	21	0.94	6	0.31	5	0.21	4	0.80	36	0.51
COTIIDAE										
Taurulus bubalis	1	0.04	6	0.31	2	0.09	0		9	0.13
LIPARIDAE										
Liparis montagni	1	0.04	1	0.05	2	0.09	0		4	0.06
SCOPHTHALMIDAE										
Zeugopterus punctatus	4	0.18	1	0.05	4	0.17	0		9	0.13
PLEURONECTIDAE										
Platichthys flesus	39	1.74	81	4.15	54	2.32	0		174	2.47
SOLEIDAE										
Solea senegalensis	2	0.09	1	0.05	3	0.13	0		6	0.09
Solea vulgaris	1	0.04	1	0.05	1	0.04	0		3	0.04
Buglossidium luteum	1	0.04	0		0		0		1	0.01
Solea lascaris	3	0.13	1	0.05	1	0.04	0		5	0.07
Microchirus variegatus	0		2	0.10	1	0.04	0		3	0.04
GOBIESOCIDAE										
Diplecogaster bimaculata	0		0		0		1	0.20	1	0.01
Not identified	24	1.07	87	4.45	71	3.05	4	0.80	186	2.64
Total	2250		1970		2341		497		7058	

sons in spring (April or May).

By January or February, the eggs of most species are present. This is the case for *Callionymus lyra, Trisopterus luscus, Arnoglossus laterna, Trachinus vipera, Buglossidium luteum, Zeugopterus punctatus,* Sparidae and *Trachinus draco;* the larvae of species with demersal eggs like *Blennius gattorugine, B. ocellaris, Symphodus melops, Gobius* sp. A and *Gobius* sp. B are

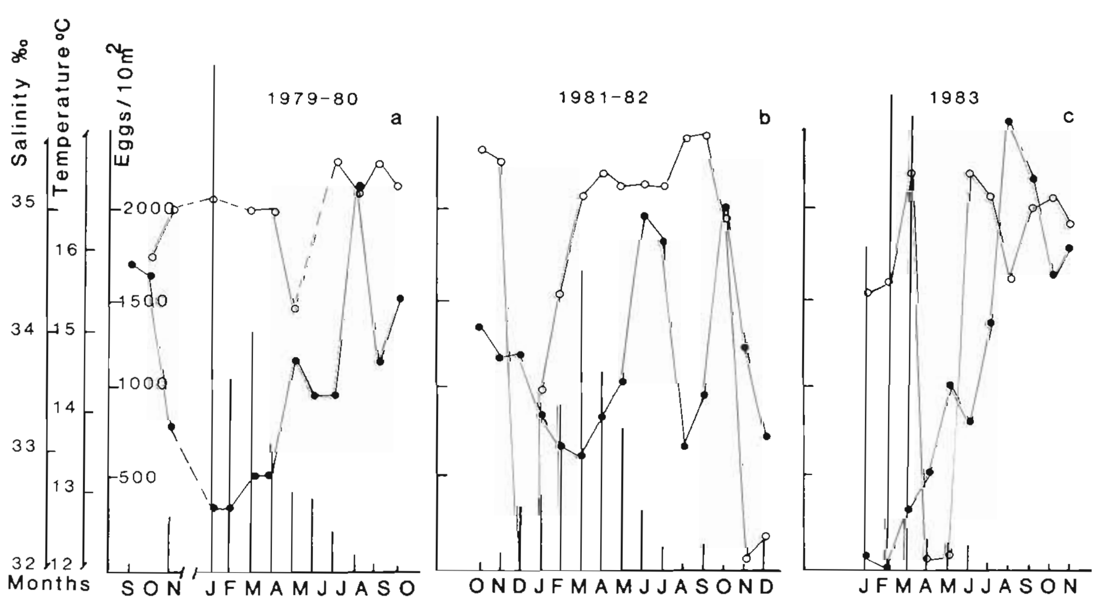


Fig. 3. Monthly egg abundances (vertical lines; mean of numbers collected at each station, expressed as numbers of eggs per 10 m² of sea surface) of pelagic fish eggs during the 3 annual cycles sampled. (●) Mean temperature of the water column; (○) mean salinity of the water column

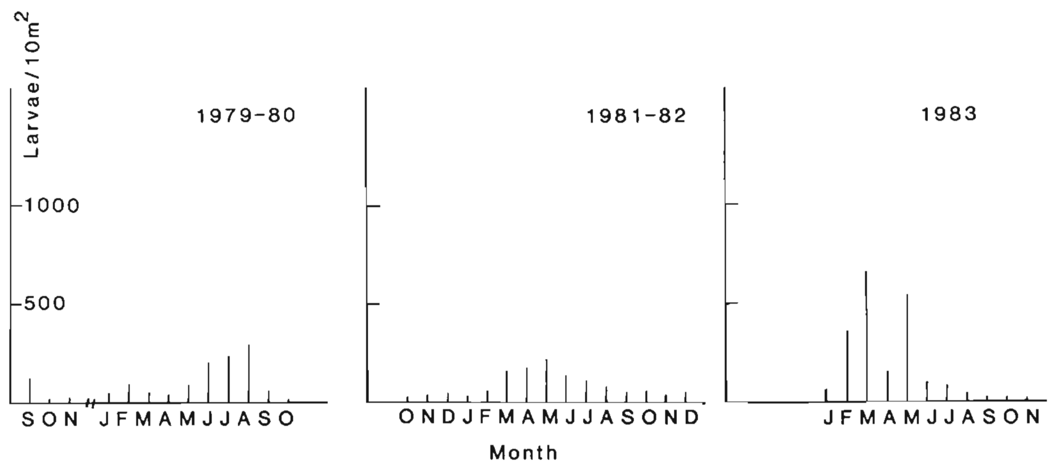


Fig. 4. Monthly larval abundances (mean of numbers collected at each station, expressed as number of larvae per 10 m^2) of fish larvae during the 3 annual cycles studied

also found during this period. All these species have a long spawning season lasting from winter to early summer. Other species, e.g. *Ctenolabrus rupestris* and *Trachurus trachurus*, spawn from April to July, and *Gobius* sp. C and *Gobius* sp. D spawn all through the year. *Engraulis encrasicholus* is the only species among those found in the ria that spawns in summer, its spawning peak being during July and August.

The abundance of eggs and larvae of each species show small variations among annual cycles. These fluctuations are, however, remarkably large in the case of sardine, *Sardina pilchardus* to the point that there is 1 yr with 2 spawnings, one in autumn and another in spring, while during the other 2 yr the autumn peak is not present; the time of maximum egg abundance fluctuates between March to May and January to March. Most of the species have fairly constant annual cycles although there are lags in the start of the spawn-

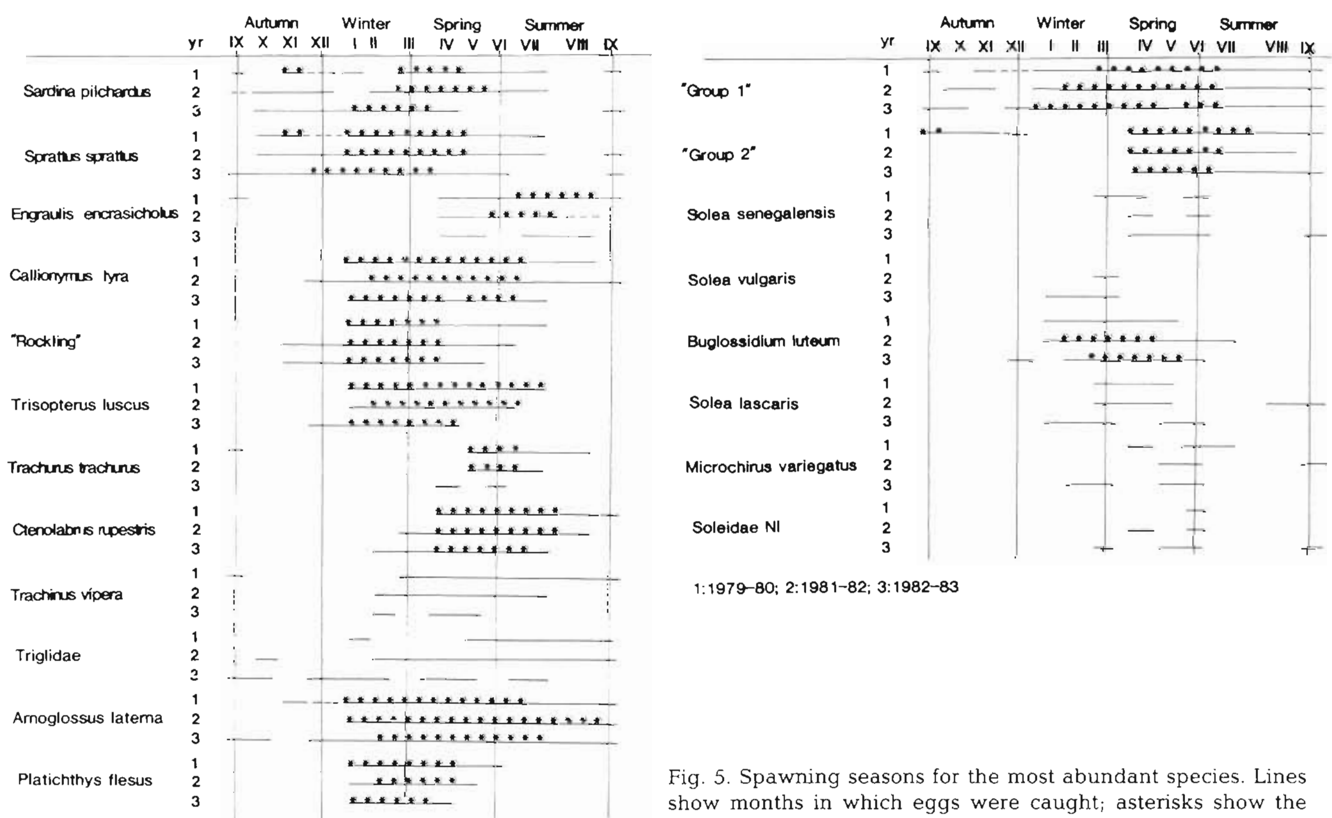


Fig. 5. Spawning seasons for the most abundant species. Lines show months in which eggs were caught; asterisks show the months of highest density

ing as well as between the spawning peaks in the 3 different sampling cycles (Figs. 5 and 6).

Spatial distribution

Figs. 7 and 8 show the spatial distribution of eggs and larvae in the ria. We divided the ria into 3 areas: outer, middle and inner (Fig. 2).

Eggs of *Sardina pilchardus, Trisopterus luscus, Arnoglossus laterna, Ctenolabrus rupestris, Callionymus lyra*, Triglidae, Group 1 and Group 2, and larvae of *C. lyra* and Ammodytidae, were most abundant in the outer ria; *Trachurus trachurus* and *Trachinus vipera* eggs, and Clupeidae, *Blennius gattorugine* and *Gobius* sp. D larvae had their greatest densities in the outer and central areas. The central area was particularly abundant in eggs of *Sprattus sprattus* and larvae of *Gobius* sp. A and *Blennius ocellaris,* and in the central and inner zones *Gobius* sp. B was most abundant. In the inner area of the ria *Buglossidium luteum* and *Engraulis encrasicholus* eggs had their greatest numbers. Eggs of *Platichthys flesus* and rockling, and larvae of *Gobius* sp. C, *Symphodus melops* and *P. flesus,* were quite ubiquitous in the ria. *P. flesus* eggs showed a positive density gradient from the outer to the inner area.

Table 5 summarizes these results. The greatest densities of most of the species were found in the outer area of the ria, while the only species which prefered the inner area were *Buglossidium luteum, Engraulis encrasicholus* and *Platichthys flesus.*

DISCUSSION

If we compare our results with literature data on eggs and larvae collected on the Atlantic coasts from Plymouth to Portugal (Arbault & Lacroix-Boutin 1968, 1969, Russell 1976, 1980, Martin 1982, Re et al. 1982, 1983) we find that the species collected in the ria are mostly the same ones as those previously found. There are some differences based on the fact that other authors sampled deeper waters; species like *Merluccius merluccius, Merlangius merlangus, Pollachius virens, Maurolicus pennati, Stomias ferox, Myctophum punctatum* and some others found in Plymouth waters, in the Cantabrian Sea and/or Galician shelf were not found in the ria. On the other hand, our results correspond with those of Lopez-Jamar (1977) in the Ria of Arosa (another Galician estuary) and Re (1979a, b, 1984) in 2 Portuguese estuaries.

In the Ria of Vigo the largest egg densities for most of the species were found during winter and spring while most larvae were collected during spring and summer; the larvae hatched therefore during the period when the upwelling of NACW enriched the water with nutrients. NACW normally occurs in the ria during spring and summer (Fraga & Margaleff 1979) and provides adequate food conditions when the larvae begin their exogenous feeding.

Eggs and larvae of most of the species were found in all parts of the ria. However, differences in abundance among the different areas occur and most of the species are more abundant in the outer area. This preference towards spawning in the outer and central areas could be related to local hydrographic conditions because it is in these areas that the upwelling of nutrient-rich NACW is most intrusive, while in the inner area environmental conditions, particularly salinity, are more variable (Fraga & Margaleff 1979).

For many of the species collected the presence of eggs more or less equally abundant all over the ria, as well as the presence of mature adults of some species in the same areas and seasons where the eggs were collected (Guerra et al. 1986), indicated that these species have a main spawning area in the Ria of Vigo. This is the case for *Sprattus sprattus, Callionymus lyra, Engraulis encrasicholus,* rocklings, *Ctenolabrus rupestris, Arnoglossus laterna, Trachinus vipera, Platichthys flesus* and *Buglossidium luteum,* among the species

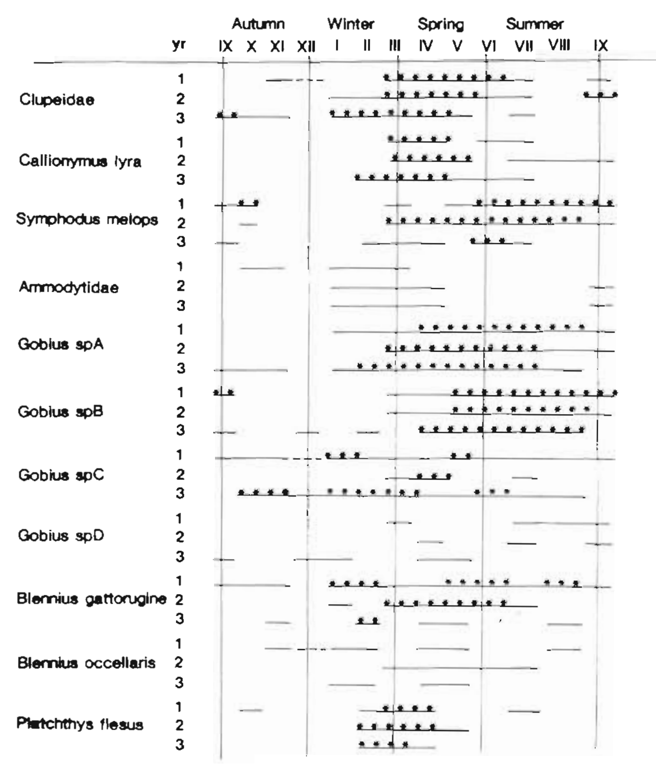


Fig. 6. Seasonal appearance in the plankton of the larvae of the different species. Lines show months in which larvae were caught; asterisks show the months of highest density

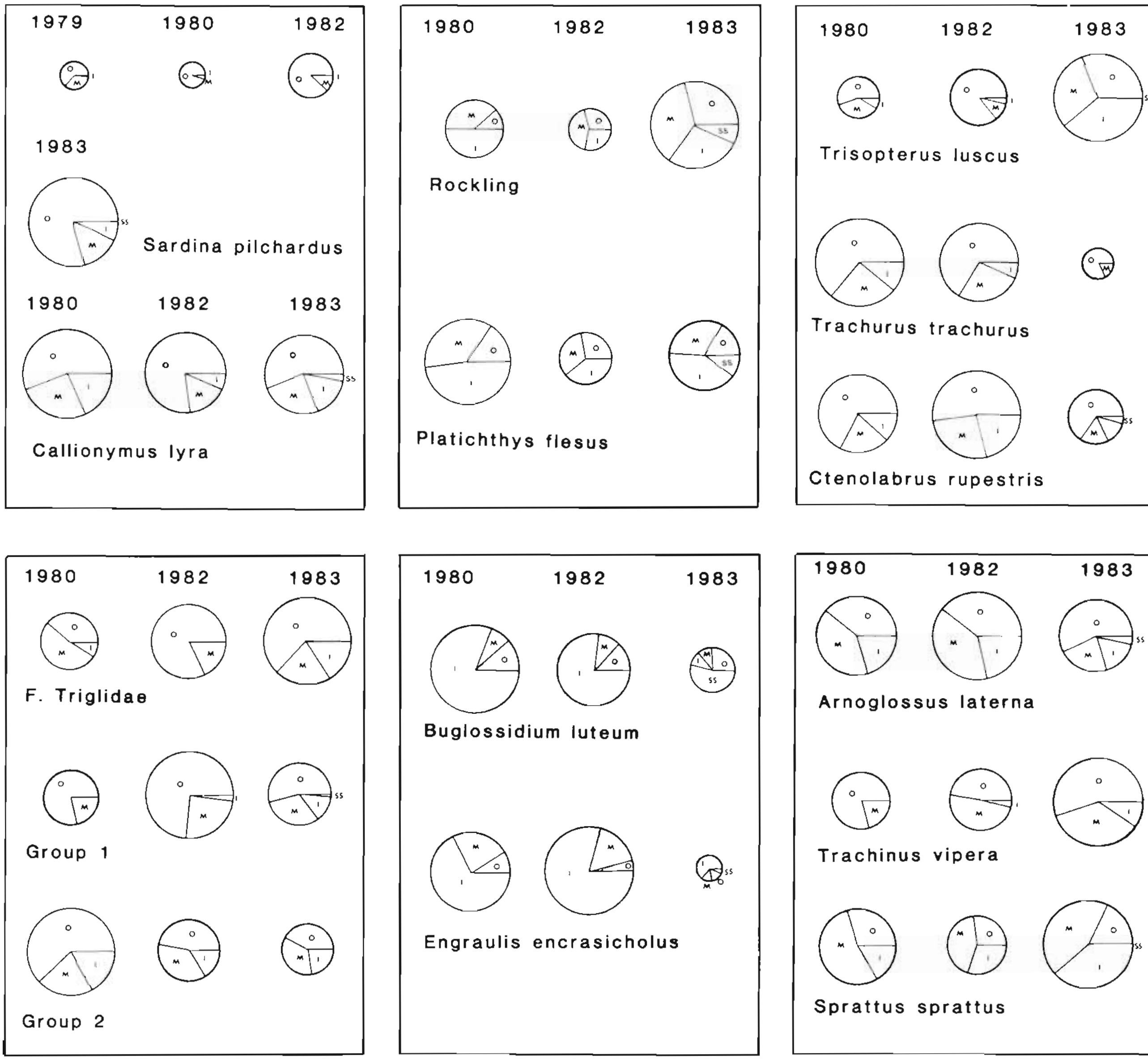


Fig. 7. Relative egg abundances (mean of numbers collected in each area), in the outer (O), middle (M) and inner (I) areas of the ria as well as in San Simón Inlet (SS) for the more abundant species. The area of the circle for each species is proportional to the relative abundance of that species in that year

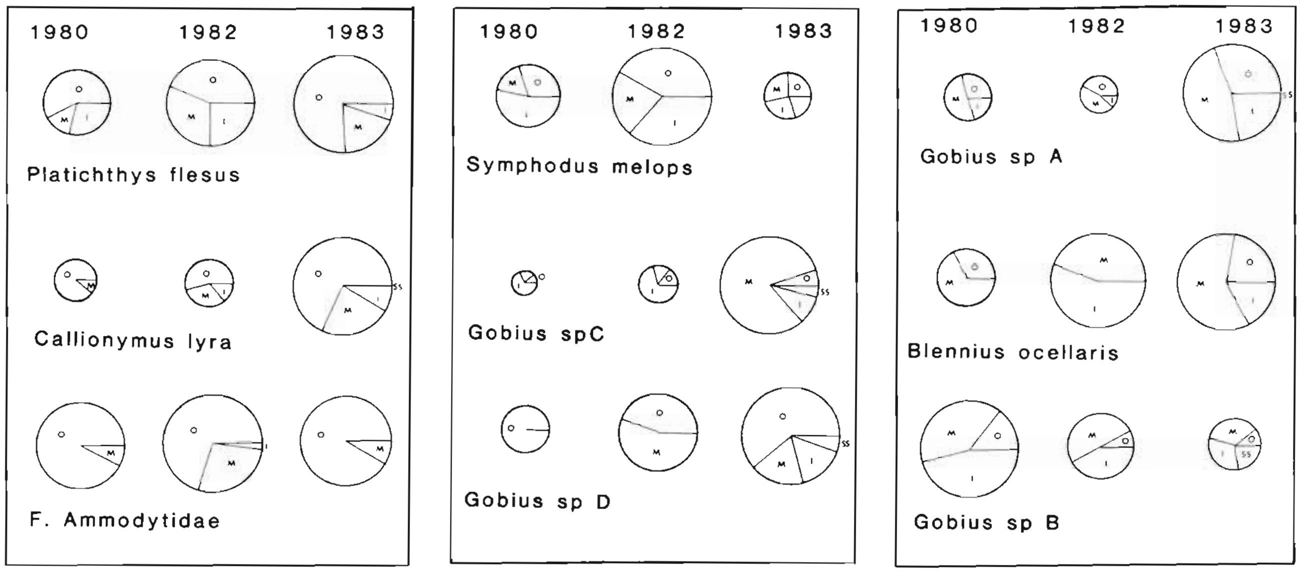
with pelagic eggs, and for species of the families Gobiidae, Blenniidae and Labridae among those with demersal eggs.

The low number of captures for *Trisopterus luscus, Echiodon drummondi, Trachurus trachurus* and Triglidae prevents elucidation of the role of the ria as spawning area for these species although we suspect that the ria is not their main spawning area.

The taxonomical difficulties that the eggs of Group 1 (*Trachinus draco, Zeugopterus punctatus* and the family Sparidae) present prevented calculation of their specific abundance. We can, however, conclude that one or more of them have their spawning area in the ria.

The eggs of species of the family Soleidae, except *Buglossidium luteum*, were scarce in our samples. It may well be that the sampling grid was not suitable for the capture of their eggs, a problem that may have also affected catches of Scophthalmidae. Species of both families are demersal inhabiting sandy shallow areas near the tide level. A more exhaustive sampling grid in the areas where adults are found would be necessary in order to establish their spawning zones.

With the exception of the larvae of 2 families,



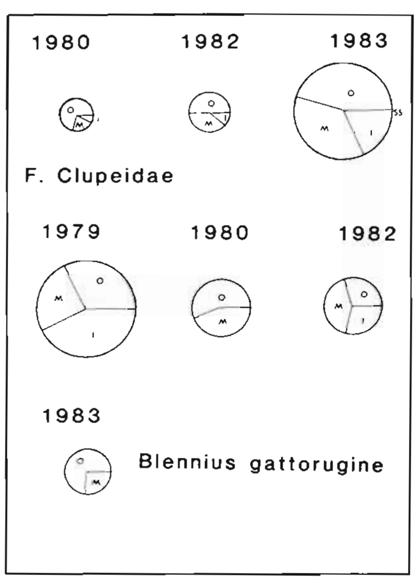


Fig. 8. Relative larval abundances (mean of numbers collected in each area) for the more abundant species in the outer (O), middle (M) and inner (I) areas of the ria

Gobiidae and Labridae, the numbers of fish larvae caught in the ria were very low. Since we found eggs of many species in high densities, we deduce that the sampling device used was not a good sampler for fish larvae. In the case of older larvae, migration from the spawning areas towards nursery areas inside or outside the ria is also possible.

Although studies dealing with the problem are not in complete agreement, evidence for net avoidance has been found in about three-quarters of the reports on fish larvae (Clutter & Anraku 1968) and many authors found more larvae, mainly in the case of larger larvae, when using larger samplers and high speed hauls (Ahlstrom 1958, Arnold 1958, Colton et al. 1961, 1962).

Table 5. Fish eggs and larvae distribution in the different strata of the Ría de Vigo

All over the ría	Outer strata	Outer and middle strata	Middle strata	Middle and inner strata	Inner strata
		Eggs			
Platichthys flesus Rockling	*Sardina pilchardus* *Callionymus lyra* *Trisopterus luscus* *Ctenolabrus ruspestris* *Trachurus trachurus* Triglidae Group 1 Group 2	*Arnoglosus laterna* *Trachinus vipera*	*Sprattus sprattus*		*Buglossidium luteum* *Engraulis encrasicholus*
		Larvae			
Gobius sp. C *Symphodus melops* *Platichthys flesus*	*Callionymur lyra* Ammodytidae	Clupeidae *Blennius gattorugine* *Gobius* sp. D	*Gobius* sp. A *Blennius ocellaris*	*Gobius* sp. B	

The larval sampling problems make it difficult to evaluate the role of the ria as a spawning area for the species with demersal eggs. Except for the families already mentioned, the number of larvae collected was very small; however, it seems reasonable to assume that those species whose larvae were collected in a constant fashion did spawn in the ria; this is the case for species of the families Gobiidae, Labridae, Blenniidae, Syngnathidae, Ammodytidae, Atherinidae, Cottidae and Liparidae.

The same sampling difficulties make it difficult to evaluate larval abundance in the studied area. Our data indicates that the larval development of many species takes place in the ria. The relative importance of the ria as a nursery area remains unresolved.

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