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DIET OF ADULT FEMALES OF *PARAPENAEUS LONGIROSTRIS* (CRUSTACEA, DECAPODA) IN THE NORTHERN TYRRHENIAN SEA (WESTERN MEDITERRANEAN)

Abstract - The foregut content analysis of the adult females of the deep water rose shrimp *Parapenaeus longirostris* (Lucas, 1846), collected on the epibathyal fishing grounds of the northern Tyrrhenian Sea, indicated a great variety of endobenthic and epibenthic organisms on which this species feed, whereas benthopelagic prey seemed to play a supplementary role in the diet. Most prey items were slow-moving invertebrates such as crustaceans, molluscs, polychaetes and echinoderms. Organic detritus was found in all the analysed specimens, especially in those caught down 300 m depth.

Key words - *Parapenaeus longirostris*, Feeding, Crustaceans, Western Mediterranean

Riassunto - Alimentazione di femmine adulte di *Parapenaeus longirostris* (Crustacea, Decapoda) nel Mar Tirreno Settentrionale. Nel presente lavoro vengono riportati i risultati di uno studio sull'alimentazione di femmine del gambero rosa *Parapenaeus longirostris* (Lucas, 1846), raccolte nelle ore di piena luce sui fondi strascicabili epibatiali del Mar Tirreno settentrionale. L'analisi del contenuto intestinale anteriore ha mostrato che la dieta è basata su organismi appartenenti alla fauna endobentonica ed epibentonica, mentre le specie bentopelagiche svolgono solo un ruolo accessorio. Le prede sono rappresentate principalmente da crostacei, molluschi, policheti ed echinodermi. Il detrito organico è stato rinvenuto in tutti gli individui esaminati, specialmente in quelli raccolti a profondità superiori a 300 m.

Parole chiave - *Parapenaeus longirostris*, Alimentazione, Crostacei, Mediterraneo occidentale.

INTRODUCTION

The deep-water rose shrimp *Parapenaeus longirostris* (Lucas, 1846) is an important nektobenthic organism of the continental slope communities of the northern Tyrrhenian Sea (Biagi *et al.*, 1989). This species is included among the most important commercial species of this zone, and it is regularly exploited by the trawl fishery (Sartor *et al.*, 1998).

Data on distribution and abundance of *P. longirostris* in the northern Tyrrhenian Sea were given by Mori *et al.* (1986), while its reproductive biology by De Ranieri *et al.* (1986). The female outnumbered the males and reach a larger size (Frogliola, 1982; Ardizzone *et al.*, 1990). Considering its abundance in different Mediterranean fishery areas (Holthuis, 1980) and the protracted spawning and recruitment periods (Tom *et*

al., 1988; Sobrino and Garcia, 1994), *P. longirostris* plays an important role in the structure and functioning of the continental slope ecosystem.

The diet of *P. longirostris* is poorly known: studies about the diet have been carried out off the Majorca Island (Massuti, 1953) and the Morocco coasts (Lagardère, 1972; Burukowsky, 1979). This paper presents some preliminary results of a study on the natural diet of adult females of *P. longirostris* inhabiting the continental slope of the northern Tyrrhenian Sea (western Mediterranean).

MATERIAL AND METHODS

The specimens were collected on the April 1994, by means of bottom trawl, during mid hours of daylight, in an area off the Giglio Isle (northern Tyrrhenian Sea, western Mediterranean) in two commercial hauls carried out at 180-300 m and 320-450 m depth (from 10°20'E 42°29'N; 10°43'E 42°20'N). They were collected about 48 h later by last fresh trawl discards on the Tyrrhenian fishing grounds, in order to avoid an additional food source for shrimps represented by the material discarded from trawlers, according to Flint and Rabalais (1981). In total, 130 adult females of *P. longirostris* (size-range 27-40 mm of carapace length) were collected. Immediately after capture, all shrimps were stored in a box with ice cubes to slow the digestion and to stop the maceration processes by the gastric mill. After about 8 hours, the shrimps were brought back to the laboratory, where they were kept frozen at -20 °C until they were examined. The preservation of the foregut contents were made with a binocular dissecting microscope spreading the contents into a Petri dish. A fullness value was assigned to each foregut: empty or near empty (< 25% full); partially full (25-49%); full (50-74%), and very full (≥ 75%) (Abelló, 1989).

The diet of penaeids has been described by several works (see Dall *et al.*, 1990), reporting that the material in the stomachs of the shrimps is finely minced and difficult to identify. So, techniques such as weighing the food, measuring the size of prey or reconstructing prey cannot be used for *P. longirostris*. Consequently, we have restricted the analysis to the frequency of occurrence (% F), a parameter that give sufficient information about the relative importance of the prey items in the diet, according to Hyslop (1980) and Williams (1981).

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RESULTS

About 26% of the foreguts of *P. longirostris* were empty or near empty and 74% contained food (28% partially full, 26% full and 20% very full).

The prey items consisted mostly of external skeletons of bottom organisms always crushed and often in advanced digestion state, so that very rarely it was possible to reach the species level in the identification (Tab. 1). In addition, some inorganic material was found.

Tab. 1 - List of the taxa found in the *P. longirostris* foreguts.

HYDROZOA
FORAMINIFERA
Globigerinidae
POLYCHAETA
Aphroditidae
Nephtyidae
MOLLUSCA
Bivalvia
Gastropoda
Cephalopoda
<i>Sepietta oweniana</i> (Orbigny)
CRUSTACEA
Ostracoda
Mysidacea
<i>Lophogaster typicus</i> Sars
Amphipoda
Lysianassidae
Decapoda
<i>Philocheras echinulatus</i> (Sars)
<i>Plesionika</i> spp.
<i>Anapagurus</i> sp.
<i>Pagurus</i> spp.
Portunidae
ECHINODERMATA
Ophiuroidea
<i>Ophiura</i> sp.
<i>Ophyocten abyssicolum</i> Marenzeller
Holoturoidea
Echinoidea
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Prey items belonged to seven major taxa: crustaceans, molluscs, echinoderms, polychaetes, foraminiferans, fishes and hydroids (Tab. 2). Crustaceans dominated both qualitatively and quantitatively; molluscs and echinoderms were for quality the second and third most important food group, respectively. Polychaetes, foraminiferans and organic material were important in terms of frequency of occurrence, but quantitatively resulted of lesser importance. Hydroids and fishes contributed little to the diet both in terms of frequency of occurrence and quantity of food.

The crustacean food group was dominated by peracarids, mainly represented by mysids (above all *Lophogaster typicus*) and amphipods (*Lysianassidae*).

Tab. 2 - Diet of the adult females of *Parapenaeus longirostris*.

Food item	% F
Crustaceans	
Peracarid appendages and other fragments	47,6
Caridean appendages	7,9
Anomuran chelae	3,2
Brachyura appendages and other fragments	7,9
Unidentified Crustaceans	42,9
Molluscs	
Bivalve fragments	25,4
Gastropod fragments	22,2
Cephalopod suckers, eyes and tentacles	9,5
Echinoderms	
Ophiuroid arms	19
Sea urchin spines and Holoturians spicules	7,9
Annelida	
Polychaete hooks, jaws and setae	25,4
Fish bones, otholiths, scales and vertebrae	14,3
Foraminiferans	36,5
Hydrozoan polyps	1,6
Organic detritus	27
Inorganic particles	6,3
Plastic material	3,2

Other crustaceans, but of lesser importance, were ostracods and juvenile decapods represented mainly by crangonids (such as *Philocheras echinulatus*) and pandalid shrimps (*Plesionika* spp.), followed by anomurans (*Anapagurus* sp. and *Pagurus* spp.) and brachyurans (Portunidae). The crustacean remains consisted of approximately 85% of exoskeleton material and only 15% of soft parts.

Molluscs were represented mostly by juvenile bivalves and gastropods, but they consisted principally of shell material respect than soft parts.

The small amount of cephalopods collected from the foregut contents of *P. longirostris* were constituted mainly by the sepiolid *Sepietta oweniana*. The small echinoderms were mainly ophiuroids (*Ophiura* sp. and *Ophyocten abyssicolum* and other unidentified species), found as fragments of arms, although sea urchins and holoturoids were also found. Most of annelids were represented by polychaetes belonging to Aphroditidae and Nephtyidae.

Fishes were also observed among the preys, but quite rarely (14.3%); most of the remains belonged to small sized species, as evidenced by the size of the vertebrae and other bones and by the size and shape of the otholiths. Foraminifera, above all Globigerinidae, were mainly recorded in foreguts containing small amounts of food, and they were always present with a scarce number of individuals.

The organic detritus, mostly as unidentified debris, was found with a relatively high percentage of occurrence, but in a low amounts and quantitatively it appeared to increase in the specimens caught in the haul down 300 m depth. Also inorganic and plastic particles were found mostly in the specimens caught in the deepest area.

DISCUSSION

The results of the study of the diet show the great variety of organisms on which *P. longirostris* feed, mainly crustaceans (amphipods and mysidaceans), molluscs, annelids and echinoderms, and that most of the prey items are slow-moving species. The major food groups found in this study were similar to those identified by Lagardère (1972) in specimens of *P. longirostris* coming from Morocco. The only differences refer to foraminiferans and ophiuroids, found by this Author in higher and lower number, respectively; this is probably due to the different distribution pattern of these taxa in the two different study areas. Moreover, Lagardère (1972) reported a minimum of feeding activity at the beginning and at the end of the night. The diet of *P. longirostris* caught off the Majorca Island is constituted mainly of decapods, fragments of the brachiopod *Griphus vitreus*, organic material and mud (Massuti, 1953).

Studies on the natural diet of various penaeids species report that the main component of the their diets were crustaceans, followed by molluscs, polychaetes and echinoderms (Lagardère, 1972; Chong and Sasekumar, 1981; Luna-Marte, 1982; Wassenberg and Hill, 1987; Dall *et al.*, 1990). Also in captivity some penaeids, e.g. *Penaeus vannamei*, prefer to consume little crustaceans (Ogle and Beaugez, 1991).

The important role of amphipods and mysids as food resource is reported also for the diet of gadiform fishes, especially the juveniles, inhabiting the continental slope and shelf of the same area (Sartor, 1995). The feeding on bivalves, gastropods and ophiuroids, organisms with high calcium content, may represent an important source for the moulting individuals and might facilitate the action of the gastric mill (Suthers, 1984).

In the decapods the digestion process takes place rapidly, with food being retained in the stomach for only a few hours (Roe, 1984); however, preys containing mostly hard parts may be retained for much longer time than those constituted principally of fleshy tissues (Wassenberg and Hill, 1987). Thus, the apparent importance of particular prey groups in the diet (e.g. cephalopods and annelids) will be underestimated, as noted by Sardá and Valladares (1990).

The organic detritus generally consisted of macerated bodies of different animals, e.g. crustaceans, molluscs, polychaetes and fish. This material may come also from the bottom sediment, representing a substrate for micro-organisms like bacteria, fungi and protozoans (Watling, 1989). Chong and Sasekumar (1981) found that the use of organic detritus as a food source resulted important for *Penaeus merguensis* when it assumes the benthic habits.

The finding of bigger quantity of organic detritus in the specimens caught down 300 m, may be related to a reduction of the feeding activity or to a change of the diet with the depth. In agreement with this hypothesis, Lagardère (1972) reported a reduction of the feeding activity in the oldest specimens that live mostly at the highest depth.

In conclusion, the results of this preliminary study show that *P. longirostris* seem to be an important opportunistic predator in the continental slope communities of the Tyrrhenian Sea. However, further studies to examine the nyctemeral feeding rhythms and to determine the trophic strategies as a function of changes in the available resources according to depth and season, are necessary.

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