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## THE GLASS EEL FISHERY AND THE BY-CATCH IN THE RIO MINHO AFTER ONE DECADE (1981-1982 and 1991-1992)

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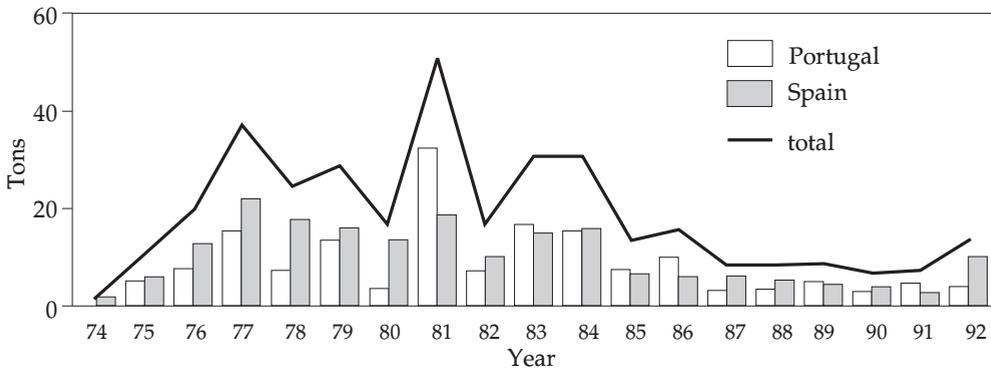
**ABSTRACT.** The results of an experimental glass eel fishery in the international Rio Minho, which took place over twelve months between November 1981 and November 1982, are compared with the data of the same period one decade later. Official statistics of the professional glass eel fishery, seasonal occurrence, mean length and weight of the glass eels are discussed. The by-catch and its biomass is determined in relation to duration of fishing, weight of captured glass eels and the official fishing season. The causes of mortality are briefly mentioned.

Key words: GLASS EEL, FISHERY, BY-CATCH, RIO MINHO

### INTRODUCTION

The Rio Minho which constitutes over 80 km the northern boundary between Portugal and Spain has become one of the most important glass eel fisheries on the Iberian Peninsula over the last two decades. The professional fishery operates at night, around the period of the new moon using anchored hamen nets (local name „tela”) on flood tides, during the months from November to April as described by Weber (1986). The glass eels and the by-catch are scooped out of the net onto a sieve with a mesh size of 4-5 mm. The glass eels pass through leaving behind the by-catch. A considerable proportion of the aquatic organisms dies on the sieve due to prolonged exposure to air or to physical injury. The glass eels are exported to Spain for human consumption.

The reduction of the official yield during the last decade led to this investigation, which compares the results of two experimental fisheries in the lower course of the Rio Minho during 1981/82 and ten years later in 1991/92.



## MATERIAL AND METHODS

In both periods the experimental glass eel fishery was carried out at a station situated 18.7 km upstream from the river mouth. Samples were taken monthly at the new moon, over a period of twelve months from November to November in 1981/82 and again in 1991/92. A commonly used hamen net (length of floatlines 2 x 10 m, height 8 m, leadline 15 m, net end 0.8 m, mesh size 1-2 mm) was anchored in the current at the beginning of the flood tide.

The glass eels were weighed alive on return to the laboratory, the results being expressed in terms of weight per hour of fishing (g/h). Mean length and weight of the glass eels were based on monthly subsamples of 50 individuals in 1981/82 and on 200 in 1991/92.

The catch was preserved in 4% buffered formalin and weighed later. It is expressed in weight per hour of fishing (including glass eels, g/h), while the by-catch is expressed in g per kg of captured glass eels (g/kg).

## RESULTS

According to the official glass eel statistics of Portugal and Spain between 1975/76 and 1983/84, the yield was always greater than 15 tons, showing a distinct maximum of 50 tons in 1980/81. Thereafter a considerable decrease down to 6 tons in 1989/90 was recorded. In 1991/92 Spanish fishermen caught 9.8 tons equalling their

TABLE 1

Official statistics of glass eel fishery (tons) from Portugal and Spain

Year	Portugal	Spain	Total
1973/74	0.05	1.6	1.65
1974/75	5	5.6	10.6
1975/76	7.5	12.5	20.0
1976/77	15	21.6	36.6
1977/78	7	17.3	24.3
1978/79	13	15.4	28.4
1979/80	3.3	13	16.3
1980/81	32.0	18.0	50.0
1981/82	6.7	9.7	16.4
1982/83	16.1	14.4	30.5
1983/84	14.8	15.3	30.1
1984/85	7	6	13
1985/86	9.5	5.5	15
1986/87	2.6	5.6	8.2
1987/88	3	5	8
1988/89	4.5	4	8.5
1989/90	2.5	3.6	6.1
1990/91	4.5	2.4	6.9
1991/92	3.6	9.8	13.4

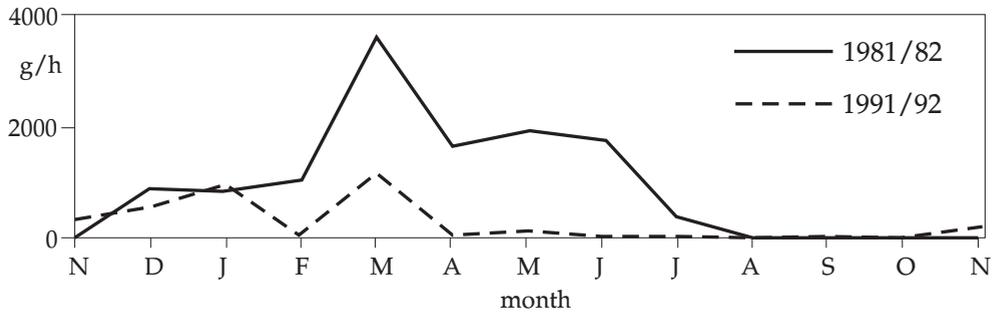
yield of 1981/82, whereas the Portuguese registered only 3.6 tons as against 6.7 tons in 1981/82 (Fig. 1, Table 1).

Comparing the two official fishing seasons of the sampling periods in terms of weight per hour of fishing (g/h), the results showed maxima in March, in 1982 with 3557 g/h and in 1992 with 1140 g/h. The lowest yield was obtained in November 1981 with 317 g/h and one decade later with 25 g/h.

Outside the official fishing seasons a big difference in sample-size became obvious between May and July. From August to October samples were poor and did not differ very much (Fig. 2).

In 1981/82 the mean length of glass eels varied between 6.6 cm and 7.2 cm and one decade later between 6.5 and 6.9 cm. The greatest difference was found in January 1982 with 7.2 cm as opposed to 6.8 cm in 1992 (Fig. 3).

The mean weight of the glass eels in 1981/82 varied from 0.27 to 0.383 g and ten years later from 0.246 to 0.352 g (Fig. 3). The greatest difference was found in August 1982 with 0.383 g as against 0.280 g in 1992 (Fig. 4).



Official statistics of glass eel fishery from Portugal and Spain

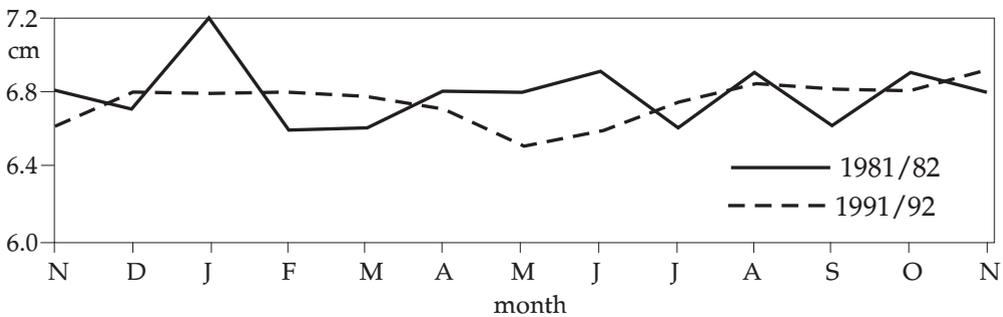


Fig. 2. Yield of the experimental glass eel fishery

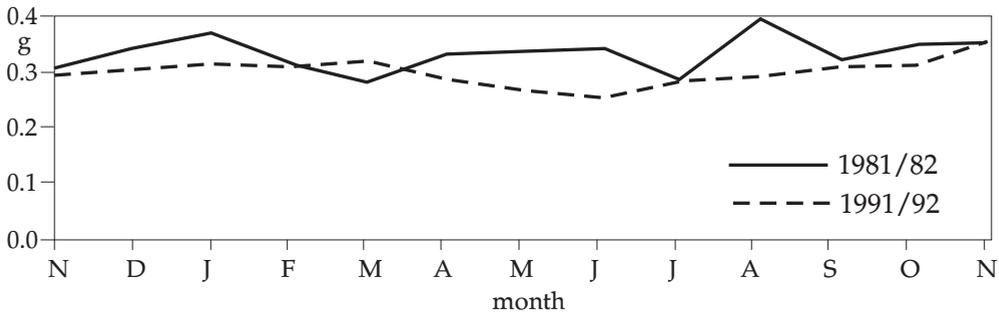


Fig. 3. Mean length of glass eels

With regard to the total catch, the glass eels dominated for the first eight months in 1981/82 after which their importance declined to less than 10%.

Ten years later the glass eels also played a dominant role from November 1991 to July 1992, February excluded, then decreasing to under 10% in August and September 1992.

In 1981/82 the by-catch, in relation to the total catch ranged from a maximum of 40.1% at the start to 36.4% at the end of the official fishing season. A minimum of 2.4% was recorded in January.

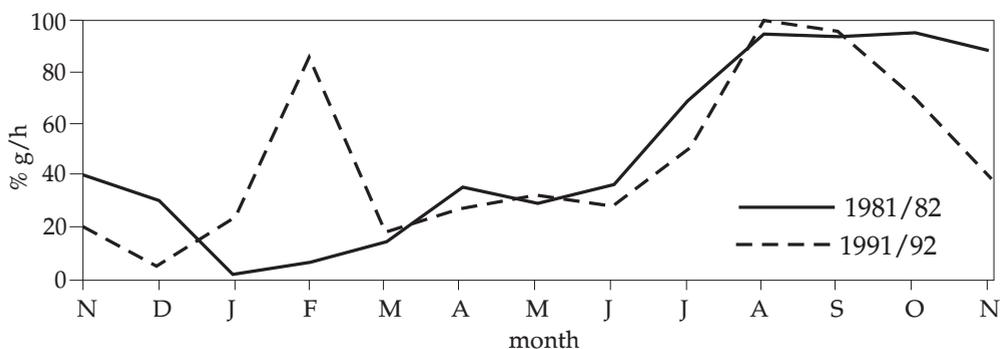


Fig. 4. Mean weight of glass eels

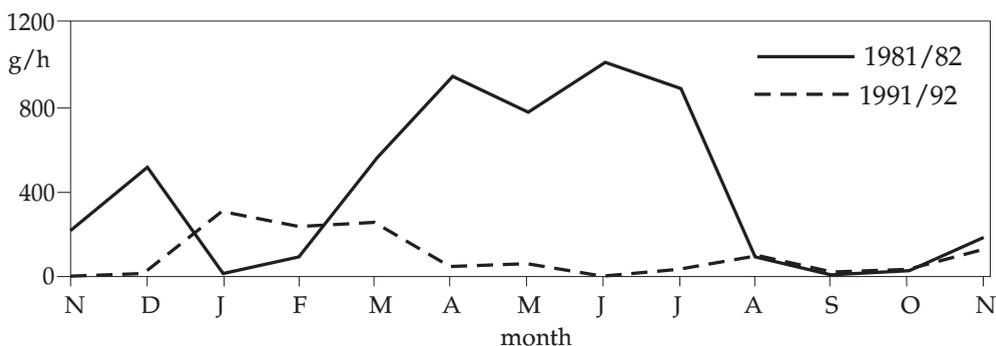


Fig. 5. Relation between by-catch and the total catch of the experimental glass eel fishery

In 1991/92 the by-catch ranged from 20% at the beginning to 27.1% at the end. The minimum appeared in December (4.3%) and the maximum in February (85.4%).

Outside the official fishing seasons the by-catch increased to just over 90% due to the decline in the occurrence of glass eels (Fig. 5).

The weight of the by-catch during the fishing season 1981/82 showed a minimum of 20 g/h (25 g per kg of glass eels) in January and a maximum of 937 g/h (572 g/kg) in April. Outside the season the weight reached a peak of 1019 g/h in June before declining to its lowest point of 14 g/h in September.

In 1991/92 the smallest amount of by-catch appeared in November with 5 g/h (200 g/kg) and the greatest in January with 313 g/h (330 g/kg). Outside the season, between May and October the weight of the by-catch varied from 5 g/h in June to 114 g/h in August (Fig. 6).

TABLE 2

Species composition of the by-catch

1981/82	1991/92
<b>Osteichthys</b>	
<i>Anguilla anguilla</i>	<i>Anguilla anguilla</i>
<i>Atherina presbyter</i>	<i>Atherina presbyter</i>
<i>Alosa fallax</i>	<i>Alosa fallax</i>
<i>Alosa alosa</i>	<i>Alosa alosa</i>
<i>Chondrostoma polylepis</i>	<i>Chondrostoma polylepis</i>
<i>Platichthys flesus</i>	
<i>Salmo salar</i>	
<i>Gasterosteus aculeatus</i>	<i>Gasterosteus aculeatus</i>
<i>Clupeidae</i>	
<i>Mugilidae</i>	<i>Mugilidae</i>
	<i>Pomatoschistus microps</i>
<b>Cyclostomata</b>	
<i>Petromyzon marinus</i>	<i>Petromyzon marinus</i>
<b>Crustacea</b>	
<i>Palaemon serratus</i>	<i>Palaemon serratus</i>
<i>Saduriella losadai</i>	<i>Saduriella losadai</i>
<i>Athyaeephyra desmaresti</i>	<i>Athyaeephyra desmaresti</i>
<i>Mysidae</i>	<i>Mysidae</i>
	<i>Crangon crangon</i>
<b>Gastropoda</b>	
<i>Bithynia tentaculata</i>	<i>Bithynia tentaculata</i>
<i>Radix peregra f. ovata</i>	<i>Radix peregra f. ovata</i>
<i>Physa fontinalis</i>	<i>Physa fontinalis</i>
<i>Valvata piscinalis</i>	
<b>Bivalvia</b>	
	<i>Corbicula fluminea</i>

In February the by-catch in 1992 differed very much from the one registered in 1982. An usually high weight of 85.4% of the total catch (274 g/h) led to calculated amount of 5850 g per kg of glass eels.

In the period of 1981/82 the by-catch consisted of 19 species of which there were 10 fish species (including young eels), 4 crustaceans, 4 gastropodes and one lamprey species. Ten years later 18 species were registered of which 7 were fish, 5 crustaceans, 4 gastropods, one bivalve and one lamprey species (Table 2).

In 1981/82 the fish component of the by-catch increased from 35.3% (g/h) in April to 87.8% in August. This was followed by a decrease in the autumn down to 2.4% by November. In contrast the crustacean portion increased from August 1982 (7.0%)

to November (83.3%) while for the rest of the period it stayed at or around 10%. The gastropods appeared mainly in September 1982 (30.0%) and October (55.6%) and were poorly represented during the other months.

Ten years later the fish were always the dominant class of the by-catch, varying between 3.9% in December 1991 to 96.1% in August 1992. The crustaceans increased from August (3.5%) to October (17.6%), whereas the gastropods appeared only in September with 8.6%.

The by-catch included juvenile species of fish, some of which are anadromous and of commercial interest, such as *Alosa alosa*, *Alosa fallax*, *Platichthys flesus*, *Salmo salar*, as well as clupeids and one species of the mugilids. Generally they occurred in low numbers during the official fishing season but in greater abundance outside of it. Young salmon appeared only once in April 1981/82. Juvenile lampreys (*Petromyzon marinus*) were caught mainly in May 1982, whereas ten years later they showed up earlier from January to March. In 1991/92, flounder, salmon and clupeids did not appear in the by-catch, but three new species were found (*Pomatoschistus microps*, *Cranzon crangon* and *Corbicula fluminea*).

## DISCUSSION

According to the official statistics from Portugal and Spain the combined yield of the glass eel fishery in the last decade recorded a maximum of 30.4 tons in 1982/83, followed by a decrease down to 6.1 tons in 1989/90. On the average 14.2 tons were caught annually in the Rio Minho. The total yield decreased by 18.4% during the last ten years, showing a new increase up to 13.4 tons in 1991/92. The amounts are underestimated because catch of the fishermen is usually underdeclared. For example, one Portuguese glass eel dealer with a market share of 26% bought 3 tons in November 1991. This means that 11.5 tons had been fished only in that month by the Portuguese fishermen, which is much different from the total official yield of 3.6 tons for 1991/92.

The number of licensed fishermen on the Portuguese side of the Rio Minho has decreased from 750 in 1983 to 450 in 1992, the number of licensed boats has decreased in the same time from 537 to 485.

The glass eel fisheries in the French rivers Vilaine, Loire and Adour also showed a reduction in the last decade. In the Vilaine the official yield decreased from 113 tons at the end of the seventies to 36 tons at the end of the eighties (Guerault et. al. 1991).

The results of the experimental glass eel fishery in the international Rio Minho also reflected a decreasing tendency. In general, the fishery in 1981/82 obtained a higher yield than one decade later. Only for two months in 1992 (January and October) better results were achieved than ten years earlier.

Another experimental glass eel fishery was carried out between May 1988 and May 1989. The maximum was reached in May 1988 (2880 g/h), whereas values under 290 g/h were obtained in Summer (Antunes and Weber 1990). Two years later, the maximum yield showed us in March 1992 (1140 g/h) and the minimum in November 1991 (25 g/h). In comparison with another Portuguese river, the highest yield of an experimental fishery in the estuary of Rio Mondego was recorded in November 1989 (989 g/h) and the lowest in february 1990 (38 g/h) (Domingos 1991).

Species of trophic interest were more abundant during the official fishing season in 1981/82, such as the silverside, *Atherina presbyter*, and the white shrimp, *Palaemon serratus*, whereas juvenile fish species of commercial interest were caught mainly outside the official fishing season. In 1991/92 the most representative class of the by-catch belonged to young eels (*Anguilla anguilla*) and silversides (*Atherina presbyter*).

The glass eel fishery affected species of trophic interest on the Rio Minho, whereas species of commercial interest were recorded during studies on the French rivers Loire and Vilaine (Gascuel et al. 1982). During another study in the Loire estuary 16 species showed up in the by-catch between February and April 1987, among which the flounder (*Platichthys flesus*), the sprat (*Sprattus sprattus*) and the brown shrimp (*Crangon crangon*) were numerically dominant. In the freshwater section of the river only 4 species of cyprinids and the flounder were registered for the by-catch (Guerault et al. 1989).

The results of the experimental glass eel fishery obtained in 1981/82 and in 1991/92 during and after the official fishing season indicated to what an extent some of the other aquatic species could have been affected in the lower part of the Rio Minho. However, it is impossible to be precise about the effect of the glass eel fishery on these species in relation to the catches of all boats from both shores in terms of any influence on the stocks. The results obtained between May and October of both periods give an idea which species of the by-catch would be affected if the professional season was prolonged by illegal fishing.

The glass eel fishery in the international Rio Minho with anchored hamen-nets („telas“) came to an end by law in 1993, but fishing with hand-nets („rapetas“) from the river shores may still be permitted between November and April.

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## STRESZCZENIE

### POŁOWY WĘGORZYKA SZKLISTEGO I PRZYŁÓW W RIO MINHO W ODSTĘPIE DZIESIĘCIOLECIA (1981-1982 i 1991-1992)

Przedstawiono wyniki eksperymentalnych połowów węgorzyka szklatego na międzynarodowym obszarze Rio Minho, prowadzonych przez 12 miesięcy (od listopada 1981 do listopada 1982) i porównano je z wynikami analogicznych odłowów prowadzonych dziesięć lat później. Omówiono oficjalne statystyki połowów węgorzyka szklatego, sezonową zmienność połowów, wielkość poławianych ryb (średnia osobnicza masa i długość). Określono poziom przyłowu w zależności od czasu połowów i masy złowionego węgorzyka. Przedstawiono przyczyny śmiertelności węgorzyka szklatego.