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DECAPOD FAUNA OF SEAGRASS BEDS IN THE ROVINJ AREA

FAUNA DESETERONOŽACA LIVADA MORSKIH CVJETNICA OKOLICE ROVINJA

Z. Ševčić

Ruđer Bošković Institute, Center for Marine Research
Rovinj, Croatia

Seagrass beds composed of the eelgrass Zostera marina , Zostera noltii and *Cymodocea nodosa* were formerly widely distributed in the Rovinj area (northern Adriatic Sea). At present, only small patches in some sheltered bays have remained. The seagrass beds are very rich in decapod fauna, 42 species have been sampled in the area. Some of these species are very common, whereas some of them are rarely reported from the Adriatic Sea. The data presented refer to the presence of species, their abundance, seasonal variation with some remarks on their role in the community.

INTRODUCTION

About twenty years ago, in the Rovinj area (northern Adriatic Sea) large surfaces of shallow sublittoral sandy bottom mixed with mud and detritus were covered by seagrass. The dense seagrass meadows were composed of vascular plants of the family Potamoge tonaceae (sometimes known as Zosteraceae) such as *Posidonia oceanica, Zostera marina, Zostera noltii* (in the elder literature often named *Zosterella nana*) and *Cymodocea nodosa* , as well as of green, brown and red algae. Unfortunately, in the course of time bottom surfaces covered with seagrasses had gradually diminished in size, so that at present only small patches in some sheltered bays have remained. Since seagrass beds had been rich in decapod Crustacea, in which they find food and shelter, seasonal investigations were performed in localities where the beds are still more or less preserved (Saline, Leso, Ruja Bays). The investigations aim to document the species composition, the seasonal variations, their importance in the food web and provide some

additional autecological data for some species before possible disappearance of seagrass beds in general. The first investigation of the decapods *Liocarcinus arcuatus* and *Paguristes oculatus* (present valid name: *P. eremita*) in the seagrass beds of the Rovinj area in 1981 and followed by investigations of *Macropodia rostrata* started in 1987. Since during the samplings of the three afore mentioned species a great number of other decapod species were captured the study of ecological and faunistic features of these species represents the subject the present paper.

HISTORICAL BACKGROUND

The seagrass associated decapod Crustacea have been often investigated in the world seas, but the attention has been chiefly focused on *Posidonia oceanica* beds (P é r è s, 1967; C h e s s a *et al.*,1972; C h e s s a *et al.*,1983; F r e s i *et al.*,1984; Z u p i and F r e s i, 1985; G a r c í a R a s o ,1990) which cover large surfaces in the Mediterranean Sea. The decapods occurring in beds of other seagrass species attracted less attention of the oceanologists. It is noteworthy that the community of the globally wide-spread eelgrass *Zostera marina* has been investigated in many areas in particular in the North Sea (R a s m u s s e n, 1973) and in the English Channel (La Manche) (J a c o b s, 1982; J a c o b s *et al.* 1982; J a c o b s and H u i s m a n, 1982), and in Japan (K i k u c h i, 1966). Some very important studies on the seagrass beds associated decapods were carried out in the subtropical waters of Florida (G o r e *et al.*, 1981; N e l s o n, 1981; H o l m q u i s t *et al.*, 1989).

Despite the fact that *Zostera* and *Cymodocea* are wide-spread in the Adriatic Sea, in particular on the north-eastern coast (P é r è s and G a m u l i n - B r i d a, 1973), there are only some spare papers mentioning decapods associated with these beds. V a t o v a (1928) was the first to give some data on decapod species sampled on some seagrass beds from the Rovinj area. More important data on decapods occurring in seagrass meadows of the Venice lagoon gave G i o r d a n i - S o i k a (1946). He listed 15 decapod species associated with *Zostera* beds. A v č i n *et al.*, 1974 analyzed in detail the seagrass communities of Koper and Strunjan Bays, but they reported only a few species. Later M a n n i n g and Š t e v č i ć (1982) mentioned several decapod species from seagrass beds sampled in the Piran Gulf.

In the Rovinj area, as afore mentioned, V a t o v a (1928) first listed some species from eelgrass beds. Ten years later B e n a c c h i o (1938) investigated the flora of seagrass meadows of the Rovinj area. Some more detailed data on the presence and abundance of decapods occurring in seagrass beds were given by G a m u l i n - B r i d a (1967), who listed 11 species. Some data of new decapod species for the Adriatic Sea captured in the area were listed by Š t e v č i ć (1985, 1990b). Data on the autecology of three decapod species (*Paguristes eremita* , *Liocarcinus arcuatus* and *Macropodia rostrata* from the investigated area were published by Š t e v č i ć (1986,

1987 and 1990a).

STUDY AREA

The decapods used in the present study were sampled in three localities: Saline, Leso and Ruja Bays (Fig. 1). All three bays are situated northwardly from the town of Rovinj, but in its immediate proximity. The localities are the following:

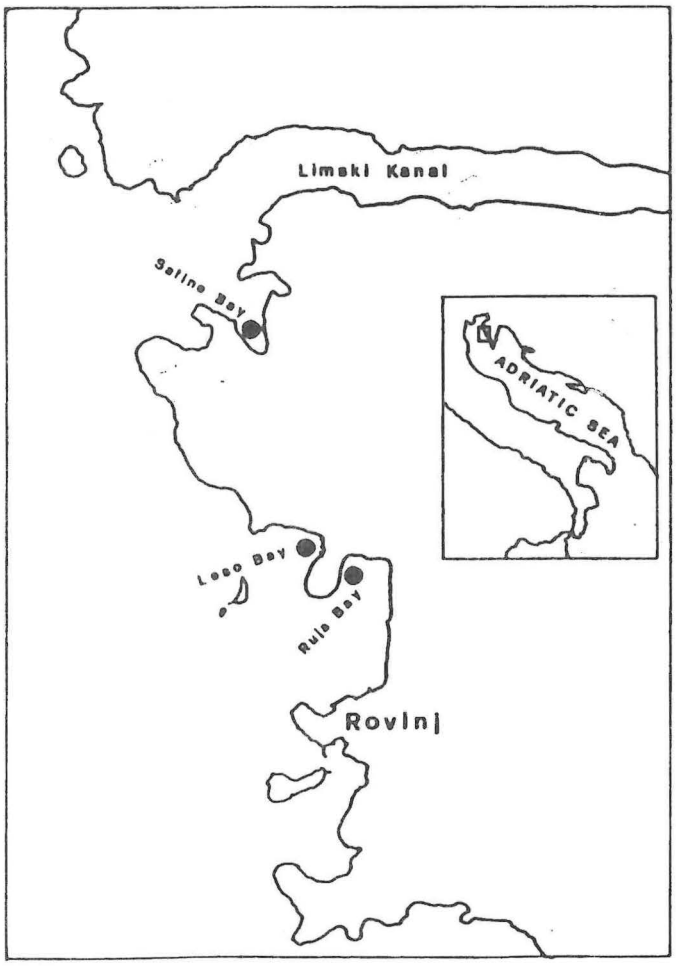

Fig. 1. Map of the study area. Full circles show the sampling localities

Saline Bay is situated at the mouth of Limski Kanal. The bay is semielliptical in shape opened to north-west winds. The maximum depth in the middle is about 23 m, but (at present) the seagrass beds occur at about 1.5 to 5 m in depth. The substrate is muddy sand mixed with detritus and covered by vegetation, formerly almost of *Zostera marina* and now replaced almost by *Zostera noltii* accompanied by a great number of various algae: *Rytiphloea tinctoria, Cladophora prolifera, Spyridia filamentosa, Dictyota dichotoma, Chaetomorpha linum, Dasycladus clavaeformis* and others. The fauna is very rich in forms and composed of fishes, crustaceans, snails, bivalves, sea-cucumbers and others. At present surfaces covered by seagrass are highly reduced, probably caused by pollution of touristic activities.

Leso (Valdelesso) Bay is located north-westwardly from the Muča (Mucia) peninsula on which the hospital is located. The bay is broadly opened to the open sea, but partly protected from the west wind by the island Figarola. It is relatively shallow (up to about 10 m). The substrate is sandy and mixed with mud and detritus. The seagrass bed is restricted to some patches separated from each other with sandy belts and distributed only between 2-5 m. The flora is composed of *Cymodocea nodosa* and *Zostera noltii* associated by some algal species which are not so rich in species as in the above mentioned bay. The fauna is also relatively very poor.

Ruja Bay is in fact a north-eastern corner of Valdibora Bay and situated southwardly of the Muča peninsula. It is broadly opened to south and south-west winds. The water is polluted. The bay is very shallow (less than 7 m). The sandy bottom is mixed with mud and detritus, covered by vegetation, in particular of various algae such as *Ulva rigida, Cladophora prolifera, Dictyota dichotoma, Spyridia filamentosa, Ectocarpus* sp. and eelgrass *Cymodocea nodosa* . The vegetation is rather dense and almost covers the bottom although surfaces covered with vegetation have gradually diminished in size so that patches of sand have been larger and larger in the last time. The fauna is rather rich in various forms such as fishes, snails, sea-cucumbers and others. The material was sampled at depths between 1.5 and 3 m.

MATERIALS AND METHODS

The material was collected in the morning by a local dredge (in fact a small beam-trawl) known as "musular". The gear mostly sampled animals of greater size (macrobenthos) including the majority of decapods, whereas the majority of smaller swimming shrimps such as various species of the families Processidae and Hippolytidae (as well as decapod larvae) were captured only occasionally. At the outset the samples were taken monthly all year round, and later samples were taken at less regular intervals to cover complete seasonal cycles and eventual temporal changes. The decapods were separated on the boat and preserved in the neutralized 5 % formol solution and later analyzed in the laboratory. For rare species only the presence and

number were recorded, for more frequent species, in particular brachyuran crabs, the dimensions of carapace, sex, and reproductive cycle (ovigerous females) were recorded. Identification of stomach (in fact: fore-gut) contents was performed at the finest possible taxonomic level.

RESULTS AND DISCUSSION

Species diversity

The (macro) decapod fauna of seagrass beds of the Rovinj area exhibits a marked species diversity. However there are some considerable differences in the faunal compo sition of particular localities and therefore they must be considered separately.

Saline Bay

The decapod fauna of Saline Bay possesses the maximal number of recorded species. It comprises 34 species, and as visible from Table 1 some species are very rich in the number of specimens. The most abundant decapod species of Saline Bay are the following: *Liocarcinus arcuatus*, *Paguristes eremita*, *Sicyonia carinata* and *Macropodia rostrata* (captured more than 100 specimens). On the other hand the majority of the species was captured in a number of less than 30 specimens. From rarely reported species from the Adriatic Sea it is worthy to note the six following ones: *Periclimenes amethysteus*, *Philocheras fasciatus*, *Anapagurus breviaculeatus*, *Galathea cenarroi*, *Liocarcinus vernalis*, *Macropodia czernjawskii*, *M. linaresi* and *Inachus communissimus*. The number of small swimming shrimps such as various processids and hippolytids is low because of the inadequacy of the sampling gear, but these shrimps are rather common in the investigated area.

Leso Bay

The results of investigations of the decapod fauna of Leso Bay is presented in Table 2. In this bay 26 species were sampled. The first reason for such a low number of species lies in the fact that the seagrass beds were very damaged and consequently the flora and fauna were very reduced. The second reason of the low number of species and specimens is due to a lesser number of samplings in comparison with the above mentioned bay. In this bay the most frequent species are the following: *Macropodia*

rostrata, Palaemon xiphias, Sicyonia carinata and *Liocarcinus arcuatus.* Among the else rare species noteworthy are the following: *Philocheras trispinosus , Liocarcinus vernalis, L . bolivari, Macropodia czernjawskii* and *M. linaresi.*

Ruja Bay

Like Saline Bay this locality exhibits a considerable species diversity and abundance in specimens. Despite the fact that pollution influences this seagrass community the vegetation is still more or less well developed and consequently more species and specimens were sampled. In this bay 30 species were recorded, from which the most abundant were the following: *Palaemon adspersus , Pagurus anachoretus , P. xiphias, Macropodia rostrata* and *Liocarcinus arcuatus* . In this bay the hermit crabs are rather frequent, whereas the shrimps and crabs are relatively less frequent than in Saline Bay. From rare 7 species in the area can be mentioned: *Periclimenes amethysteus , P . scriptus , Philocheras fasciatus , P . trispinosus , Anapagurus breviaculeatus,* and *Macropodia czernjawskii* .

If we compare all results including the number of species with the corresponding number of specimens per particular locality (Tab. 4) we can see all the similarities and differences between them. In all three localities 42 decapod species were sampled. The number of decapod species associated with seagrass communities from the investigated area is unexpectedly high. In species richness the decapod fauna of the Rovinj seagrass beds can be compared with that from some subtropical regions e.g. Florida, where G o r e *at al.* (1981) recorded 36 species and H o l m q u i s t *et al.* (1989) found 51 species, or with the southwest Mediterranean coast of Spain from which G a r c i a R a s o (1990) reported 50 decapod species. It must be pointed out that all localities have, in particular at the present time, very damaged seagrass beds, and therefore the number of species is presumably not so high as formerly. Moreover Rovinj is situated in the northern part of the Adriatic Sea where else the number of species is reduced in relation to the Mediterranean Sea. In our samples some species listed in papers of Italian and Spanish researchers are lacking, such as: *Eualus occultus , Calcinus tubularis , Lysmata seticaudata , Ebalia deshayesi , Paractaea monodi* etc. which occur in the southern Mediterranean parts. It is astonishing that some species captured earlier in the area such as *Cestopagurus timidus* and *Acanthonyx lunulatus* were not recorded during the investigations.

Concerning the differences between the localities, as visible from tables 1-3, they are considerable as in the species composition as in the number of specimens per species. In spite of the differences 20 species are common for all three localities, the remaining 22 species are variously presented in each bay. In order to numerically express the ifferences in fauna composition of these three bays the Sörensen's quotient (QS) of similarity was used. It is the following:

Saline - Leso 73.33 Saline - Ruja 78.13

Leso - Ruja 75.00

As visible the maximal quotient similarity is between Saline and Ruja, whilst the minimal similarity is between Saline and Leso. The differences are, however, more expressed in the number of specimens of various species making the fauna composition of these bays very different. The differences are caused by two principal reasons. In the bays the process of degradation of seagrass beds is of a various degree. The greatest degradation is in Leso Bay where the number as of species as of specimens is the lowest. In Saline Bay where the seagrass bed, which was at the outset of investigations, was not damaged, and the number of species was considerably great, whereas the last sampling showed the diminishing in species and specimens numbers. In Ruja Bay the vegetation cover is still ever rather dense so that the conditions of occurrence of decapods is more or less satisfactory, although the degradation is visible. The second reason of differences lies in the vegetation composition, where the ratio algae : seagrasses is different in the investigated bays. The algae are dominant in Ruja Bay, different and less numerous in Saline, and reduced in Leso Bay. It is regrettable that these natural communities constantly disappear and that these investigations will soon be only of historical interest.

The majority of recorded species have been previously known as common inhabitants of seagrass beds (Palaemonidae, Processidae, Hippolytidae, *Anapagurus breviaculeatus, Macropodia* - species. The most abundant species occurring in all three localities are *Liocarcinus arcuatus* (365 captured specimens), *Paguristes eremita* (278), *Macropodia rostrata* (247), *Palaemon adspersus* (228), *Sicyonia carinata* (209) and *Palaemon xiphias* (202 specimens) and can be considered as true inhabitants of seagrass beds. The majority of species are not so closely "tied" to the seagrass beds and can be found in others shallow infralittoral communities e.g. *Maja crispata, Pisidia longimana , Athanas nitescens , Paguristes eremita, Ethusa mascarone* and others. Some species such as *Diogenes pugilator , Philocheras trispinosus* or *Parthenope angulifrons* are mostly inhabitants of fine sand bottoms but occasionally enter seagrass beds.

Reproduction period

As a by-product of the long-term faunistic investigations of the decapod fauna of seagrass beds obtained some very interesting data on the ecology of many species were obtained. These new data refer mainly to the time of reproduction or more precisely when the females are ovigerous, what is possible to establish for all decapods with the exception of Penaeidea, or in this case of *Sicyonia carinata* . The data are presented in

Table 4. The time of reproduction of many species of the Adriatic decapods was already recorded by Pesta (1918) and here are added some new data for the majority of sampled species. Due to regular monthly samplings it was possible to record more precisely the time when the females are ovigerous. The present data agree in the majority of cases with the old ones, but some are quite new, because many new species after Pesta were recorded for the area.

Migrations

V a t o v a (1943) first observed seasonal changes in communities composition in the Rovinj area, but he did not directly work on the seagrass beds. The seasonal fluctuation in total abundance of the decapod species was directly investigated by H e c k (1976) and J a c o b s *et al.* (1982). How it is with the seagrass associated decapods in the Rovinj area? Since the samples were taken all year round it was possible to follow the changes in the species presence and specimen number. From the tables 1-3 it is visible that some species as for instance *Macropodia rostrata* exhibit a marked seasonality in the specimen number. It was frequent during the colder months but during August was always minimal, but during this period it can be sampled in other communities in deeper water (S t e v c i c, 1990a). In contrary *Maja crispata* (formerly known under name *M. verrucosa*) is more frequent during the summer months than during winter. It shows that many species perform an offshore-inshore migration in a greater or lesser degree. The number of hermit crabs is more or less constant during all seasons with the exception of *Paguristes eremita* which in Saline Bay was more frequent during summer.

Autecology

The primary task of the present investigations, as mentioned above, was the study of some most abundant decapod species, which results have been already published (S t e v c i c, 1987, 1989, 1990a). Namely, for autecological investigations of a species a greater number of specimens must be available (almost between 200-300), which can be captured during all seasons. Accordingly three most abundant species (*Paguristes eremita* , *Liocarcinus arcuatus* , *Macropodia rostrata*) were investigated. Other species captured in a lesser number of specimens give only a partial picture of their main autecological characters, but since they are more or less rarely reported every information could serve for their more complete knowledge. Some data on abundance and seasonality and time reproduction are presented in the four tables and here will be added only data concerning their food items. Additional data refer to the following species:

Macropodia longirostris . The maximal carapace length recorded during investigations

was 30.5 mm and 13.2 mm width. The minimal size of ovigerous female was 21.2 mm in carapace length and 11.0 in width. The stomach content of 24 specimens was analyzed finding algae (20 times), detritus (4), seagrass (3), shrimps (3), isopods (1), polychetes (1), sand (6) and undetermined organic matter (7).

Macropodia czernjawskii . Maximal carapace length was 10.3 mm and width 5.3 mm. Minimal ovigerous female: 6.3 mm length, and 4.3 mm width. Only five stomachs were analyzed and twice finding amorphous organic mater, and detritus and sand only once.

Inachus communissimus . Maximal carapace length was 22.5 mm and width 24.0 mm. Minimal size of ovigerous females 11.1 mm length and 11.8 mm width of the carapace. 19 stomachs were analyzed. Sand (20 times), detritus (17), polychetes (6), shrimps (4) other decapods (3), higher vascular plants (3) and compact organic mater (4 times) were found.

Pagurus cuanensis . In this hermit crab 39 stomachs were analyzed and finding: detritus (32 times), sand (25), algae (4) vascular plants (7) (mostly seagrass), bivalves (1), undetermined organic mater (3).

Diogenes pugilator . 18 stomachs were analyzed. They contained: sand (16 times), detritus (16), vascular plants (1), and undetermined organic matter (1).

Decapods in the food web

Due to a great number of decapods in the seagrass beds their role in the food web is of considerable importance. It has been already established for *Posidonia oceanica* and other beds (C h e s s a *et al.*, 1972; N e l s o n, 1981; C h e s s a *et al.*, 1983; F r e s i *et al.*, 1984; Z u p i and F r e s i, 1985). The examination of a great number of stomach contents of decapods captured in the investigated area have been already published and here presented indicates the important role of decapods in food webs in seagrass communities. The decapods represent a very important chain in the links of matter and energy circulation. The decapods feed on various food items and they are eaten by many other predators. They are almost opportunistic omnivores and they use for their food all edible organisms in their immediate proximity. They often feed on the bottom surface layer containing detritus and sand, but only rare species are specialized for such a feeding (*Diogenes pugilator*). Moreover the majority feed on all animals which they are able to catch, but only *Palaemon xiphias* is known as a true predator (F r e s i *et al*, 1984). It is unexpected that the portunid crab *Liocarcinus arcuatus* feed partly with plants and that some decapod can eat seagrass which is avoided by the majority of other animals.

CONCLUSIONS

In the Rovinj area the bottom surfaces covered by seagrass beds composed of *Zostera marina* , *Z. noltii* and *Cymodocea nodosa* mixed with algae have diminished together with the associated decapod fauna. Seagrass beds remained only in some sheltered bays and they were investigated in Saline, Leso and Ruja Bays. The decapod fauna is composed of 42 species, from which some species are very abundant permitting autecological investigations. Due to seasonal and long term investigations some important data concerning their abundance, migrations, reproductive periods and food items were obtained.

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Z. Š t e v č i ć

Institut "Ruđer Bošković", Centar za istraživanje mora, Rovinj, Hrvatska

KRATKI SADRŽAJ

Livade morskih cvetnica koje sačinjavaju vrste *Zostera marina, Z. noltii* i *Cymodocea nodosa* (porodica Potamogetonaceae) do prije dvadesetak godina bile su široko rasprostranjene na rovinjskom području. Sada su preostale samo male površine ("pjege") podmorskih livada pretežno u nekim zaštićenim uvalama. Te livade imaju izvanredno bogatu faunu deseteronožnih rakova (Crustacea Decapoda) koju sačinjavaju 42 vrste. Neke od nazočnih vrsta, prvenstveno onih koje žive u dobro istraženim livadama voge (*Posidonia oceanica*) i koje su široko rasprostranjene srazmjerno su dobro poznate, dok su nekoliko njih vrlo rijetke i stoga vrlo slabo istražene. Zahvaljujući dugogodišnjim sezonskim istraživanjima triju uvala okolice Rovinja (Saline, Leso i Ruja) omogućeno je bolje poznavanje bogatstva vrsta, njihove ekologije i rasprostranjenosti. Za veći broj vrsta utvrđeno je njihovo sezonsko kolebanje, vrijeme razmnožavanja, a za nekoliko vrsta i sastav hrane te time njihovo mjesto u lancu kruženja tvari i energije u ovoj specifičnoj životnoj zajednici.

Table 1.

Day	13	25	04	10	17	20	18	18	20	17	16	13	19	03	17	04	28	15	15
Month	10	11	01	02	03	04	05	06	07	08	09	10	11	05	08	12	02	06	10
Year	81	81	82	82	82	82	82	82	82	82	82	82	82	84	84	84	85	90	90
Sicyonia carinata	6	6	10	10	9	4	3	4	4	2	3	15	16	2	-	10	6	11	4
Hippolyte inermis	-	-	-	-	2	-	-	-	1	1	-	-	-	1	-	-	-	-	-
Thoralus chranchi	-	-	-	-	1	-	1	-	-	-	-	-	-	1	-	-	-	2	-
Processa edulis	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	
Palaemon adspersus	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	2
Palaemon xiphias	-	-	-	-	-	-	-	-	-	-	4	8	4	-	-	4	5	-	9
Periclimenes amethysteus	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Philoceras fasciatus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Paguristes eremita	3	11	24	14	16	33	32	29	23	16	33	5	6	3	-	-	2	1	-
Diogenes pugilator	-	-	2	-	2	-	3	8	3	1	1	1	-	-	-	-	-	-	-
Clibanarius erythropus	-	1	-	-	-	2	-	1	1	-	-	-	2	-	-	-	-	-	-
Anapagurus breviaculeatus	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Pagurus anachoretus	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	1	-	-
Pagurus cuanensis	-	-	1	8	1	8	4	2	3	5	4	3	1	-	-	-	1	-	-
Galathea cenarroi	-	-	4	9	4	2	3	2	-	-	-	1	-	-	-	-	-	1	-
Galathea intermedia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Galathea squamifera	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pisidia longimana	-	-	8	5	3	3	-	2	3	2	1	1	-	-	-	2	-	2	-
Porcellana platycheles	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
Pilumnus hirtellus	1	2	-	-	2	-	-	2	-	2	4	1	-	-	1	-	-	-	-
Carcinus aestuarii	1	1	-	1	-	8	3	-	-	-	1	-	-	4	-	-	6	-	-
Liocarcinus arcuatus	25	11	15	14	15	34	22	22	5	3	-	27	14	6	7	5	50	15	2
Liocarcinus vernalis	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Maja crispata	-	2	-	2	-	-	-	-	-	-	1	-	4	-	-	-	-	-	-
Macropodia czernjawskii	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	4	-	-	-
Macropodia linaresi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Macropodia longirostris	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-
Macropodia rostrata	-	2	15	15	22	7	2	4	-	-	23	1	2	7	-	18	2	2	-
Inachus communissimus	-	-	-	8	2	7	2	-	-	-	-	-	-	1	-	-	-	-	-
Achaeus cf. gracilis	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-
Pisa cf. muscosa	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Parthenope angulifrons	1	-	1	1	2	2	-	-	5	-	-	-	-	-	1	-	-	-	-
Ethusa mascarone	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	1	-
Ilia nucleus	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2.

Day	02	09	12	02	47	10	08	19	16	11	13	15	16	15	20
Month	03	04	05	06	07	08	09	10	11	12	01	05	06	10	02
Year	87	87	87	87	87	87	87	87	87	87	88	90	90	90	91
Sicyonia carinata	1	-	-	-	4	1	1	-	20	23	9	-	3	1	3
Hippolyte inermis	-	-	-	-	1	2	1	-	1	-	-	-	-	1	1
Hippolyte longirostris	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Thoralus chranchii	-	-	1	3	-	-	-	-	-	-	-	3	-	-	-
Athanas nitescens	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Processa edulis	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
Palaemon adspersus	1	-	2	-	-	-	-	-	-	3	7	-	-	-	-
Palaemon xiphias	2	-	1	1	5	4	1	9	14	22	-	1	1	22	6
Philocheras fasciatus	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Philocerhus trispinosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Paguristes eremita	-	-	-	-	1	1	-	-	2	-	-	-	-	-	-
Diogenes pugilator	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-
Pagurus anachoretus	-	-	-	-	1	-	1	-	-	1	1	2	2	-	-
Pagurus cuanensis	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-
Pisidia longimana	1	-	-	-	1	-	-	-	-	-	1	-	-	-	-
Liocarcinus arcuatus	5	2	-	-	-	-	3	4	4	5	2	2	2	2	5
Liocarcinus bolivari	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Liocarcinus vernalis	-	-	-	5	-	-	-	-	-	-	-	-	-	-	2
Maja crispata	-	-	-	-	12	1	1	-	-	-	-	-	-	-	1
Inachus communissimus	1	1	-	-	-	-	-	-	-	1	-	-	-	-	-
Macropodia czernjawskii	-	-	-	-	-	-	2	-	-	3	3	1	-	1	-
Macropodia linaresi	-	-	-	-	-	4	-	-	-	-	-	-	1	3	-
Macropodia longirostris	1	1	-	-	-	-	-	1	3	1	8	-	-	1	-
Macropodia rostrata	1	8	-	-	-	-	1	7	11	12	25	-	-	-	4
Parthenope angulifrons	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Ilia nucleus	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-

Table 3.

Day	02	09	19	02	14	10	26	08	19	16	11	13	13	04	19	15	15	20
Month	03	04	05	06	07	08	08	09	10	11	12	01	02	03	06	05	10	02
Year	87	87	87	87	87	87	87	87	87	87	87	88	88	88	88	90	90	91
Sicyonia carinata	-	-	-	-	-	-	-	-	-	1	8	-	2	3	2	-	1	1
Hippolyte inermis	-	1	1	1	3	1	6	2	2	-	-	-	-	3	-	-	-	-
Thoralus cranchii	-	1	-	3	-	-	-	-	-	-	-	-	-	1	1	-	1	-
Alpheus dentipes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Processa edulis	-	1	-	-	-	-	-	-	-	2	1	-	1	1	1	1	-	-
Palaemon adspersus	-	1	9	-	9	1	9	5	15	16	28	11	19	12	6	6	36	25
Palaemon elegans	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Palaemon xiphias	-	-	2	-	2	1	1	2	17	25	14	4	7	-	1	1	2	-
Periclimenes amethysteus	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Periclimenes scriptus	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Philocheras fasciatus	-	6	-	-	-	-	-	-	-	-	6	-	-	6	-	-	-	-
Philocheras trispinosus	-	-	-	-	1	-	-	-	-	-	3	-	-	4	-	-	-	-
Paguristes eremita	1	1	-	2	2	1	1	-	-	-	2	1	2	1	3	3	-	2
Diogenes pugilator	-	-	2	1	2	-	1	3	-	-	-	-	-	1	4	20	-	-
Clibanarius erythropus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Pagurus anachoretus	-	-	5	2	-	4	1	6	1	3	15	7	3	2	-	4	1	-
Pagurus cuanensis	2	2	1	1	-	-	-	1	-	-	3	-	2	6	5	-	-	-
Anapagurus breviaculeatus	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Pisidia longimana	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pilumnus spinifer	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Carcinus aestuarii	-	-	-	-	1	-	-	1	-	-	1	1	-	2	-	-	-	1
Liocarcinus arcuatus	2	1	5	2	-	-	1	-	2	3	2	6	-	-	2	6	3	1
Maja crispata	-	-	-	-	-	2	-	1	-	-	1	-	-	-	-	-	-	-
Achaeus cf. gracilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Inachus communissimus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Macropodia czernjawskii	-	3	-	-	-	-	-	-	1	-	2	4	2	-	-	-	1	-
Macropodia linaresi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Macropodia longirostris	3	1	1	-	-	-	-	1	1	-	2	-	1	-	1	-	-	-
Macropodia rostrata	14	1	-	-	-	-	1	1	5	3	6	8	8	4	2	-	-	3
Parthenope angulifrons	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-

Table 4.

Species	Localities	Localities	Localities	Reproduction time
	Saline	Leso	Ruja	(Ovigerous females)
Sicyonia carinata (Brünnich, 1768)	125	66	18	
Hippolyte inermis Leach, 1815	5	7	20	IV-X
Hippolyte longirostris (Czerniavsky, 1868)	-	1	-	-
Thoralus cranchii (Leach, 1817)	5	7	6	V-VI
Athanas nitescens (Leach, 1814)	-	1	-	-
Alpheus dentipes Guérin, 1832	-	-	1	-
Processa edulis (Risso, 1816)	2	2	8	-
Palaemon adspersus Rathke, 1837	6	14	108	IV-VIII
Palaemon elegans Rathke, 1837	-	-	1	-
Palaemon xiphias Risso, 1816	34	89	79	V-IX
Periclimenes amethysteus (Risso, 1827)	2	-	2	VI-X
Periclimenes scriptus (Risso, 1822)	-	-	1	-
Philocheras fasciatus (Risso, 1816)	1	1	18	III-VI
Philocheras trispinosus (Hailstone, 1835)	-	5	8	III
Paguristes eremita (Linnaeus, 1767)	251	5	22	III-VII
Diogenes pugilator (Roux, 1829)	21	3	34	V-VII
Clibanarius erythropus (Latreille, 1818)	7	-	4	VII
Pagurus anachoretus Risso, 1827	4	8	54	V-IX
Pagurus cuanensis Bell, 1845	41	2	23	I-IX
Anapagurus breviaculeatus Fenizia, 1937	2	-	3	II
Galathea cenarroi Zariquiey Alvarez, 1968	26	-	-	-
Galathea intermedia Lilljeborg, 1851	1	-	-	-
Galathea squamifera Leach, 1814	1	-	-	-
Pisidia longimana (Risso, 1816)	32	3	1	IV-IX
Porcellana platycheles (Pennant, 1777)	3	-	-	-

Table 4.continued

Pilumnus hirtellus (Linnaeus, 1761)	15	-	-	IX
Pilumnus spinifer H. Milne Edwards, 1834	-	-	1	-
Carcinus aestuarii Nardo, 1847	25	-	7	II-III
Liocarcinus arcuatus (Leach, 1814)	286	43	36	II-VI
Liocarcinus bolivari Zariquiey Alvarez, 1948	-	1	-	-
Locarcinus vernalis (Risso, 1816)	1	2	-	-
Maja crispata Risso, 1827	6	15	4	VIII
Achaeus cf. gracilis O. G. Costa, 1839	3	-	1	V
Pisa cf. muscosa (Linnaeus, 1758)	1	-	-	-
Inachus communissimus Rizza, 1829	20	3	1	I-V
Macropodia czernjawskii (Brand, 1880)	10	10	13	-
Macropodia linaresi Forest & Zariquiey Alvarez, 1964	1	8	2	VIII
Macropodia longirostris (Fabricius, 1775)	7	16	11	IV-V
Macropodia rostrata (Linnaeus, 1761)	122	69	56	I-VI
Parthenope angulifrons Latreille, 1825	13	1	2	IV
Ethusa mascarone (Herbst, 1785)	1	-	-	-
Ilia nucleus (Linnaeus, 1785)	1	1	-	-