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Habitats and biodiversity of decapod crustaceans in the SE Gulf of California, México

Michel E. Hendrickx
Estación Mazatlán, Instituto de Ciencias del Mar y Limnología, UNAM. Apdo. Postal 811, Mazatlán 82000 Sinaloa, México.

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Abstract: Samples of benthic macro-fauna were obtained in different habitats along and off the coast of Southern Sinaloa, Gulf of California, Mexico, from 1978 to 1991. Occurrence of species of decapod crustaceans was registered for six habitats, from the intertidal to depth of 1200 m. A total of 299 species were collected, belonging to 53 families and including 17 species of Penaeoidea, 45 of Caridea, 6 of Thalassinidea, 5 of Palinura, 1 of Astacidea, 63 of Anomura, and 162 of Brachyura. Number of species varied considerably from one habitat to another. Highest biodiversity was observed in the Bay of Mazatlán, with 121 species, followed by the continental shelf and the rocky intertidal (107 species each), the estuarine/coastal lagoons (48 species), the upper slope (18 species) and the sandy beaches (9 species). One species was found to be strictly insular-terrestrial and two are primarily associated with the flotsam. The results of this survey were compared with distribution data available for decapod crustaceans fauna from the SE Gulf of California and the Eastern Tropical Pacific zoogeographic region (ETP). The fauna collected represents 82% of the species cited for the area for coastal and shallow subtidal habitats (to ca. 115 m depth) and 57.6% of deep-water (> 200 m) species known to occur in the Gulf of California. Except in two cases, similarity indices (SI) based on number of species common to any pair of habitats were all very low. Continental shelf and the Bay of Mazatlán have 57 species in common (SI = 0.50), while rocky shore habitat and the Bay of Mazatlán share 27 species (SI = 0.24). Comparative studies of decapod crustaceans communities for the ETP are almost lacking alltogether. Available data, however, indicate that biodiversity observed in Southern Sinaloa is so far the highest on record for marine and brackish-water habitats for a given section of this tropical zoogeographic region.

Key words: Decapod crustaceans, biodiversity, habitats, Gulf of California.

Subtropical and tropical marine invertebrates communities are largely undescribed. This is due fundamentally to the complexity of species-rich habitats found in tropical seas as well as to a lack of trained scientists and institutional infrastructure in many countries bordering them. Consequently, present knowledge of many tropical marine communities is far from being adequate, and it might never be so considering their present rate of alteration by the increased frequency and intensity of anthropogenic damage (Hatcher *et al.* 1989). As stated by McNeely *et al.* (1990), "As more taxonomic and survey work is done [...] more new discoveries are made ... [and] ... more new gaps are found in the data". The same authors (*op. cit.*) emphasized the urgent need for an increase of comprehensive surveys and inventories which would require, as a basic tool, closer cooperation between major taxonomic institutions and training of a large number of parataxonomists to collect and document specimens. Taxonomic lists and biodiversity studies in specific habitats serve as points of departure for (among others) studying the structure of food chains, the relative abundance of species, and number of species or total number of organisms of various physical sizes (May 1992). Although invertebrate groups often include small and obscure species, they must be counted along with other living resources requiring conservation and careful management (Beattie 1994). This is of paramount importance when one considers that conservation practice in poorly known areas of the tropics cannot be organized or reinforced without reliable inventory of resources and human activities (Hatcher *et al.* 1989). Two thirds of world population inhabits coastal areas, and while most tropical countries are still developing or testing their strategies of resources exploitation, their rapid development and population growth has already had a significant effect on resources utilization and a negative impact on natural coastal ecosystems (Birkeland 1987, Hatcher *et al.* 1989).

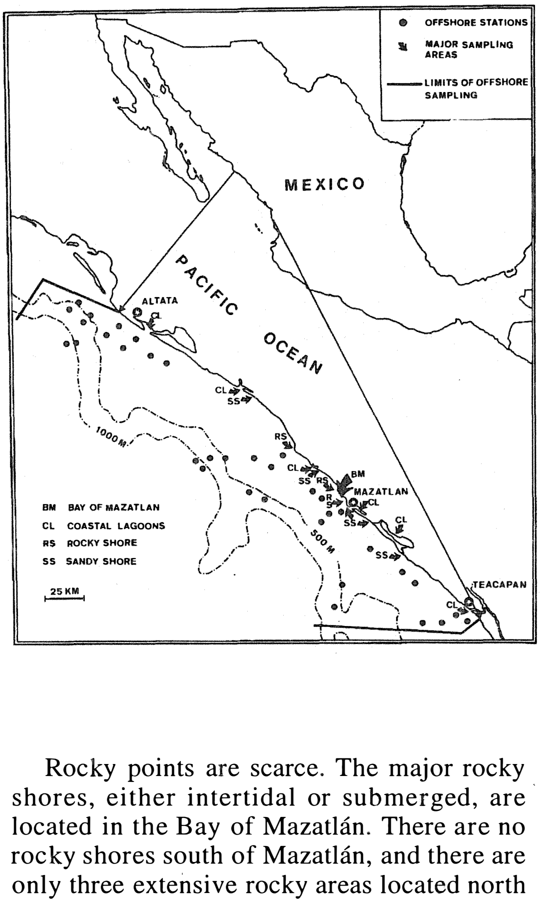
The Gulf of California, is now widely recognized as a zoogeographic province of the Eastern Pacific tropical region (see Brusca and Wallerstein 1979, Hendrickx 1992a, 1993a). Information dealing with its benthic decapod crustaceans fauna has increased dramatically in the last ten years (see Hendrickx 1993a, 1994b). Recent biodiversity studies on this group of invertebrates indicate that: 1) As many as 580 species are found in the Cortes Province (Gulf of California and SW tip of Baja California Peninsula); 2) This is the highest biodiversity recognized to date for any previously defined zoogeographic unit in the whole eastern tropical region (Mexico to northern Peru), where approximately 930 species of decapod crustaceans are known to occur; 3) Southern Sinaloa appears as one of the richest coastal and marine ecosystems, with 350 species (Hendrickx 1993a, 1993b, 1993c); 4) Deep-water (> 200 m) decapod crustaceans in the eastern Pacific Ocean number 183 species (Wicksten 1989), of which 100 occur within the limits of the Eastern Tropical Pacific (ETP); furthermore, review of Wicksten's data and of precise ranges of these deep-water species in the Gulf of California allowed Hendrickx (1990) to conclude that only 26 species were known to be present off the coast of Sonora-Sinaloa. Seven species were recently added to that list (Hendrickx 1995c).

From a zoogeographic stand point, the benthic macrofauna of the southern Gulf of California is under the influence of three major faunistic components. The warm temperate Californian fauna partly extends south of the recognized California Province southern boundary (Magdalena Bay, Baja California) and some species penetrate into the Gulf of California, along one or both coast. The endemic component of the Gulf, which accounts for 15.3% (Gulf of California proper) to 17.5% (Cortez Province, extended to Magdalena Bay) of the known species of decapod crustaceans, also represents an important factor as many endemics have their southernmost distribution limit close to or at the Gulf of California southern limit. Nevertheless, it is now clearly recognized that the SE Gulf of California macrofauna is predominantly influenced by the highly diverse tropical fauna of Panamic origin (Brusca 1980, van der Heiden and Findley 1989, Hendrickx 1992a, 1993b).

Considering the urgent need to develop a strategy for conservation of shallow tropical marine ecosystems from anthropogenic damages, and the necessity to establish a source of information to be used as a reliable reference of data in future comparative studies, a long-term sampling program was developed in Southern Sinaloa in 1979. Marine and estuarine shallow water systems were routinely sampled, including the continental shelf and the upper slope to about 1200 m depth. This paper presents the results of this survey, and it is believed to be the first to document the repartition of a given group of marine invertebrates - the decapod crustaceans - in a multi-habitats tropical coastal area from the West coast of America.

DESCRIPTION OF THE AREA

The area designated herein as "Southern Sinaloa" extends from Teacapan (22°30'N) to North of the Altata lagoon complex (24°40'N) (Fig. 1) along approximately 280 km of coastline. It is located in the southeastern section of the Gulf of California and includes major habitats such as sandy and rocky shores, coastal lagoons and estuaries, a large semi-protected bay (the Bay of Mazatlán) and a gently slopping soft and mixed bottom continental shelf (Hendrickx, 1986a, 1992a). The upper slope is found further offshore. The sandy shore habitat dominates the coastal area, with long and narrow stretches of beaches interrupted by rivers mouth or coastal-lagoons inlets. Of these, most correspond to seasonally overflowing coastal lagoons or river heads that dry up from December to May-June and accumulate water during the rainy season. Several major rivers connect to the sea all year round. Major coastal lagoons also connect permanently to the sea, sometimes through artificially maintained channels. Smaller coastal lagoons are connected permanently to the sea via an estuary, but most present a closed inlet that open only seasonally, generally during flooding periods, when accumulated rain water, high tides and heavy waves generated by tropical depressions off the Pacific coast of Mexico, combine to wash away the sand bar.



Rocky points are scarce. The major rocky shores, either intertidal or submerged, are located in the Bay of Mazatlán. There are no rocky shores south of Mazatlán, and there are only three extensive rocky areas located north of Mazatlán. Tidal amplitude is rather reduced (ca. 1.5 m) when compared to other areas of the Gulf of California, where tides of up to 10 m have been observed. Tidal currents are usually weak, although tropical depression and hurricanes occurring from July to October off the SW coast of tropical Mexico can have dramatic effect on the stability of beaches in the area (Montayo-Ley *et al.* 1988, Hendrickx 1993b).

One of the most interesting ecosystem in the area is the Bay of Mazatlán, a semi-enclosed body of water extending over approximately 40 km^2, with three major islands and two emerging rocks. The shore is mostly sandy with several rocky points and some large extension of rocky beaches found next to the hills and on the islands. Below about 5 m depth and immediately in front of the sandy beaches, the bottom is made of coarse and medium sand which is progressively replaced offshore with finer sand mixed with variable amount of silt and clay (Orozco-Romo 1980). Maximum depths of 14-15 m are found just beyond the islands, although depths of up to 20 m occur in the navigation channel at the harbor entrance.

The study area is under direct influence of the warm tropical Mexican Coastal Current in the summer (May to September). Shallow coastal water experience a considerable decrease in temperature during the winter (October to April) due to the influence of southwards flowing currents north of Cape Corrientes and local upwelling produced by northerly winds (Alvaréz-Borrego 1983, Hendrickx *et al.* 1984, Hendrickx 1995b). As in other tropical/subtropical areas, there are only two typical seasons in the SE Gulf of California, which are influenced more by wind, rainfall and current patterns than temperature. Onshore water temperatures normally vary between 30-32° C in the summer and 18-20°C in the winter. Subtidal epibenthic water temperatures in the Gulf of California have been analyzed by Hendrickx (1992a).The Southeastern Gulf of California presents relatively stable environmental conditions in the winter, with outer (90-110 m) and midshelf (60-75 m) temperature of 13.2 and 15.4°C, and inner shelf (30-40 m) temperature reaching 14.2-17.2°C. Summer bottom water temperatures are much higher on the inner shelf (26.4-27.2°C) than in deeper water (15.6-21.1°C). Below ca. 120 m the epibenthic environment becomes hostile with rapid dissolved oxygen depletion (< 0.5 ml O_2/l). Anoxic conditions consistently occur on the deeper part of the outer shelf and on the upper slope (Hendrickx 1995b) to ca. 500-750 m, depending on location. From 200 m and deeper, bottom water temperature decreases steadily from 11 to ca. 4-5°C at 1200 m (Hendrickx 1992b). Extension of the continental shelf (0-200 m) is notably significant in the

Cortez Province, and it represents 12.3% of the area covered by sea; comparative value for upper slope, to 1000 m, is 12.1%. This corresponds to a total of ca. 172,000 km^2 of offshore habitat (Hendrickx 1993a).

MATERIAL AND METHODS

Since 1979, specimens of decapod crustaceans were obtained from sampling operations in southern Sinaloa. Depending upon the habitat sampled, specimens were collected with dredges and grabs, otter trawls, cast nets, traps and baited lines, hand nets and by hand. Intertidal species were mostly collected by hand during low tides and rotenone fish-killer was occasionally used in rocky pools. In coastal lagoons deepest channels, samples were obtained with a small 25 x 50 cm bottom dredge while dip-nets were used along channel edges or in dense patches of sea-grass. Cast nets were also occasionally used in open areas and fish-baited traps were left overnight in deepest channels. Surf species were caught in depths of 1 to 2 m with a 25 x 50 cm bottom dredge. Soft bottom associated species of the Bay of Mazatlán were captured using 5 and 10 l Van Veen grabs and a 3.5 m x 4.5 m otter-trawl. The continental platform decapod crustaceans were collected with a 40 l Van Veen grab, a 2.5 m wide oyster dredge and semi-commercial or commercial otter trawls (12 to 28 m). Upper slope samples were obtained with a modified Agassiz dredge. All collected material was kept in a 4-8 % formaldehyde solution for at least 48 hours after collection. Samples were then washed with freshwater and preserved in 70 % ethanol. Preserved specimens were generally incorporated in the Invertebrates Reference Collection of the Estación Mazatlán UNAM (see Hendrickx 1994a). Species are listed according to the habitats where they were collected: sandy shore, including the surf zone; rocky shore, from the upper intertidal and down to about 5 m depth; estuaries and coastal lagoons; 5-20 m shallow coastal water of the Bay of Mazatlán soft bottom; continental shelf beyond the 20 m depth and to a maximum of 120 m depth; upper slope, from ca. 200 to 1200 m depth. Species found indistinctly in two or more habitats were included in corresponding lists. Lists of species obtained for distinct habitats were compared among themselves using Sorensen Similarity Index, SI = 2C/A+B, where C = number of species in common, A and B = number of species for habitat A and B (Sorensen 1948) and to existing lists found in the literature.

RESULTS

A total of 299 species were collected during the study period (Tables 1, 2). Of these, 287 were found in coastal habitats and on the shelf, representing 82% of all decapod crustaceans species cited for the area by Hendrickx (1993b), who included species found immediately north and south of Southern Sinaloa in addition to those species that had actually been collected within the study area boundaries. Slope species occurring in the Gulf of California were computed by Hendrickx (1990, 1992b, 1995c) on the basis of existing literature and new records. Of the 33 known species, 19 (57.6%) were actually collected during the study period. All collected species have been listed for each habitat in an appendix at the end of this paper.

The sandy shore and surf zone habitat: Considering the 9 species cited herein, the sandy shore decapod crustacean community is the less diversified of all. Except for *Coenobita compressus,* which is a terrestrial species of hermit-crab, and *Ocypode occidentalis* which is found in the supratidal zone, all species in this habitat are dwelling organisms living buried or semi-buried in sand beyond the water line and well-adapted to the wave action; they are commonly found in the surf zone and occasionally at the lower limit of the intertidal during neep-tide (Albuneidae and Hippidae).

The rocky shore habitat: A total of 107 species were collected, including 11 species that are not considered common or typical for this habitat. As expected, Penaeoids shrimps are not well represented in the rocky intertidal, and only two species of *Sicyonia* were collected there. These are caught infrequently in tidal pool or trapped between rocks at low tide. In turn, 17 species of Caridean shrimps were found, including 12 species of Alpheidae. The three species of *Panulirus* collected in the area are generally found beyond 5 m depth, and occasionally occur in shallower water. Two of

TABLE 1

Numbers and % ( ) of species of decapod crustaceans collected in the area for each family. Numbers of species cited for the area (= 100 %) are provided for comparative purposes and include both species collected during this study and species cited for the area (see text). (*) This survey

Family	Number of species Collected	Cited	Family	Number of species Collected	Cited
Benthesicymidae	1 (100)	1*	Galatheidae	6 (100)	2 + 4*
Penaeidae	7 (78)	9	Porcellanidae	34 (83)	41
Sicyoniidae	7 (87)	8	Dromiidae	2 (67)	3
Solenoceridae	2 (100)	2	Raninidae	1 (100)	1
Pasiphaeidae	1 (100)	1	Dorippidae	3 (100)	3
Palaemonidae	8 (62)	13	Calappidae	8 (89)	9
Gnathophyllidae	1 (100)	1	Leucosiidae	10(77)	13
Alpheidae	18(64)	28	Inachidae	6 (67)	9
Crangonidae	1 (100)	1*	Inachoididae	7 (100)	7
Glyphocrangonidae	1 (100)	1*	Tychidae	2 (100)	2
Hippolytidae	7 (87)	7 + 1*	Epialtidae	4 (80)	5
Nematocarcinidae	1 (100)	1*	Pisidae	7 (100)	7
Ogyrididae	1 (100)	1	Majidae	1 (100)	1
Processidae	3 (75)	3 + 1*	Mithracidae	11(92)	12
Pandalidae	3 (33)	8 + 1*	Parthenopidae	7 (78)	9
Nephropidae	1 (100)	1*	Aethridae	1 (100)	1
Scyllaridae	1 (100)	1	Atelecyclidae	1 (100)	1*
Palinuridae	3 (100)	3	Portunidae	12(100)	12
Polychelidae	1 (100)	1	Cancridae	2 (100)	2
Axiidae	1 (25)	3 + 1*	Xanthidae	34(87)	39
Callianassidae	2 (100)	2	Goneplacidae	9 (90)	10
Upogebiidae	3 (100)	3	Gecarcinidae	3 (100)	3
Albuneidae	3 (60)	5	Grapsidae	13(100)	13
Hippidae	2 (100)	2	Pinnotheridae	9 (64)	14
Coenobitidae	1 (100)	1	Ocypodidae	8 (100)	8
Diogenidae	14(100)	14	Palicidae	1 (100)	1
Paguridae	3 (33)	9			

TABLE 2

Number of species of decapod crustaceans collected in each habitat. Percentages were obtained considering (A) total number of species found during the study (299) and (B) total number of species cited for the area (see text)

Habitat	Number of species collected	As % of total number of species (A)	(B)
Sandy shore	9	3.0	2.6
Rocky shore	107	35.8	30.6
Est./lagoons	48	16.1	13.7
Bay of Mazatlan	121	40.5	34.6
Shelf	107	35.8	30.6
Upper slope	19	6.3	57.6
Peculiar	3	1.0	0.9

these (*P. inflatus* and *P. gracilis*) are subject to an intensive fishery in the area (Pérez-González *et al.* 1992). Most Porcellanidae occurring in Southern Sinaloa are associated to the rocky habitat, and as many as 26 of the 34 species collected during the study were found in this habitat while only 7 species of hermit-crabs were found there, usually in tidal pools. Brachyuran crabs dominate the community: 19 spider crabs (Majoidea), 22 Xanthidae and 8 Grapsidae make the bulk of the true crabs community, which also includes *Aethra scutata* and *Cronius ruber*, the latter an uncommon species for this habitat.

The coastal lagoons/estuaries habitat: Coastal lagoons, estuaries and associated mangrove forest of Southern Sinaloa harbour a relatively high variety of species of decapod crustaceans (48 in total). In addition to the 4 species of *Penaeus* known for the area, 5 species of caridean shrimps were collected in these systems. Thalassinids were represented in samples by 4 species, including two undetermined Callianassidae. Anomuran crabs numbered only 4 species, all very characteristics for this habitat. Brachyuran crabs represent the most diversified component (30 species). Most species were never encountered in other habitats.

The Bay of Mazatlán soft bottom community: Fourteen species of Penaoid shrimps were collected in the bay, and this represents almost 2/3 of the 23 shelf species known from the entire Gulf of California. It should be noted, however, that the two species of *Metapenaeopsis* recorded from the Gulf and *Solenocera mutator* are unknown or extremely rare in water shallower than 30 m, and that *Sicyonia affinis* and *Trachypenaeus faoe* have been cited only once off the coast of Sinaloa (Hendrickx 1986b, 1995a). Caridean shrimps have been relatively well studied in southern Sinaloa (Hendrickx *et al.* 1983, Hendrickx and Wicksten 1987) and the Bay of Mazatlán soft bottom habitat hosts 22 species. Some, however, are rather associated with submerged isolated rocky structure (*e.g. Alpheus armillatus, Synalpheus sanjosei)*, and should therefore be considered atypical for this habitat. It is noteworthy that all three species of *Lysmata* known from the entire Eastern Tropical Pacific occur in the Bay, and that the tiny *Ogyrides alphaerostris*, unrecorded for this region until 1987, is a dominant species of the soft bottom community (Hendrickx and Wicksten 1987, Wicksten and Hendrickx 1992). Except for the slippery lobster, *Evibacus princeps*, which typically occurs on sandy bottom close to shore, lobsters and mud-shrimps (Thalassinidea) are scarce. Anomura (20 species in total) includes a small series of medium sized hermit crabs species which feature an unbroken distribution pattern from inside the Bay towards the adjacent shelf. Porcelain crabs are known to be mostly intertidal, sometimes extending their habitat to the shallow subtidal where rocky bottom and associated fauna and flora (*e.g.* sponges and coralina) serve as refuges for many species of *Petrolisthes, Pachycheles* or *Megalobrachium*. Exclusively subtidal porcelain occurring in the Gulf of California include the genera *Orthochela, Euceramus, Porcellana, Minyocerus, Ulloaia* and *Polyonix*, all of them represented at least with one species in the Bay of Mazatlán. The largest group of species is, again, the Brachyura. As expected, it comprises mostly subtidal species (all Dorippidae, Calappidae, Leucosiidae, Portunidae, Parthenopoidea, Goneplacidae, and Pinnotheridae; most Majoidea) and some Xanthidae atypical for this habitat. Portunids are well-represented, as they include 9 of the 15 species known from the Gulf of California.

The continental shelf: Although in most places the upper slope cannot be clearly detected before 150-160 m deep, the shelf fauna start vanishing much earlier. A sharp decrease in oxygen concentration is responsible for this, and from 90-110 m onwards, only a few species adapted to low-oxygen concentration are to be found (see Hendrickx 1992a). Altogether 107 species of decapod crustaceans have been sampled. As expected, species typically associated with the subtidal environment are well represented; this includes 26 species of shrimps (13 Penaeoidea and 13 Caridea) and 9 species of hermit crabs, which reach their highest diversity for the area. Brachyuran crabs again dominate the community as far as number of species (66) is concerned (particularly the Calappidae, Leucosiidae, Parthenopoidea, Portunidae and Goneplacidae). Some families of decapod also appear for the first time: Pandalidae, Galatheidae, Dromiidae and Cancridae, with 2 species each; Raninidae and Palicidae with one species only.

The upper slope (ca. 200 to 1200 m): In addition to 7 species (*Solenocera mutator, Sicyonia ingentis, S. picta, Porcellana hancocki, Pleuroncodes planipes, Platymera gaudichaudii, and Stenocionops ovata*) already collected in other habitats, 12 species were found exclusively on the upper slope. Of these, 3 species were only recently reported for the area (Hendrickx 1995c). Altogether, these 19 species belong to as many as 16 families, 5 of which are exclusively found below 200 m (Benthesicymidae, Nematocarcinidae, Glyphocrangonidae, Nephropidae, and Pylochelidae).

DISCUSSION

Fifty-three families of benthic decapod crustaceans (including the Majoidea *sensu* Drach and Guinot 1983, and the Pandalidae *sensu* *lato*, not *sensu* Christoffersen 1989) are known to include southern Sinaloa in their distribution range. Specimens of all these families were collected during this study, and as many as 32 were represented in samples by all known species, thus providing a 100 % collecting rate considering the number of species reported for the area by Hendrickx (1990, 1993b). For the rest, collecting rate varied from 25% (Axiidae) to 92% (Mithracidae), with most families (18 out of 21) scoring at least 60%. Families with few species sometimes present a relatively low collecting rate (60-80%), often corresponding to a single missing species (*e.g.* Processidae and Dromiidae) (Table 1). The number of upper slope species previously known for the area was occasionally equal to "0" (*e.g.* Nematocarcinidae, Glyphocrangonidae). However, for the sake of consistency, species collected during the present survey were consequently considered as present in the sampling area, and were therefore added to the number of "known" species.

As seen earlier, number of species recorded per habitat is highly variable. The minimum value (9 species) was found for the sandy shore (3.0% of total for this survey and 2.6% of all species known for the area). The long, unprotected beaches are under the influence of waves, and occasional offshore atmospheric disturbances results in strong displacement of sandy beaches that does not favor long term settlement of species. Values for other habitats are much higher (Table 2), and the highest number of species corresponds to the Bay of Mazatlán (121 species, 40.5% of total for this survey, 34.6% of all known species for the area). Rocky shore and continental shelf score similar values (both 107 species), while coastal-lagoons and estuaries are supporting a much lower diversity (48 species), as expected. Rocky shores found in Southern Sinaloa are typical of tropical-subtropical region and they offer shelter and food to a high variety of species of invertebrates, most of them present and abundant all year-round. Well-protected, semi-protected and unprotected areas are found. The lower section of the midlitoral and part of the sublitoral fringe is often occupied by colonies of the Zoanthidae *Palythoa* and *Zoanthus*. Some semiprotected areas are also colonized by *Padina durvillaei* and other species of algae (*e.g.* *Caulerpa sertularoides*, *Hypnaea panosa, Colpomenia*) (Sánchez-Vargas and Hendrickx 1987), which favor settlement of gastropods mollusks and majid crabs. Coastal lagoons and estuaries represent an adverse habitat for marine species. Turbidity is generally very high, water temperature may increase considerably when compare to adjacent coastal water, and many coastal lagoons experience strong tidal or seasonal salinity variations (Hendrickx 1984, Alvarez del Castillo *et al.* 1992). Hence, species found in this habitat are mostly species adapted to these environmental conditions, although temporal invaders are occasionally spotted close to the area connecting to the adjacent sea. Salinity within the lagoons systems can vary from almost fresh water to hypersaline depending upon the amount of rain and the exchange rate with adjacent sea water (Hendrickx 1984, Flores-Verdugo 1989). Biodiversity on the upper slope drops dramatically to 19 species only, although this represents 57.6% of species presently known from deep-water off Sonora-Sinaloa.

As expected, similarity between communities sampled in distinct habitats is very low. Number of species in common for any given pair of habitats varies from 0 to 57. When comparing intertidal with subtidal habitats, species occurring in more than one habitat are essentially species that lives at the threshold of their normal depth range. Thus, several rocky shore species are extending into the Bay of Mazatlán subtidal habitat, and 27 species are found in both habitats (Similarity index S = 0.24). Highest similarity, however, is found between the shelf fauna and the Bay of Mazatlán, with 57 species in common (S= 0.50) (Table 3).

Comparative data for the Eastern Pacific are lacking almost all together. The only comprehensive, closely related study was published almost twenty years ago by Abele (1976), and dealt with the Pacific (and Caribbean) decapod fauna of Panama associated with four major habitats. Data were mostly related to intertidal fauna. Sandy beach fauna of Panama included 16 species (none of *Lepidopa*, and 8 unidentified species of "*Callianassa*") vs. only 9 for Southern Sinaloa. Twenty species were reported for the mangrove habitat in Panama, but no Caridea, *Penaeus* or *Callinectes*, all predominantly subtidal species, were included; comparatively, Southern Sinaloa strictly "mangrove" fauna (no shrimp, no swimming-crabs) is made

TABLE 3

Numbers of species common to pair of habitats. Similarity index for pair of habitats (0.00 to 0.50) were obtained using Sorensen index SI (SS = sandy shore; CL = coastal lagoons - estuaries; RS = rocky shore; CS = continental shelf; BM = Bay of Mazatlán; SL= slope)

	SS	CL	RS	CS	BM	SL
SL	00	00	00	06	02	
BM	03	05	27	57		0.02
CS	00	04	03		0.50	0.10
RS	00	07		0.03	0.24	0.00
CL	02		0.09	0.05	0.06	0.00
SS		0.08	0.00	0.00	0.04	0.00

of 41 species, which is still a much higher figure than in Panama. The *Pocillopora* coral community of Panama was made of 53 species, including 8 obligate commensals. Pocilloporid corals is an unknown habitat in Southern Sinaloa, and a comparative analysis seems inappropriate. Still, excluding unidentified species cited by Abele (11 out of 53; *op. cit.*), obligate commensals (8 species), and Panamic species not extending to the SE Gulf of California (5 species), 20 out of the 29 species left are also found in other habitats of Southern Sinaloa. The last habitat studied by Abele (1976) was the rocky intertidal, for which he cited 78 species (23 identified only to genus or family, and 12 Panamic species not reaching the SE Gulf of California). Southern Sinaloa rocky shore community includes 107 species, including 27 of the 43 properly identified, non-exclusively Panamic species cited by Abele (*op. cit.*). Here again, 6 species cited for the Panamic rocky shore habitat have been found in other habitats in Southern Sinaloa. Composition of decapod crustaceans community from a coastal lagoon of SW Mexico was analyzed by Alvarez del Castillo *et al.* (1992) who reported 74 species, including 31 species atypical for this habitat and collected exclusively in the rocky intertidal of the lagoon permanent inlet. The only consistent analysis of decapod crustaceans associated to sandy beaches in the ETP was provided by Dexter (1974, 1976) who cited 7 species for beaches in Mexico, Costa Rica, and Colombia.

Data related to subtidal soft bottom decapod crustaceans community in the ETP are not available, except for Hendrickx (1992a: 6) who concluded that approximately 308 species of decapod crustaceans were associated to the continental shelf for the entire Gulf of California (58% of all known species). Other reports are surprisingly scarce. They often appear to be uncompleted due to selective methods of sampling (e.g. large mesh-size commercial shrimp-nets) or because they represent results of short period, isolated surveys. Alvarez-León (1979) reviewed the marine species of commercial importance from the Pacific coast of Colombia and listed 27 species of decapod crustaceans, mostly captured by the commercial fishing fleet. Méndez (1981) reported 69 marine and 13 fresh and brackish water species shrimps from Peru; 30 species were associated with the continental shelf, and 39 were slope species. Comparatively, 62 species of Penaeoidea and Caridea were collected during this survey, out of 88 known species for the area (Table 1). During a prospective survey of the Gulf of Tehuantepec, Sosa-Hernández *et al.* (1980) reported only 28 species of decapod crustaceans obtained by trawling below 25 m depth. One of the most intensive survey for the ETP was made in the Gulf of Nicoya, Costa Rica, a tropical estuary of 10-20 km wide, with bottom water salinity ranging from 28 to 37‰, and temperature from 14 to 28°C. Benthic macro-fauna was sampled during three cruises, between 8 and 52 m depth, resulting in a total of 48 collected species of decapod crustaceans (Maurer *et al.* 1984). Comparatively, nearly three times as many species were collected in the Bay of Mazatlán, the most closely related habitat for Southern Sinaloa. More recently, Bianchi (1991) reported only 11 shelf species of decapod crustaceans in samples obtained by trawling (50 to ca. 250 m depth range) from the Gulf of Tehuantepec, Mexico, to the Gulf of

Papagayo, Nicaragua. Although the author recognized that "Species identification often poses serious problems in tropical areas [and] no guides [...] were available for the eastern central Pacific", it is surprising that large, common and easily recognizable species such as *Hepatus kossmanni, Euphylax robustus* or *E. dovii* were not reported in this survey. Another list of species available for the continental shelf of the Eastern Tropical Pacific is by Hendrickx and Vázquez-Cureño (1995), who reported 46 species of decapod crustaceans collected by trawling during two CEEMEX cruises in the Gulf of Tehuantepec, from 26 to 180 m depth.

Upper slope data are again lacking. Wicksten (1989) cited 183 deep-water species for the eastern Pacific, of which only 26 were known to be present off the coast of Sonora-Sinaloa. During this survey, 19 species were obtained: 9 of the 26 species known to be present, 3 additional deep-water species not cited earlier for the Gulf (Hendrickx 1995c), and 7 species also found on the shelf. The only available comparative data related to slope decapod crustaceans fauna is again by Méndez (1981); of the 69 marine species of shrimps she reported from Peru, 39 were slope species.

On the basis of present survey, it can be concluded that: 1) There is a dramatic lack of data related to composition of decapod crustaceans communities in the entire ETP; 2) The biodiversity observed in the study area is the highest ever reported for the Pacific coast of Mexico; 3) The environmental features of the Bay of Mazatlán combined with its rich fauna, allow us to classify this system as one of the most diversified sizable body of water north of Banderas Bay.

RESUMEN

Se obtuvieron muestras de la macro-fauna bentónica de diferentes hábitats a lo largo y frente a las costas del sur de Sinaloa, golfo de California, México desde 1978 hasta 1991. Se registró la ocurrencia de especies de crustáceos decápodos para seis hábitats, desde la zona intermareal hasta una profundidad de 1200 m. Se recolectó un total de 299 especies, perteneciendo a 53 familias: 17 especies de Penaeoidea, 45 Caridea, 6 Thalassinidea, 5 Palinura, 1 Astacidea, 63 Anomura y 162 Brachyura. El número de especies varió considerablemente de un hábitat al otro. La diversidad más alta observada fue en la bahía de Mazatlán con 121 especies, seguida por la plataforma continental y el intermareal rocoso (107 especies cada uno), estuarios/lagunas costeras (48 especies), la plataforma superior (18 especies) y las playas arenosas (9 especies). Una especie correspondió estrictamente a un hábitat insular terrestre y dos están primariamente asociadas con el flotsam. Los resultados de este estudio fueron comparados con las informaciones de distribución disponibles para la fauna de crustáceos decápodos del sureste del golfo de California y el Pacífico Este Tropical. La fauna recolectada representa el 82% de las especies citadas para el área para los hábitats costeros y poco profundos (hasta *ca.* 115 m de profundidad) y 57.6% de las especies de aguas profundas (> 200 m) conocidas para el golfo de California. Exceptuando dos casos, el índex de similitud (SI) basado en el número de especies comunes a cualquier par de hábitats fue siempre muy bajo. La plataforma continental y la bahía de Mazatlán tienen 57 especies en común (SI = 0.50), mientras que el hábitat de la zona rocosa y la bahía de Mazatlán comparten 27 especies (SI = 0.24). Son pocos los estudios comparativos de comunidades de crustáceos decápodos para el Pacífico Este Tropical. Sin embargo, la información disponible, indica que la biodiversidad observada en el sur de Sinaloa es por mucho la más alta registrada para los hábitats de agua marina y salobre para una sección dada de esta región zoogeográfica tropical.

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Appendix 1

Species of decapod crustaceans collected in different habitats in southern Sinaloa: 299 species. Because some species have been collected in more than one habitat, total number of entries is 413. (*) Not a common species. (**) Surf zone, occasional. Specimens are deposited in the Reference Collection of the Estación Mazatlán, UNAM

Sandy shore, intertidal (9 species).

Anomura
Albunea lucasia de Saussure, 1835
Lepidopa cf. *deamae* Benedict, 1903
Lepidopa esposa Efford, 1971
Lepidopa mearnsi Benedict, 1903
Lepidopa mexicana Efford, 1971
Hippa strigillata (Stimpson, 1860)
Emerita rathbunae Schmitt, 1935
Coenobita compressus H. Milne Edwards, 1837
Brachyura
Ocypode occidentalis Stimpson, 1860

Rocky shore, intertidal (107 species).

Penaeoidea
Sicyonia laevigata (Stimpson, 1871)
Sicyonia martini Pérez-Farfante & Boothe, 1981
Caridea
Gnathophyllum panamense Faxon, 1893
Alpheus leviusculus Dana, 1852
Alpheus schmitti Chace, 1972
Alpheus armillatus H. Milne Edwards, 1837
Alpheus cylindricus Kingsley, 1878
Alpheus splendidus Coutière, 1897
Alpheus sulcatus Kingsley, 1878
Alpheus malleator Dana, 1852
Synalpheus digueti Coutière, 1909
Synalpheus sanjosei Coutière, 1909
Synalpheus biunguiculatus (Stimpson, 1860)
Synalpheus lockingtoni Coutière, 1909
Synalpheus nobilii Coutière, 1909
Palaemon ritteri Holmes, 1895
Thor algicola Wicksten, 1987
Lysmata galapagensis Schmitt, 1924
Brachycarpus biunguiculatus (Lucas, 1849)
Palinura
Panulirus gracilis Streets, 1871
Panulirus inflatus (Bouvier, 1895)
Panulirus penicillatus (Olivier, 1791)
Anomura
Trizopagurus magnificus (Bouvier, 1898)
Calcinus californiensis Bouvier, 1898
Clibanarius albidigitus Nobili, 1901
Clibanarius digueti Bouvier, 1898
Clibanarius panamensis Stimpson, 1859
Paguristes anahuacus Glassell, 1938
Pagurus lepidus (Bouvier, 1898)
Petrolisthes agassizzi Faxon, 1893
Petrolisthes armatus (Gibbes, 1850)
Petrolisthes crenulatus Lockington, 1878
Petrolisthes edwardsii (de Saussure, 1853)
Petrolisthes gracilis Stimpson, 1858
Petrolisthes haigae Chace, 1962
Petrolisthes hians Nobili, 1901
Petrolisthes hirtispinosus Lockington, 1878
Petrolisthes lewisi (Glassell, 1936)
Petrolisthes nobilii Haig, 1960
Petrolisthes ortmanni Nobili, 1901
Petrolisthes polymitus Glassell, 1937
Petrolisthes robsonae Glassell, 1935
Petrolisthes sanfelipensis Glassell, 1936
Petrolisthes tonsorius Haig, 1960
Neopisosoma dohenyi Haig, 1960
Neopisosoma mexicanum (Streets, 1871)
Pachycheles calculosus Haig, 1960
Pachycheles panamensis Faxon, 1893
Pachycheles setimanus (Lockington, 1878)
Pachycheles spinidactylus Haig, 1957
Clastotoechus diffractus (Haig, 1957)
Euceramus panatelus Glassell, 1938
Pisidia magdalenensis (Glassell, 1936)
Megalobrachium festai (Nobili, 1901)
Megalobrachium sinuimanus (Lockington, 1878)
Brachyura
Eucinetops lucasi Stimpson, 1860
Eucinetops rubellula Rathbun, 1923
Inachoides laevis Stimpson, 1860
Pitho sexdentata Bell, 1835
Pitho picteti (de Saussure, 1853)
Acanthonyx petiveri Milne Edwards, 1834
Epialtus minimus Lockington, 1877
Epialtus sulcirostris Stimpson, 1860
Eupleurodon trifurcatus Stimpson, 1871
Pelia pacifica A. Milne Edwards, 1875
Pelia tumida (Lockington, 1877)
Herbstia camptacantha (Stimpson, 1860)
Herbstia tumida (Stimpson, 1871)
Ala cornuta (Stimpson, 1860)
Mithrax armatus de Saussure, 1853
Mithrax spinipes (Bell, 1835)
Mithrax denticulatus Bell, 1835
Teleophrys cristulipes Stimpson, 1860
Microphrys platysoma (Stimpson, 1860)
Thoe sulcata sulcata Stimpson, 1860
Aethra scutata Smith, 1869
Cronius ruber (Lamarck, 1818)
Liomera cinctimana (White, 1847)
Platypodiella rotundata (Stimpson, 1860)
Cataleptodius occidentalis (Stimpson, 1871)
Xanthodius sternberghii Stimpson, 1859
Xanthodius stimpsoni (A. Milne Edwards, 1860)
Cycloxanthops vittatus (Stimpson, 1860)
Metopocarcinus truncatus Stimpson, 1860
Panopeus bermudensis (1) Benedict & Rathbun, 1891
Panopeus chilensis Milne Edwards & Lucas, 1844
Panopeus miraflorensis Abele & Kim, 1889
Eurypanopeus confragosus Rathbun, 1933

Eurypanopeus planus (Smith, 1869)
Micropanope cristimanus Stimpson, 1871
Menippe frontalis A. Milne Edwards, 1879
Pilumnus pygmaeus Boone, 1927
Pilumnus reticulatus Stimpson, 1860
**Pilumnus townsendi* Rathbun, 1923
Heteractaea lunata (Milne Edwards & Lucas, 1843).
Ozius perlatus Stimpson, 1859
Epixanthus tenuidactylus (Lockington, 1877)
Ozius verreauxii de Saussure, 1853
Eriphia squamata Stimpson, 1859
Plagusia immaculata Lamarck, 1818
Plagusia depressa tuberculata Lamarck, 1818
Percnon gibbesi (H. Milne Edwards, 1853)
Grapsus grapsus (Linnaeus, 1758)
Geograpsus lividus (Milne Edwards, 1837)
Pachygrapsus tranversus (Gibbes, 1850)
**Planes cyaneus* Dana, 1852
Tetragrapsus jouyi (Rathbun, 1893)
(1)?=*P. miraflorensis* Abele & Kim, 1989

Coastal lagoons and estuaries (48 species).

Penaeoidea
Penaeus vannamei Boone, 1931
Penaeus stylirostris Stimpson, 1871
**Penaeus californiensis* Holmes, 1900
**Penaeus brevirostris* Kingsley, 1878
Caridea
Palaemonetes hiltoni Schmitt, 1916
Palaemon gracilis (Smith, 1871)
Macrobrachium tenellum (Smith, 1871)
Alpheus mazatlanicus Wicksten, 1983
**Synalpheus biunguiculatus* (Stimpson, 1860)
Thalassinidea
Callianassidae sp. A
Callianassidae sp. B
Upogebia dawsoni Williams, 1986
Upogebia thistlei Williams, 1986
Anomura
Coenobita compressus H. Milne Edwards, 1859
Clibanarius albidigitus Nobili, 1901
Clibanarius panamensis Stimpson, 1859
Petrolisthes robsonae Glassell, 1945
Petrolisthes lindae Gore & Abele, 1973
Brachyura
Callinectes arcuatus Ordway, 1863
Callinectes bellicosus (Stimpson, 1859)
Callinectes toxotes Ordway, 1863
Panopeus bermudensis (1) Benedict & Rathbun, 1891
Panopeus chilensis Milne Edwards & Lucas, 1844
Panopeus purpureus Lockington, 1876
Panopeus miraftoresensis Abele & Kim, 1989
Hexapanopeus sinaloensis Rathbun, 1930
Eurytium albidigitus Rathbun, 1933
Eurytium affine Streets & Kingsley, 1876
Cyrtoplax schmitti Rathbun, 1935
Malacoplax californiensis (Lockington, 1877)
Cardisoma crassum Smith, 1870
Gecarcinus quadratus de Saussure, 1853
Armases magdalenense Rathbun, 1918
Sesarma rhizophorae Rathbun, 1906
Sesarma sulcatum Smith, 1870
Aratus pisoni (Milne Edwards, 1837)
Goniopsis pulchra (Lockington, 1876)
**Pachygrapsus transversus* (Gibbes, 1850)
Scleroplax granulata Rathbun, 1892
Pinnixa valerii Rathbun, 1931
Ucides occidentalis (Ortmann, 1897)
Ocypode occidentalis Stimpson, 1860
Uca princeps (Smith, 1870)
Uca latimanus (Rathbun, 1893)
Uca musica musica Rathbun, 1914
Uca crenulata crenulata (Lockington, 1877)
Uca zacae Crane, 1941
Uca vocator ecuadoriensis Maccagno, 1928

(1) Probably *P. mirafloresensis* Abele & Kim, 1989

Bay of Mazatlan soft bottom, 5-25 m depth (122 species).

Penaeoidea
Penaeus brevirostris Kingsley, 1878
Penaeus californiensis Holmes, 1900
Penaeus stylirostris Stimpson, 1871
Trachypenaeus pacificus Burkenroad, 1934
Trachypenaeus brevisuturae Burkenroad, 1934
Xiphopenaeus riveti Bouvier, 1907
Sicyonia disdorsalis (Burkenroad, 1934)
Sicyonia disedwardsii (Burkenroad, 1934)
Sicyonia ingentis (Burkenroad, 1938)
Sicyonia laevigata Stimpson, 1871
Sicyonia martini Pérez-Farfante & Boothe, 1981
Sicyonia picta Faxon, 1893
Solenocera florea Burkenroad, 1938
Caridea
Leptochela serratorbita Bate, 1888
Automate dolichognatha de Man, 1938
Automate rugosa Coutière, 1900
Salmoneus serratidigitus Coutière, 1896
**Alpheus armillatus* H. Milne Edwards, 1837
Alpheus floridanus Kingsley, 1878
**Synalpheus sanjosei* Coutière, 1909
**Synalpheus digueti* Coutière, 1909
Neopontonides dentiger Holthuis, 1951
Periclimenes infraspinis (Rathbun, 1902)
Ogyrides alphaerostris (Kingsley, 1880)
Lysmata californica (Stimpson, 1866)
Lysmata galapagensis Schmitt, 1924
Lysmata intermedia (Kingsley, 1880)
Latreutes antiborealis Holthuis, 1952
Trachycaris restricta (A. Milne Edwards, 1878)
Thor algicola Wicksten, 1987
Brachycarpus biunguiculatus (Lucas, 1849)
Pontonia margarita Smith, 1869
Processa peruviana Wicksten, 1983
Processa sp.
Ambidexter panamensis Abele, 1972
Thalassinidea
Callianassidae sp.
Upogebia jonesi Williams, 1986
Palinura
Evibacus princeps Smith, 1866
**Panulirus gracilis* Streets, 1871
**Panulirus inflatus* (Bouvier, 1895)
Anomura
Albunea lucasia de Saussure, 1835

Lepidopa esposa Efford, 1971
Lepidopa mearnsi Benedict, 1903
Dardanus sinistripes (Stimpson, 1859)
Aniculus elegans Stimpson, 1859
Paguristes sp.
Paguristes digueti Bouvier, 1892
Pagurus gladius (Benedict, 1892)
Orthochela pumila Glassell, 1936
**Petrolisthes agassizii* Faxon, 1893
**Petrolisthes crenulatus* Lockington, 1878
Petrolisthes sanfelipensis Glassell, 1936
Euceramus panatelus Glassell, 1938
Euceramus transversilineatus (Lockington, 1878)
Minyocerus kirki Glassell, 1938
Porcellana cancrisocialis Glassell, 1936
Pisidia magdalenensis (Glassell, 1936)
**Megalobrachium festai* (Nobili, 1901)
Ulloaia perpusillia Glassell, 1935
Polyonix quadriungulatus Glassell, 1935
Brachyura
Ethusa panamensis Finnegan, 1931
Hepatus kossmanni Neumann, 1878
Hepatella amica Smith, 1869
Osachila acuta Stimpson, 1871
Iliacantha hancocki Rathbun, 1935
Persephona townsendi (Rathbun, 1893)
Leucosilia jurinei (de Saussure, 1853)
Randallia agaricias Rathbun, 1898
Randallia americana (Rathbun, 1893)
Randallia bulligera Rathbun, 1898
Collodes gibbosus (Bell, 1835)
Collodes tenuirostris Rathbun, 1893
Pyromaia tuberculata (Lockington, 1877)
Erileptus spinosus Rathbun, 1893
Inachoides laevis Stimpson, 1860
Podochela latimanus (Rathbun, 1893)
Podochela veleronis Garth, 1958
Stenorhynchus debilis (Smith, 1871)
Pitho picteti (de Saussure, 1853)
**Acanthonyx petiveri* Milne Edwards, 1834
Epialtus minimus Lockington, 1877
**Epialtus sulcirostris* Stimpson, 1860
Pelia pacifica A. Milne Edwards, 1875
Neodoclea boneti Buitendijk, 1950
Notolopas lamellatus Stimpson, 1871
Notolopas mexicanus Garth, 1940
**Maiopsis panamensis* Faxon, 1893
Mithrax armatus de Saussure, 1853
Mithrax denticulatus Bell, 1835
Microphrys platysoma (Stimpson, 1860)
Hemus sp.
Hemus finneganae Garth, 1958
Leiolambrus punctatissimus (Owen, 1839)
Heterocrypta macrobrachia Stimpson, 1871
Mesorhoea belli (Milne Edwards, 1878)
Callinectes arcuatus Ordway, 1863
Portunus acuminatus (Stimpson, 1871)
Portunus asper (A. Milne Edwards, 1861)
Portunus iridescens (Rathbun, 1893)
Portunus xantusii xantusii (Stimpson, 1860)
Arenaeus mexicanus (Gerstaecker, 1856)
Euphylax dovii Stimpson, 1860
Euphylax robustus A. Milne Edwards, 1861
Cronius ruber (Lamarck, 1818)
Actaea angusta Rathbun, 1898
Edwardsium lobipes (Rathbun, 1898)
**Xanthodius stimpsoni* (A. Milne Edwards, 1860)
**Panopeus bermudensis* (1) Benedict & Rathbun, 1891
Hexapanopeus orcutti Rathbun, 1930
Microcassiope xantusi (Stimpson, 1871)
Pilumnus townsendi Rathbun, 1869
**Heteractaea lunata* (Milne Edwards & Lucas, 1843)
Euryplax polita Smith, 1870
Speocarcinus granulimanus Rathbun, 1893
Oediplax granulata Rathbun, 1893
Pinnixa sp.
Pinnixa affinis Rathbun, 1898
Pinnixa pembertoni Glassell, 1935
Pinnixa cf. schmitti Rathbun, 1918
Pinnixa transversalis (H. Milne Edwards & Lucas, 1844)
Calyptraeotheres granti Glassell, 1933

(1) Probably *P. miraforesensis* Abele & Kim, 1989

Continental shelf, 25 - 115 m depth (107 species).

Penaeoidea
Penaeus brevirostris Kingsley, 1878
Penaeus californiensis Holmes, 1900
Penaeus vannamei Boone, 1931
Trachypenaeus pacificus Burkenroad, 1934
Xiphopenaeus riveti Bouvier, 1907
Sicyonia aliaffinis (Burkenroad, 1934)
Sicyonia disdorsalis (Burkenroad, 1934)
Sicyonia disedwardsii (Burkenroad, 1934)
Sicyonia ingentis (Burkenroad, 1938)
Sicyonia martini Pérez-Farfante & Boothe, 1981
Sicyonia picta Faxon, 1893
Solenocera florea Burkenroad, 1938
Solenocera mutator Burkenroad, 1938
Caridea
Automate dolichognatha de Man, 1938
Automate rugosa Coutière, 1900
Salmoneus serratidigitus Coutière, 1896
Alpheus floridanus Kingsley, 1878
Alpheopsis cortesiana Wicksten & Hendrickx, 1986
Pantomus affinis Chace, 1937
Plesionika mexicana Chace, 1937
Trachycaris restricta (A. Milne Edwards, 1878)
Lysmata californica (Stimpson, 1866)
Lysmata intermedia (Kingsley, 1880)
Latreutes antiborealis Holthuis, 1952
Processa peruviana Wicksten, 1983
Processa sp.
Palinura
Evibacus princeps Smith, 1866
Anomura
Petrochirus californiensis (Stimpson, 1859)
Dardanus sinistripes (Stimpson, 1859)
Aniculus elegans Stimpson, 1859
Paguristes sp.
Paguristes bakeri Holmes, 1900
Paguristes digueti Bouvier, 1892
Paguristes praedator Glassell, 1937
Pagurus gladius (Benedict, 1892)
Pagurus smithi (Benedict, 1892)
Pleuroncodes planipes Stimpson, 1860
Munida mexicana (Benedict, 1903)
Porcellana cancrisocialis Glassell, 1936

Porcellana hancocki Glassell, 1937
Polyonix nitidus Lockington, 1878
Brachyura
Cryptodromiopsis larraburei (Rathbun, 1910)
Hypoconcha panamensis Smith & Verrill, 1869
Raninoides benedicti Rathbun, 1935
Ethusa ciliatifrons Faxon, 1893
Ethusa lata Rathbun, 1893
Calappa convexa de Saussure, 1853
Calappa saussurei Rathbun, 1898
Platymera gaudichaudii Milne Edwards, 1837
Cycloes bairdi Stimpson, 1860
Hepatus kossmanni Neumann, 1878
Osachila lata Faxon, 1893
Lithadia cumingii Bell, 1855
Ebalia cristata Rathbun, 1898
Iliacantha hancocki Rathbun, 1935
Iliacantha schmitti Rathbun, 1935
Persephona edwardsii Bell, 1855
Persephona cf. orbicularis Rathbun, 1893
Persephona townsendi (Rathbun, 1893)
Randallia americana (Rathbun, 1893)
Randallia bulligera Rathbun, 1898
Euprognatha bifida Rathbun, 1893
Collodes gibbosus (Bell, 1835)
Collodes granosus Stimpson, 1860
Collodes tenuirostris Rathbun, 1893
Paradasigyius depressus (Bell, 1835)
Pyromaia tuberculata (Lockington, 1877)
Erileptus spinosus Rathbun, 1893
Inachoides laevis Stimpson, 1860
Podochela latimanus (Rathbun, 1893)
Stenorhynchus debilis (Smith, 1871)
Stenocionops ovata (Bell, 1835)
Mithrax tuberculatus Stimpson, 1860
Parthenope hyponca (Stimpson, 1871)
Parthenope exilipes (Rathbun, 1893)
Parthenope excavata (Stimpson, 1871)
Solenolambrus arcuatus Stimpson, 1871
Leiolambrus punctatissimus (Owen, 1839)
Heterocrypta macrobrachia Stimpson, 1871
Mesorhoea belli (Milne Edwards, 1878)
Callinectes arcuatus Ordway, 1863
Portunus acuminatus (Stimpson, 1871)
Portunus asper (A. Milne Edwards, 1861)
Portunus iridescens (Rathbun, 1893)
Portunus xantusii affinis (Faxon, 1893)
Portunus xantusii xantusii (Stimpson, 1860)
Euphylax robustus A. Milne Edwards, 1861
Cancer amphioetus Rathbun, 1898
Cancer johngarthi Carvacho, 1989
Actaea angusta Rathbun, 1898
**Medaeus spinulifer* (Rathbun, 1898)
Edwardsium lobipes (Rathbun, 1898)
Hexapanoeus orcutti Rathbun, 1930
Microcassiope xantusi (Stimpson, 1871)
Pilumnus townsendi Rathbun, 1869
Quadrella nitida Smith, 1869
Trizocarcinus dentatus Rathbun, 1893
Euryplax polita Smith, 1870
Panoplax mundata Glassell, 1935
Speocarcinus granulimanus Rathbun, 1893
Oediplax granulata Rathbun, 1893
Chasmocarcinus latipes Rathbun, 1898
Chasmophora macrophtalma (Rathbun, 1898)
Chacellus pacificus Hendrickx, 1989
Pinnixa sp.
Pinnixa transversalis (H. Milne Edwards & Lucas, 1844)
Palicus fragilis (Rathbun, 1893)

Upper slope, ca. 200 to 1200 m depth (19 species).

Penaeoidea
Benthesicymus tanneri Faxon, 1893
Sicyonia ingentis (Burkenroad, 1938)
Sicyonia picta Faxon, 1893
Solenocera mutator Burkenroad, 1938
Caridea
Acantephyra brevicarinata Hanamura, 1989
Nematocarcinus agassizii Faxon, 1893
Lebbeus scrippsi Wicksten & Mendez, 198[illegible]
Heterocarpus affinis Faxon, 1893
Paracrangon areolata Faxon, 1893
Glyphocrangon spinulosa Faxon, 1893
Astacidea
Nephropsis occidentalis Faxon, 1893
Palinura
Stereomastis nana (S.Smith, 1884)
Anomura
Porcellana hancocki Glassell, 1938
Munidopsis depressa Faxon, 1893
Munidopsis diomedeae (Faxon, 1893)
Pleuroncodes planipes Stimpson, 1860
Brachyura
Platymera gaudichaudii Milne Edwards, 1837
Trachycarcinus corallinus Faxon, 1893
Stenocionops ovata (Bell, 1835)

Peculiar habitat (3 species).

Brachyura
Gecarcinus planatus Stimpson, 1870 (Insular)
Plagusia immaculata Lamarck, 1818 (Flotsam)
Planes cyaneus Dana, 1852 (Flotsam)