ICES PAPER C.M.1987/L:17
Ref. G

THE FOOD OF EARLY POST-LARVAL PLAICE, Pleuronectes platessa.

by

O.Hamerlynck, C.R.Janssen & E.Van Landtschoote

Marine Biology Section, State University of Gent
Ledeganckstraat 35, B 9000 Gent, Belgium.

ABSTRACT

Food-limitation in late larval and early post-larval plaice, Pleuronectes platessa, may be an important factor in the determination of year class strength.

In this study data on stomach content, hepato-somatic index and condition index of metamorphosing and early post-larval plaice from a sandy beach in the mouth of the Western Scheldt are compared to data from the Zwin lagoon.

Settlement in the area starts at the end of February. All plaice examined from the sandy beach were fasting. Their condition, as measured by hepato-somatic index and condition index, did not differ significantly from the condition of feeding post-larvae from the lagoon. Thus starvation during metamorphosis is rejected as an important factor in determining year class strength.

In the Zwin lagoon the juveniles of less than 20 mm standard length feed mainly on calanoidea, polychaetes and harpacticoidea.

INTRODUCTION

Recruitment in plaice, *Pleuronectes platessa*, is known to be more stable than in any other commercial North Sea species (ICES Working Group reports). As fluctuations in initial year class strength are reduced within the first months after settlement an important density-dependent mortality occurs in the nursery areas during or just after settlement of the larvae (Zijlstra et al. 1982).

In general density-dependent mortality can be due to predation, to competition for food or to parasitism and disease. Most studies emphasize the role of predation: the high densities of young plaice attract older flatfish (Riley & Corlett 1966, Macer 1967, Lockwood 1972 in Lockwood 1980a), gadoids (Edwards & Steele 1968) and shrimp (Bergman et al. 1976). Several authors (Steele & Edwards 1970, Rauck & Zijlstra 1978, Ursin 1982, Poxton et al. 1983) suggest food-limitation may be important. However Zijlstra et al. (1982) show that the food supply in the shallow nursery areas of the Wadden Sea is adequate from June onwards (about one month after settlement). Parasitism and disease are not considered important in any study.

In this paper we study the food of metamorphosing and early post-larval plaice in the subtidal of a sandy beach in the mouth of the Western Scheldt and in the Zwin lagoon. Although the Delta area of the rivers Rhine, Meuse and Scheldt is an important nursery area for plaice (Zijlstra 1972), few studies have been published on its plaice population. The results in this study are from a very small area, so it would be unwise to extrapolate to the entire Delta.

DESCRIPTION OF THE AREA

The area investigated is a gently sloping sandy beach on the border between Belgium and the Netherlands. It is close to the entrance of the Zwin lagoon, in the mouth of the Western Scheldt, Southern Bight.

The sediment type is well sorted, fine sand (172µm median grain size) with generally less than 5% silt/clay.

Salinity varies between 27.4 and 31.1 ‰. Sea water temperatures are shown in Fig.1.

The Zwin lagoon is a 125 ha saltmarsh with tidal creeks and gullies.

MATERIALS AND METHODS

From 26 February 1985 to 23 february 1987 monthly samples were obtained using a two-meter beam trawl, as described by Kuipers (1975), towed by a small 160 hp motor vessel. Sampling scheme disturbance due to adverse conditions was rather frequent. Per sampling date 7 hauls were made parallel to the shore, following the 3.5 to 4.5 m depth line, over a distance of 700 m. Total surface covered thus approximated 10000m^2. Trawling started 2 hours before low tide. Between 90 and 130 m^2 were covered per minute depending on current speeds. Fish densities were calculated by assuming 10 % efficiency for plaice of less than 20 mm standard length.

From August to December 1984 fortnightly samples were obtained with a handpulled net in the Zwin lagoon. Pushnetting was done in the Zwin lagoon on 9 April 1987.

All fish caught were immediately anaesthesized in a benzocaine solution to prevent regurgitation of stomach content. Within minutes after capture the fish were preserved in neutralised formaldehyde 7% final concentration. At least three months after capture all fish were measured to the nearest 0.1 mm standard length, using a drawing mirror and curvimeter. Staging of larvae was done according to the nomenclature of Ryland (1966).

From each sample containing *Pleuronectes platessa* of less than 20 mm standard length a number of fish were selected at random for stomach analysis. The content of stomach, intestine and rectum were analysed separately. All food items were identified, if possible to species level. Stomach content was then dried at 110 °C for 2 hours for the calculation of Fullness Index (FI). Livers were dried for 5 days at 60 °C for the measurement of Liver Dry Weight (LDW). Fish were dried for 5 days at 60 °C and then incinerated for 2 hours at 550 °C for Ash Free Dry Weight (AFDW) measurement (to .001 mg). Total weight (TW) = AFDW + LDW.

Fullness index (FI):

FI= Dry Weight of stomach content * 100 / TW

Condition index (CI):

CI = TW (g) * 100 / length (cm)^3

Hepato-somatic index (HSI):

HSI = LDW * 100 / TW

Food composition is expressed as percentage AFDW (Berg 1979).

RESULTS

The number of fish caught, calculated densities, mean lengths and Fullness Indices are summarized in Table 1. Relative percentages of different stages are shown in Fig.2. Mean length, mean CI and mean HSI with 95% confidence limits are shown in Fig.3.

On 26 February 1985 74 larval and 0-group post-larval plaice were caught. Of the 40 gastro-intestinal tracts examined not a single one contained a food item either in the stomach, the intestine or the rectum. Some fish had small amounts of detritus in the mouth or in the gastro-intestinal tract.

On 26 March 1985 70 larval and 0-group post-larval plaice were caught. Of the 40 gastro-intestinal tracts examined, 38 were empty, 1 contained a cyclopoid in the stomach and a harpacticoid in the intestine and 1 had a harpacticoid in the stomach. Many fish again contained some detritus.

Weather conditions did not allow sampling until 10 May 1985. By that time great numbers of *Pleurobrachia pileus* had invaded the area and efficient sampling was impossible. Only 2 plaice larvae (stage 3) were caught, presumably in the water column. At the next sampling on 7 July 0-group plaice were present but they were over 20 mm.

On 29 January 1986 and 14 February 1986, no 0-group plaice were caught, but substantial numbers of I-group plaice and dab were present. On 17 March 1986 4 larval plaice were caught, all 4 with empty gastro-intestinal tracts. On 15 April 1986 another 12 larval and 0-group plaice were caught. All stomachs were empty, but one specimen contained 2 Cirripedia cypris larvae, one in the intestine and one the rectum. These were weighed separately and both had a dry weight of 0.016 mg, which is the dry weight prior to digestion.

In May and June 1986 sampling was impossible due to high densities of *Pleurobrachia pileus* and *Aurelia aurita*. Towards the end of June the 0-group plaice were over 20 mm standard length.

On 21 January 1987 no larval or 0-group plaice were caught. On 23 February 4 larval plaice were caught, 2 were subsequently lost and the 2 remaining ones contained some nematodes. After this date adverse weather precluded further sampling in the area.

Two larval and 19 0-group plaice caught in the Zwin lagoon on 9 April 1987 all had stomachs, intestines and rectum well filled with calanoids, harpacticoids and some small polychaetes. Percentage Ash Free Dry Weight composition of the stomach contents is shown in Fig.4.

There are no significant differences in mean CI and mean HSI between the larval and early post-larval plaice in the subtidal of the beach and those that have settled inside the lagoon (Fig.3).

The results of the hand-pulled trawls in the lagoon in 1984 show that 0-group plaice leave the area when they reach 60-70 mm standard length.

DISCUSSION

Stage 4 and 5 larvae arrive in the area from the end of February (1985, 1987) or mid March (1986) until the beginning of May. This is about six weeks earlier than in the Wadden Sea (Zijlstra et al. 1982). According to Ryland (1966) they must have hatched about 9 to 10 weeks earlier, presumably in the English Channel (Houghton & Harding 1976).

The metamorphosing and small 0-group plaice do not feed. Lockwood (1984) found similar results in 20% of the late larval and 0-group population in Filey Bay from May trough June. According to Lockwood (1984) an empty intestine means the fish have not eaten for (at least) 24 to 36 hours. He links his findings with the observation by Riley (1966) that, in the laboratory, feeding rate decreases during stage 4. As the duration of stage 4 is about 12 days (Riley 1966) the period of fasting in our area is probably much longer than 24 to 36 hours. Presumably the larvae do not feed during the whole process of metamorphosis. Energy requirements in our area will be much lower than in Filey Bay (Lockwood 1984) because of the difference in water temperature during metamorphosis, i.e. 2 to 4 °C instead of 10-12 °C.

Creutzberg et al. (1978) note that most plaice larvae entering the Wadden Sea with the tidal current have empty stomachs. In laboratory experiments lack of food is a stimulus to leave the bottom. Starving plaice larvae may thus be carried off with the current to more suitable areas (Creutzberg et al. 1978).

Mortality during metamorphosis can not be estimated in the area because it is open to migration. Prolonged fasting seems to be tolerated well, as condition of the fish is not adversely affected. If density-dependent mortality occurs at this stage it is thus probably not a feeding problem, in contrast to what zero Fullness Indices may suggest. Moreover there does not seem to be any consistant difference in the condition of the fish between "high" density (1985) and "low" density (1986) years.

CONCLUSION

In the area investigated plaice larvae undergo metamorphosis without feeding. Their condition during fasting does not differ significantly from the condition of post-larvae that have resumed feeding. After metamorphosis a substantial proportion of the population presumably uses the tidal currents to reach more suitable feeding areas, the true nurseries. In the Zwin lagoon they feed mainly on calanoidea, polychaetes and harpacticoidea.

ACKNOWLEDGEMENTS

This work was carried out with the logistic support of Rijkswaterstaat Meetdienst Vlissingen. A.Van Reusel did the nematode identifications and R.Huys helped with harpacticoid identification. The first author acknowledges a grant of the Institute for the stimulation of Scientific Research for the Benefit of Industry and Agriculture.

REFERENCES

Berg,J. 1979. Discussion of methods of investigating the food of fishes, with reference to a preliminary study of the prey of *Gobiusculus flavescens* (Gobiidae). Mar.Biol.50:263-273.

Bergman,M. Kuipers,B., Spliethoff,P. Veer, H. van der 1976. Garnalen en krabben als mogelijke predatoren van 0-jarige schol op het Balgzand. Visserij 29:432-438.

Creutzberg,F., Eltink,A.Th.G.W. & Noort,G.J. van 1978. The migration of plaice larvae *Pleuronectes platessa* into the Western Wadden sea. In: McLusky,D.S. & Berry,A.J. (eds.): Physiology and behaviour of marine organisms. Pergamon Press, Oxford, p.243-251.

Houghton,R.G. & Harding,D. 1976. The plaice of the English Channel: spawning and migration. J.Cons.int.Explor.Mer 36:229-239.

Kuipers,B.R. 1975. On the efficiency of a two metre beam trawl for juvenile plaice (*Pleuronectes platessa*). Neth.J.Sea Res.9:69-85.

Lockwood,S.J. 1974. The settlement, distribution and movements of 0-group plaice *Pleuronectes platessa* (L.) in Filey Bay, Yorkshire. J.Fish Biol. 6:465-477.

Lockwood,S.J. 1980a. Density-dependent mortality in 0-group plaice (*Pleuronectes platessa*) populations. J.Cons.int.Explor.Mer.39:148-153.

Lockwood,S.J. 1980b. The daily food intake of 0-group plaice (*Pleuronectes platessa* L.) under natural conditions. J.Cons.int.Explor.Mer 39:154-159.

Lockwood,S.J. 1984. The daily food intake of 0-group plaice (*Pleuronectes platessa* L.) under natural conditions: changes with size and season. J.Cons.int.Explor.Mer 41:181-193.

Macer,C.T. 1967. The food web in Red Wharf Bay (North Wales) with particular reference to young plaice (*Pleuronectes platessa*). Helgolander wiss. Meeresunters. 15:560-573.

Rauck,G. & Zijlsta, J.J. 1978. On the nursery aspects of the Wadden sea for some commercial fish species and possible long-term changes. Rapp.P.-v.Reun.Cons.perm.int.Explor.Mer 172:266-275.

Riley,J.D. 1966. Marine fish culture in Britain. VII. Plaice (*Pleuronectes platessa* L.) post-larval feeding on *Artemia salina* L. nauplii and the effects of varying feeding levels. J.Cons.perm.int.Explor.Mer 30:204-221.

Riley,J.D. & Corlett,J. 1966. The numbers of 0-group plaice in Port Erin Bay 1964-66. Rep.mar.biol.Stn Port Erin 78:51-56.

Ryland,J.S. 1966. Observations on the development of larvae of plaice, *Pleuronectes platessa* L. in aquaria. J.Cons.perm.int.Explor.Mer 30:177-195.

Ursin,E. 1982. Stability and variability in the marine ecosystem. Dana 2:51-67.

Zijlstra,J.J. 1972. On the importance of the Wadden Sea as a nursery area in relation to the conservation of the southern North Sea fishery resources. Symp.zool.Soc.Lond.29:233-258.

Zijlstra,J.J., Dapper,R. & Witte,J.J. 1982. Settlement, growth and mortality of post-larval plaice in the western Wadden Sea. Neth.J.Sea Res.15:250-272.

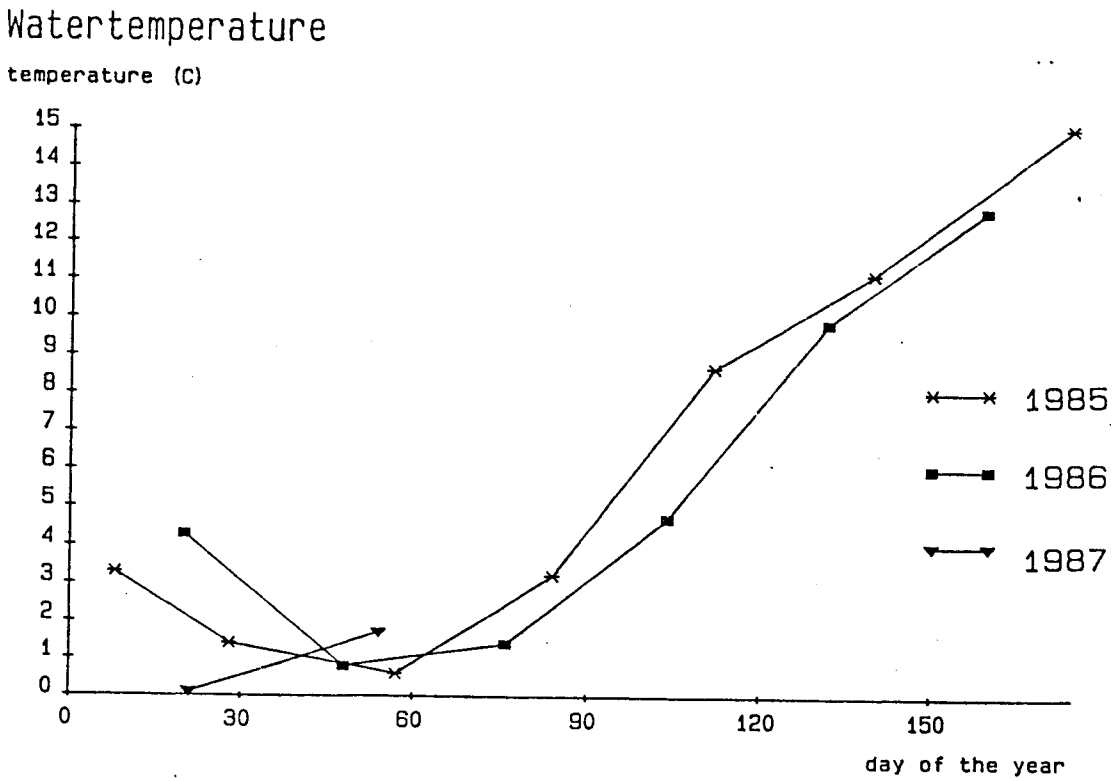

Watertemperature
temperature (C)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0
30
60
90
120
150
day of the year
1985
1986
1987

Fig.1.

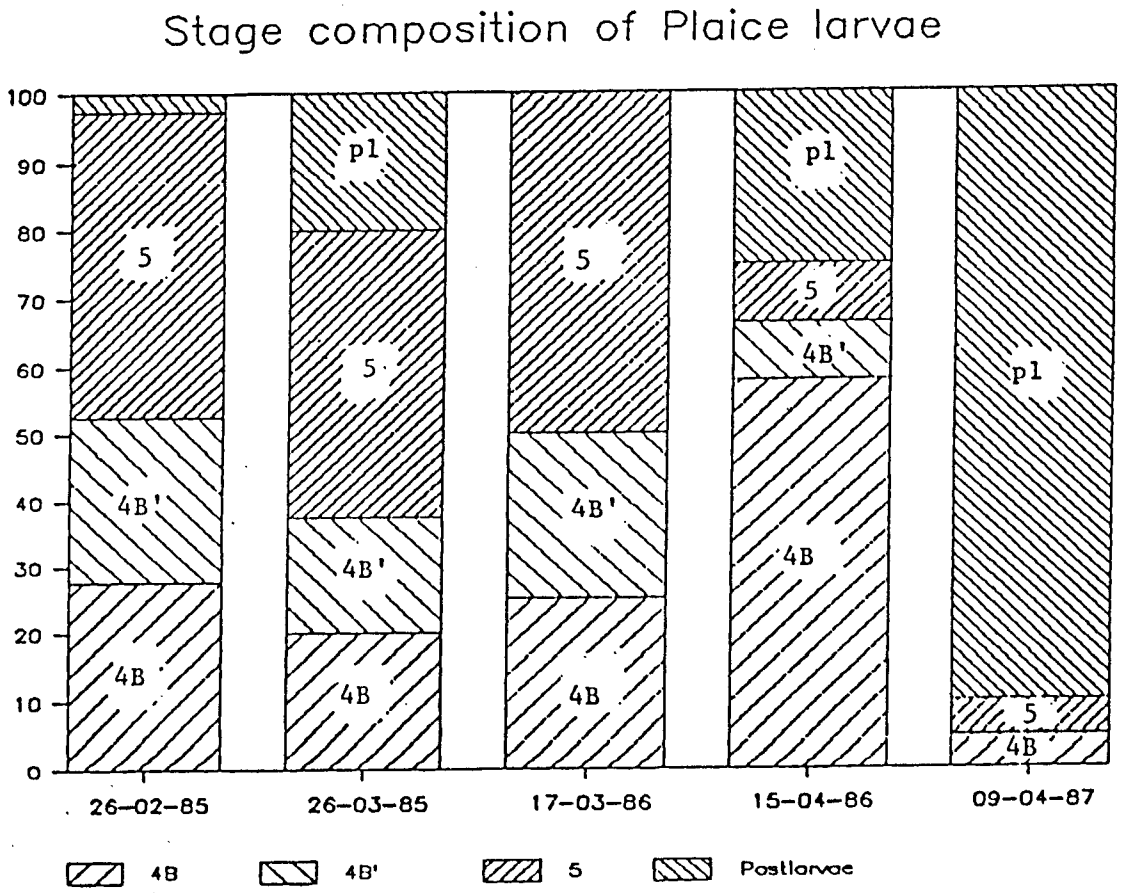
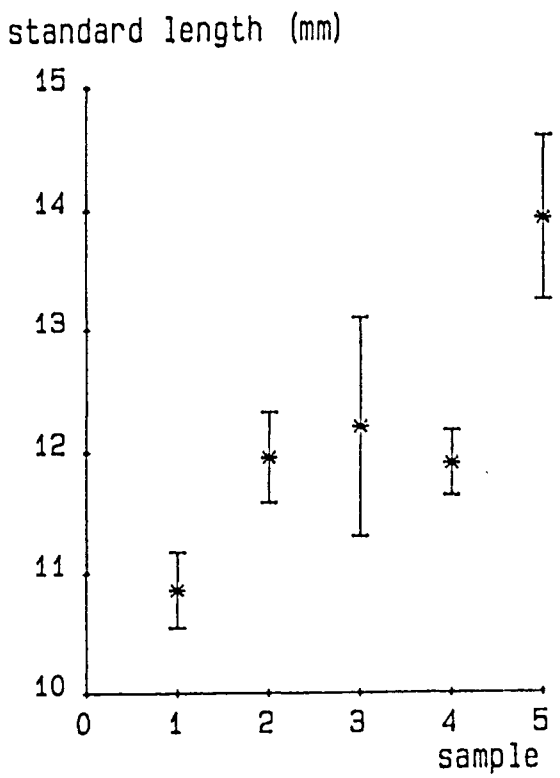
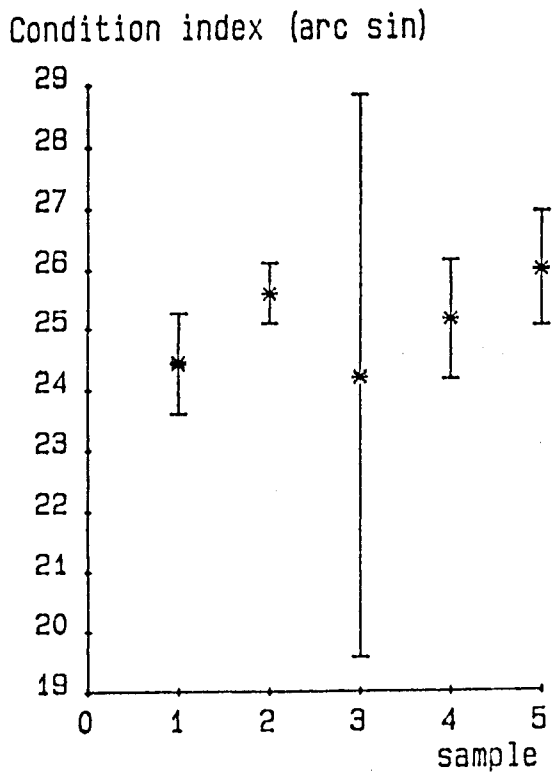
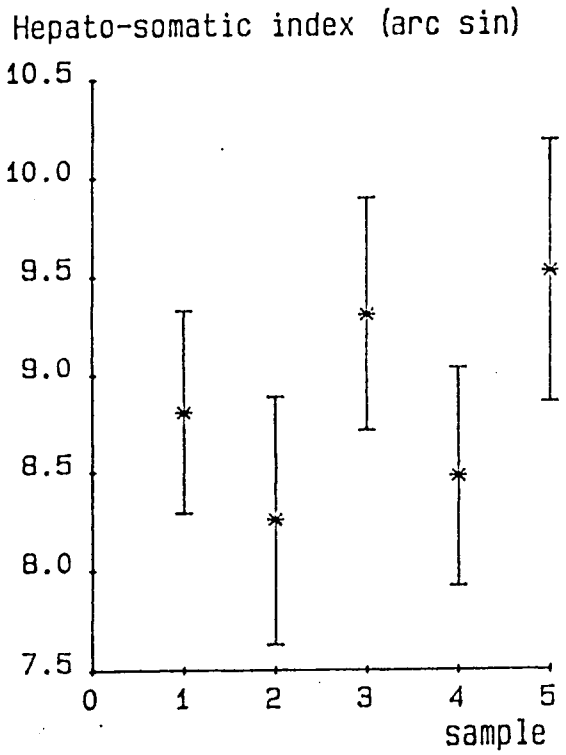

Stage composition of Plaice larvae
100
90
80
70
60
50
40
30
20
10
0
pl
5
4B'
4B
26-02-85
26-03-85
17-03-86
15-04-86
09-04-87
4B
4B'
5
Postlarvae

Fig.2.

Pleuronectes platessa







sample codes:
1. 26.02.85
2. 26.03.85
3. 17.03.86
4. 15.04.86
5. 09.04.87 (Zwin)

Fig.3.

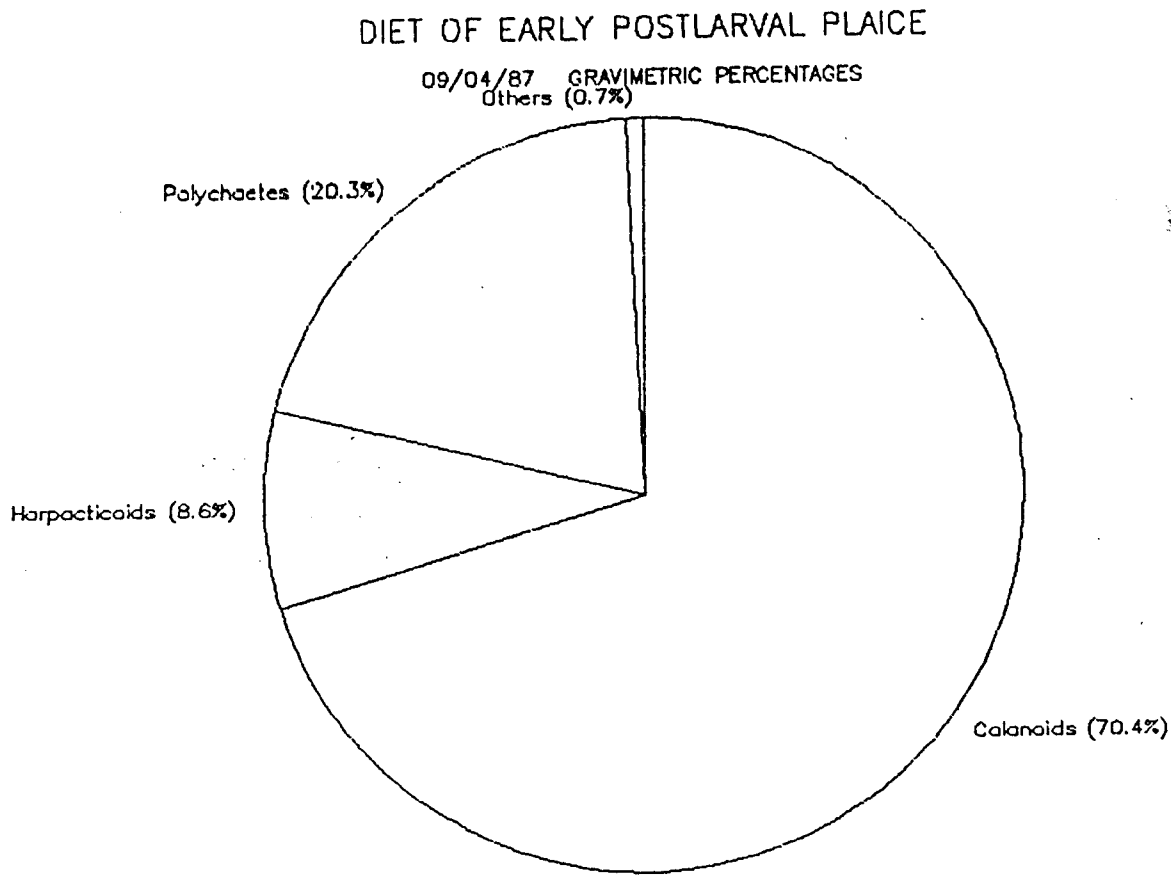


Fig.4.

	sampling date	N caught (N stomachs)	density (N/1000m²) mean + s.e.	Fullness Index mean + s.e.
BEACH	26.02.85	74(40)	233 + 82	0
	26.03.85	70(40)	211 + 126	0.02 + 0.03
	29.01.86	0	0	-
	14.02.86	0	0	-
	17.03.86	4(4)	4 + 4	0
	15.04.86	12(12)	13 + 12	0
	21.01.87	0	0	-
	23.02.87	4(2)	4 + 11	0
LAGOON	15.04.87	21(21)	approx. 1000	8.5 + 1.52

Table 1. Number of fish caught per sampling date, number of stomachs examined, mean density, mean Fullness Index.