

FEEDING HABITS OF THE PRAWNS *PROCESSA EDULIS* AND *PALAEEMON ADSPERSUS* (CRUSTACEA, DECAPODA, CARIDEA) IN THE ALFACS BAY, EBRO DELTA (NW MEDITERRANEAN)

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Feeding habits of the prawns Processa edulis and Palaemon adspersus (Crustacea, Decapoda, Caridea) in the Alfacs Bay, Ebro Delta (NW Mediterranean).— The stomach contents of 147 *Palaemon adspersus* Rathke, and 102 *Processa edulis* (Risso) were analyzed. The frequency of occurrence method and the points method were used. The role of these species in the food web of *Cymodocea nodosa* meadows is defined. Results indicate that both species are predators of benthic invertebrates rather than scavengers or detritus feeders. The main food items varied according to species. The diet of *Palaemon adspersus* consisted almost entirely of crustaceans, molluscs, and plant material, with amphipods playing a major role. *Processa edulis* ate an almost equal amount of crustaceans and polychaetes. In *P. adspersus*, most dietary items differed according to size classes of prawn.

Key words: Feeding, Prawns, *Palaemon*, *Processa*, Ebro Delta.

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INTRODUCTION

Processidae prawns are abundant in coastal waters of temperate and tropical areas. *Processa edulis* (Risso, 1816) is a common littoral mediterranean prawn (ZARIQUIEY ÁLVAREZ, 1968). The diet of *P. edulis* have been studied by CHESSA et al. (1990), who showed the position of *P. edulis* in the food web of *Posidonia oceanica* meadows in the Sardinian coast (Italy).

The Palaemonidae prawn *Palaemon adspersus* Rathke, 1837 is distributed in shallow water, often in estuarine conditions,

and has been recorded from as far north as the Norwegian Sea to the Marocco coast (LAGARDÈRE, 1971) and the Mediterranean (ZARIQUIEY ÁLVAREZ, 1968). This species is the subject of commercial fisheries in many areas (JENSEN, 1958; HOLTHUIS, 1980; FIGUERAS, 1984). The diet of *Palaemon adspersus* from the Atlantic waters of Europe has been described (INYANG, 1978; BERGLUND, 1980; FIGUERAS, 1986), but no information has been reported on its diet in Mediterranean waters.

In the Alfacs Bay, Ebro Delta, *Palaemon adspersus* and *Processa edulis* are abundant

in shallow meadows of *Cymodocea nodosa* (Ucria) Ascherson (FUSTÉ, 1988; GUERAO, 1993). The two species, moreover *P. adspersus*, are fished with trawl nets (GUERAO, 1993).

The objectives of the present study are to describe the diet of the two dominant caridean prawn species in the study area, and to compare the diet between species and between size classes within each species.

MATERIAL AND METHODS

The study site was the Alfacs Bay, Ebro Delta, on the Spanish Mediterranean coast (40° 37'N 0° 36'E). Sampling was carried out from a platform of the bay, where the bottom is covered by the eelgrass *Cymodocea nodosa* (PÉREZ & CAMP, 1986). Depth ranges from 0.5 to 2 m.

All samples were collected monthly or bimonthly from April 1991 to January 1992 using "rastells" (special type of dragged gears) at dawn (6.00-8.00). All specimens were preserved in 70° alcohol immediately after capture. Approximate percentage fullness was determined visually for each stomach. Only prawns with stomachs more than half full of food were used in the calculations. Total length (TL) of each specimen was measured from the tip of rostrum to the posterior end of the telson (excluding spines). A total of 147 specimens of *Palaemon adspersus* and 102 specimens of *Processa edulis* were studied. Size-frequencies of prawns analyzed are shown in figure 1.

The stomach of each animal was dissected out and the entire contents washed onto a microscope slide. Analysis was performed under both stereo and compound microscopes. Prey were identified to the level of species or to the lowest possible

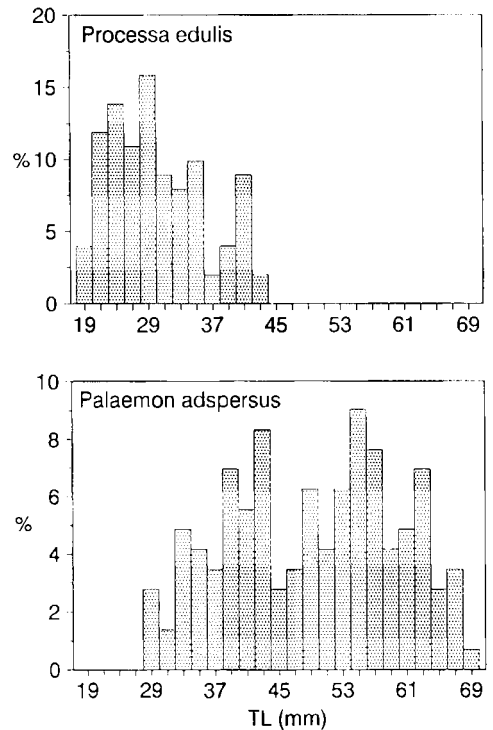


Fig. 1. Size-frequencies of *Palaemon adspersus* and *Processa edulis* specimens collected.

Histogramas de frecuencias de tallas de los ejemplares de *Palaemon adspersus* y *Processa edulis* capturados.

taxonomic level. Importance of prey taxa was evaluated by ranking them by percentage frequency of occurrence and percentage points (HYSLOP, 1980; WILLIAMS, 1981). Percentage frequency of occurrence is the number of stomachs containing a particular prey taxon divided by the number of stomachs with food, multiplied by 100. To estimate volume of prey, points were assigned to each prey item using the method of WILLIAMS (1981). Percentage points is the points of a particular prey taxon divided by the total points of all taxa, multiplied by 100. The subjective points method was used

because, unlike the frequency method, it does not lend disproportionate importance to very small prey or data from stomachs that are nearly empty. However, the two methods have been found to give similar ranks to most prey taxa (WILLIAMS, 1981).

In order to compare the diet between size classes, all samples of *P. adspersus* were considered together and individuals were then investigated in the following size groups: 30-39.9 mm, 40-49.9 mm, 50-59.9 mm and 60-70 mm. The number of individuals in each group varied from 27 to 53. In *P. edulis*, the following size groups were chosen: 20-29.9 mm and 30-39.9 mm.

Only frequency of occurrence was used for statistical analysis. Since there were missing data values, statistical comparison of dietary composition was performed with non-parametric tests. The Smirnov test was used to detect differences between species; the Friedman test was used to detect differences between size classes (SOKAL & ROHLF, 1981).

RESULTS

In *Palaemon adspersus*, crustaceans were the most frequently eaten prey and contributed the largest volume to the diet (table 1, fig. 2). Among crustaceans, amphipods were the most frequently eaten prey (70%) and contributed the most volume (40%) of any taxon. The remains of isopods were found in 20% of the stomachs examined (about 11% of the diet volume). The copepods occurred in 14% of the stomachs but the volume in the diet was low (about 1.8%). The remaining crustacean items consisted of mysids, ostracods and decapods, mainly *Processa edulis* (table 1). Plant material and molluscs (Gastropoda and Bivalvia) were secondary prey items (table 1,

fig. 2); plant material is important in terms of frequency (40%) but in terms of percentage volume was much less so (about 7%). Polychaetes, hydroids, ophiuroids, mites, sand and unidentified organic matter composed the rest of the stomach contents of *P. adspersus*. In general, stomach fullness was high in this species: less than 20% had empty stomachs and a high proportion (50%) were > 50% full. However, all females in pre-spawning stage, with the ovary ripe (13% of females) had empty stomachs.

The diet differed significantly between *P. adspersus* and *Processa edulis* ($p < 0.05$). In *P. edulis*, crustaceans and polychaetes were the dominant prey and contributed the most volume to the diet (table 1, fig. 2). Among crustaceans, amphipods (mainly *Erichthonius* sp.) were eaten most frequently (56.8%) and contributed the largest volume to the diet (about 34.5%). The frequency of occurrence and percentage of points of the remaining crustaceans items were low. The remains of polychaetes, mainly *Sabellaria spinulosa* and Nereidae, were found in 66% of the stomachs and the volume of the diet was about 42%. Molluscs (Opisthobranchia, Cephalaspidea) and plant material were less important resources. In general, stomach fullness was very high in this species: less than 18% had empty stomachs and a high proportion (72%) were > 50% full. However, all the females in pre-spawning stage (15%) had empty stomachs.

The diet did not vary with body length in *P. edulis*; however, the frequency of occurrence of prey items eaten differed significantly between size classes of *P. adspersus* ($p < 0.05$). The frequency of occurrence of isopods, decapods, molluscs and plant material increased with size of prawns, while the frequency of amphipods and copepods decreased (fig. 3).

Table 1. Percentage frequency of occurrence (%FRE) and percentage points (%PTS) of prey taxa found in stomachs of *Palaemon adspersus* and *Processa edulis*.Frecuencia de ocurrencia (%FRE) y porcentaje de puntos (%PTS) de las presas encontradas en los estómagos de *Palaemon adspersus* y *Processa edulis*

Prey taxa	<i>P. adspersus</i> (n = 147)		<i>P. edulis</i> (n = 102)	
	% FRE	% PTS	% FRE	% PTS
Crustacea				
Capreloidea	6.8	3.0	1.9	1.1
Gammaridea, unidentified	39.2	20.5	29.4	13.0
<i>Erichthonius</i> sp.	14.0	8.6	25.4	19.0
<i>Aora</i> sp.	4.7	2.7	1.9	1.4
<i>Dexamine</i> sp.	5.4	4.3	–	–
Isopoda, unidentified	11.5	4.0	1.9	0.5
<i>Cymodoce</i> sp.	5.4	4.0	7.8	3.0
<i>Dynamene</i> sp.	1.4	1.5	–	–
<i>Zenobiana prismatica</i>	0.6	0.3	–	–
<i>Idotea baltica</i>	2.0	1.8	1.9	0.7
Misidacea, unidentified	0.6	0.3	–	–
<i>Siriella clausii</i>	1.3	1.0	–	–
Copepoda harpacticoida	13.6	1.8	1.9	0.1
Ostracoda	1.3	0.1	–	–
Decapoda, unidentified	3.4	1.2	–	–
<i>Processa edulis</i>	5.4	3.3	–	–
Arachnida				
Halacaridae	0.6	0.1	–	–
Mollusca				
Gastropoda, unidentified	14.9	4.0	–	–
<i>Rissoa</i> sp.	11.5	2.9	–	–
<i>Bittium</i> sp.	9.0	2.1	–	–
Cephalaspidea	–	–	3.9	2.9
Bivalvia, unidentified	12.9	3.3	–	–
<i>Venerupis</i> sp.	2.7	0.7	–	–
Polychaeta				
<i>Sabellaria</i> sp.	3.4	1.4	35.2	24.9
Nereidae	1.4	0.8	11.7	6.5
Polychaeta, unidentified	10.2	4.6	19.6	10.3
Hydrozoa				
Hydroids	8.1	1.5	1.9	0.2
Echinodermata				
Ophiuroidea	12.2	1.7	–	–
Plants				
Algae	15.6	2.5	1.9	0.2
Sea grass	30.6	4.5	3.9	0.2
Unidentified organic matter	53.0	7.4	35.3	6.7
Sand	34.6	4.1	45.0	9.3

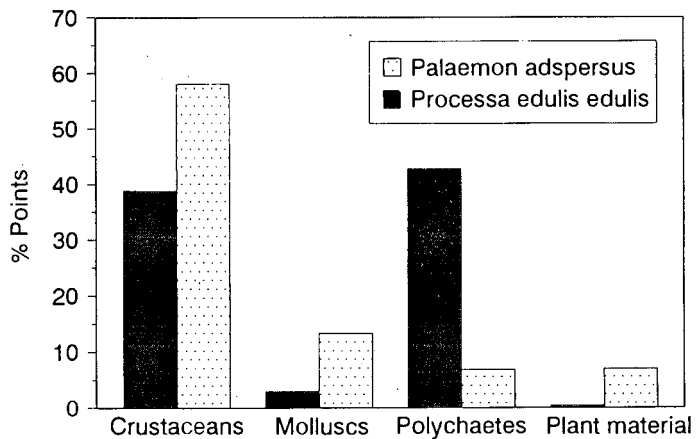
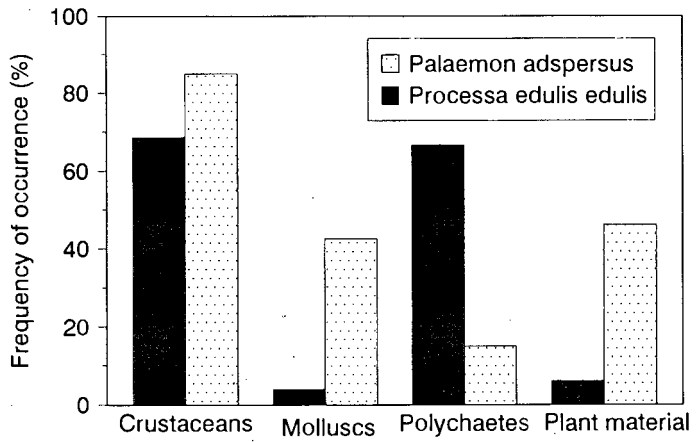


Fig. 2. Relative composition of food found in stomachs of *Palaemon adspersus* and *Processa edulis*.

Composición del alimento encontrado en los estómagos de *Palaemon adspersus* y *Processa edulis*.

DISCUSSION

The two caridean prawns studied showed a nocturnal activity pattern in a non-tidal area (HAGERMAN & OSTRUP, 1980; LABAT & NOEL, 1987; WESTIN & ANEER, 1987; GUERAO, 1993). INYANG (1978) showed the high percentage of empty stomachs among specimens of the *Palaemon adspersus* collected after noon. The nocturnal activity probably influences high stomach-fullness

in *P. adspersus* and *Processa edulis* caught at dawn in Alfacs Bay. The same explanation has been suggested by FIGUERAS (1986) for *Palaemon serratus* (Pennant, 1777) and *P. adspersus* from the Spanish North Atlantic coast. FIGUERAS (1986) showed the relationship between stomach-fullness and the maturation stage of the *Palaemon serratus* and *P. adspersus* females. The same relationship was shown by GUERAO (1993) for these species and for

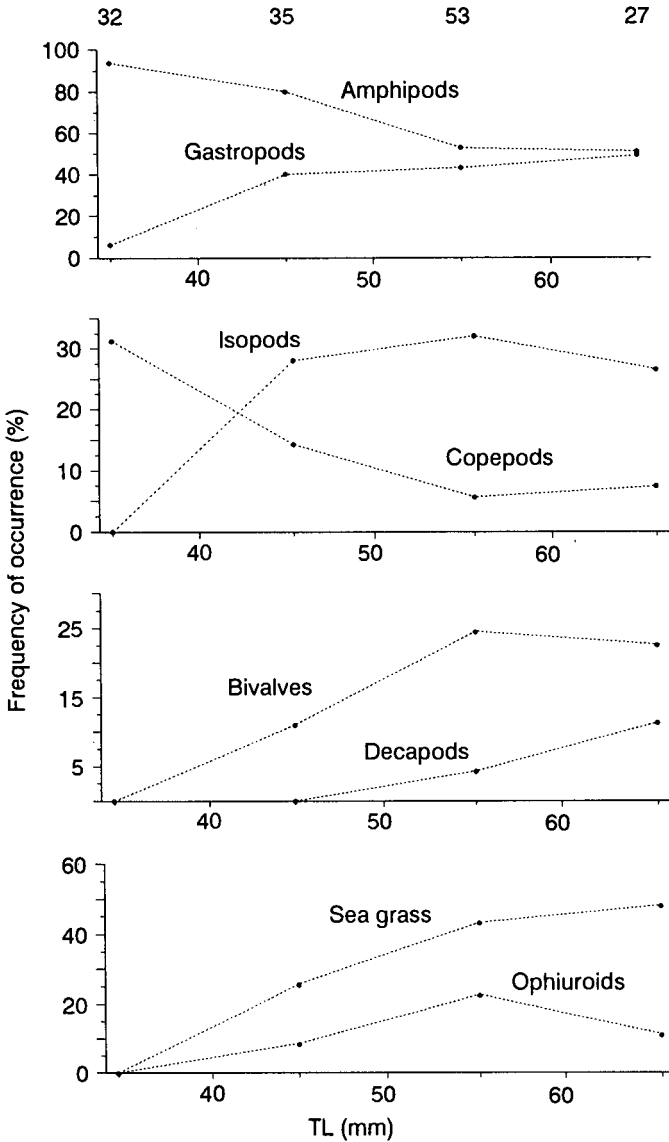


Fig. 3. *Palaemon adspersus*: frequency of occurrence of eight food items in 10 mm size classes. Numbers above top graph indicate sample size for each data point.

Palaemon adspersus: frecuencia de ocurrencia de ocho tipos de alimento según clases de talla de 10 mm. Los números que se encuentran sobre el gráfico indican el tamaño muestral para cada clase de talla.

P. xiphias. In pre-spawning stage, the ovary filled almost all the cephalothorax; this would explain the empty stomachs in these females.

Investigations of *Palaemon* species in estuaries and coastal water have reported that many species are opportunistic omnivorous

or carnivorous (SUBRAHMANYAM, 1975; INYANG, 1978; SITTS & KNIGHT, 1979; SORBE, 1983; FRESI et al., 1984; FIGUERAS, 1986; EMMERSON, 1987). According to INYANG (1978), *Palaemon adspersus* is generally omnivorous, feeding on benthic organisms. The most important prey items

are crustaceans, and plant material does not play an important role in its diet. The present results agree with those of FIGUERAS (1986), who showed that algae and small crustaceans are the most important food for *P. adspersus* and *Palaemon serratus*. FORSTER (1951) found that *P. serratus* (as *Leander serratus*) and *Palaemon elegans* Rathke, 1837 (as *L. squilla*) in the English Channel feed mainly on filamentous algae. Although the local availability of food is probably one of the major factors that affect their diet. BERGLUND (1980) showed that *Palaemon elegans* has the feeding mode of a generalist: in rock pools it thrives on a diet of *Enteromorpha intestinalis* (L.) Link while on the *Zostera* beds it has a varied diet: small crustaceans, polychaetes, algae, detritus and sand grains. EMMERSON (1987) reported that *Palaemon pacificus* (Stimpson, 1860) is a highly opportunistic feeder.

The diet of *Palaemon adspersus* varied appreciably with the size of the prawn. The size and hardness of prey items was different among size classes. INYANG (1978) showed that the frequency of occurrence of molluscs tended to increase with the size of the individuals. The present results showed that the frequency of occurrence of isopods, decapods, molluscs and plant debris increased with the size of prawns, while the frequency of amphipods and copepods decreased.

In *Processa edulis*, the present results are similar to those of CHESSA et al. (1990). This species is almost exclusively carnivorous, its most important prey items being crustaceans and polychaetes. Plant material is rare in its diet and may be ingested accidentally as prey are gleaned from among algae and sea grass. The diets of the *P. edulis* and *Palaemon adspersus* differed, principally, in the proportion of polychaetes and molluscs, and the total

number of prey items in the stomach contents. This may be explained by the differences in prey selection between these species. The different body size of the two prawns species may be related to the lower variety of prey items in the total of stomach contents of *P. edulis*. Behavioral interactions may also affect the diets of the prawns. The distributions of *P. edulis* and *P. adspersus* overlapped at the study area and remains of *P. edulis* were found in the stomach contents of the largest specimens of *P. adspersus*. Further studies are needed on the interactions of these species.

In summary, stomach contents of *Palaemon adspersus* and *Processa edulis* indicate that these two species feed mainly on a variety of benthic organisms. The prawns are trophic links between the benthos and the fish which prey upon the prawns (FRESI et al., 1984). In the Alfacs Bay, the prawns also, presumably, have an important trophic role in the transport of energy to higher consumer levels. Future studies should assess the magnitude and rate of prey consumption by prawns in the area.

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