Occurrence of a continental slope decapod crustacean community along the edge of the minimum oxygen zone in the south eastern Gulf of California, Mexico

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ABSTRACT. Decapod crustaceans living in deep-water in the south eastern Gulf of California were collected during two research cruises in August 1991 and 2000. Benthic sledges were operated in the depth range of 550 to 2250 m. Vertical distribution of dissolved oxygen was obtained at selected stations and epibenthic oxygen content was measured at almost all sampling stations. A total of 31 species was collected, 21 strictly benthic and eight strictly pelagic. They belong to the Penaeoidea (five species), the Caridea (13 species), the Anomura (seven species), the Astacidea (one species), the Thalassinoidea (two species), the Eryonoidea (two species) and the Brachyura (one species). The oxygen minimum zone at bottom level represents a dispersal barrier for continental shelf species, including species known to have a wide bathymetric distribution. The deep-water decapod crustacean fauna (i.e., below 550 m) living along the offshore edge of this oxygen minimum zone is dominated by species of *Munidopsis*. The number of benthic species collected at the stations varied considerably, from zero to 15. The highest numbers of species were caught in the depth range of 1188-1245, where hypoxic (0.6-0.76 ml O2/l) conditions prevailed. Stations with higher oxygen content had fewer benthic species. Factors other than oxygen content, affect the occurrence of species in the area.

KEY WORDS: Decapod crustaceans, continental slope, southeastern Gulf of California, hypoxia.

INTRODUCTION

While the northern part of the Gulf of California is relatively shallow, with the exception of the Delfin basin, the central and southern parts increase in average depth towards the mouth of the Gulf. Several deep basins are found offshore with depths reaching 3000 m or more. The southern Gulf of California opens to the Pacific, with depths greater than 3000 m at the entrance (PARKER, 1964; ALVAREZ-BORREGO & SCHWARTZLOSE, 1979). In the southern Gulf, water temperature does not show any special structure. It decreases monotonically with depth and reaches values of less than 10 °C below 400-500 m. There is an orderly progression to the deepest portions of the Gulf of from 10 °C to <4 °C at 2000 m. The southernmost basin, from about 26º N to the mouth of the Gulf, has epibenthic water temperatures of 2 °C or less, characteristic of the bottom water of the equatorial Pacific (PARKER, 1964).

Epibenthic dissolved oxygen concentration has been recognized as a major limiting factor for benthic and demersal species. Although it is generally admitted that respiration in most marine invertebrates is not significantly affected until extremely low oxygen concentrations are reached, i.e. below 2.0 ml/l or even less (ROSENBERG et al. 1991; DIAZ & ROSENBERG, 1995), decreasing oxygen content near the bottom or in the water column can create an anoxic zone where no macrofauna occur (DIAZ & ROSENBERG, 1995). Species diversity at depths from 100 m to 2140 m off the coast of Southwest Africa, and at depths of 1100-1300 m in the Santa Catalina Basin, off California, has been shown to decline with reduced oxygen content of the bottom water or to be lower than adjacent areas where oxygen content is higher (JUMARS, 1976; GRASSLE, 1989).

Oxygen minimum zones have long been recognized in different parts of the world, either in fjords, coastal water

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or in open ocean. The widest area where severe hypoxia has been observed is in the east Pacific (Wyrtki, 1966; Kamykowski & Zentara, 1990). Severe hypoxia can drastically reduce diversity and size of natural communities (see Nilsson & Rosenberg, 1994).

Since deep water crustaceans were collected by the "Albatross" in 1891 off the coast of Mexico to Peru, almost no studies have been performed in the southern Gulf of California. The most complete study of the deep water fauna of the east Pacific slope is by Parker (1964), based on series of 11 samples obtained on the middle continental slope (731-1799 m), and of 19 samples obtained between 1800 and 4122 m in the abyssal southern basins and outer slope of the Gulf of California. Parker's definition of assemblages, however, was based mostly on molluscs and the occurrence of decapod crustaceans must be inferred from a long data matrix (Parker, 1964: Table 7) and related to a map of sampling stations. He found 14 species of decapod crustaceans below 500 m of which only two were recorded in the Southeastern Gulf of California. Wicksten (1989) provided a synthesis of all species of eastern Pacific decapod crustaceans with the majority of records at 50 m or deeper (defined as "offshore species"). A total of 183 species is included, of which 117 have records in the depth category of 500-1000 m, 96 at 1000-1500 m and 46 at depths >1500 m (Wicksten, 1989). An analysis of habitats and biodiversity of decapod crustaceans in the Southeastern Gulf of California (Hendrickx, 1996a) reported that 19 deepwater species were collected between 200 and 1200 m, some of which represent new records for the area (Hendrickx, 1996b).

An oxygen minimum zone has long been recognized in the Gulf of California. According to Parker (1964), this zone of low oxygen concentration (ca. 0.5 ml/l) at or near the bottom forms a fringe parallel to the coast that extends, on both sides of the Gulf, from the east and west entrances to ca. 29° N. Up to 90 km wide, it mostly covers the outer continental shelf and the upper slope, roughly from 100m to 500 or 1000 m, depending on location. Recent studies, however, indicate that almost anoxic conditions are occasionally found on the shelf at 60 m (Hendrickx et al., 1984; Garduño-Argueta & Calderón Pérez, 1995).

The purpose of this study is to define the deepwater decapod crustacean community that occurs on the offshore side on the oxygen minimum, roughly in the depth range of 550 to 2200 m, in the SE Gulf of California.

METHODS

Crustaceans samples were dredged at depths of 550 to 2250 m in the SE Gulf of California. Material was obtained during two cruises aboard the R/V "El Puma" of the Universidad Nacional Autónoma de Mexico. Samples were obtained with benthic sledges at 11 stations in August 1991 (TALUD III cruise) and at eight stations in August 2000 (TALUD IV), off the coast of Sinaloa, Mexico (Table 1). The sledges were operated at depths from 550 to 1380 m (TALUD III) and from 785 m to 2250 m (TALUD IV). Two different benthic sledges were used: a 2.5 m wide by 1.0 m high modified Agassiz sledge equipped with a collecting net of ca. 5.5 cm (2 1/4") stretch mesh lined with ca. 2.0 cm (3/4") mesh net (TALUD III) and a 2.35 m wide by 0.95 m high standard benthic sledge equipped with a collecting net of ca. 5.5 cm (2 1/4") stretch mesh lined with ca. 2.0 cm (3/4") mesh net in the mouth area (TALUD IV). At selected sampling stations of the TALUD III cruise and at all sampling stations of TALUD IV cruise, a previously calibrated CTD probe equipped with an oxygen sensor was used to obtain temperature, salinity and dissolved oxygen profiles from surface to near bottom level. During the TALUD IV cruise, an opening-closing bottle was used to obtain near bottom water samples used to measure the dissolved oxygen by the Winkler method (duplicate samples). During the TALUD III cruise, oxygen measurements were obtained from the pre-calibrated probe (a SEB Seacat Profiler) and are considered reliable for biological interpretation. The CTD probes and opening-closing bottle were not operated less than 15 m off the bottom.

TABLE 1

Sampling stations where decapod crustaceans were caught during the TALUD III and IV cruises.

Station	Date	Position Lat. N	Position Long. W
10/III	18/Aug/1991	23.41.9	107.31.8
10A/III	18/Aug/1991	23.44.3	107.38.6
14A/III	19/Aug/1991	24.38.8	108.26.9
14B/III	19/Aug/1991	24.39.2	108.37.8
19/III	20/Aug/1991	25.12	109.07
20A/III	24/Aug/1991	25.12.6	109,06
24/III	21/Aug/1991	25.33.6	109.42.02
24A/III	24/Aug/1991	25.45.2	109.46.8
4/IV	23/Aug/2000	21.59.0	106.35.0
13/IV	24/Aug/2000	23.17.51	107.29.85
14/IV	24/Aug/2000	23.13.4	107.41.8
18/IV	25/Aug/2000	24.15.2	108.17.1
19/IV	25/Aug/2000	24.15.3	108.24.1
20/IV	25/Aug/2000	24.27.4	108.35.26
25/IV	26/Aug/2000	24.53.2	108.59.4
26/IV	26/Aug/2000	24.56.4	109.05.6
27/IV	26/Aug/2000	24.59.0	109.12.1
33/IV	27/Aug/2000	25.45.9	109.48.1
34/IV	27/Aug/2000	25.40.67	109.54.4
35/IV	27/Aug/2000	25.53.98	110.11.29

Crustaceans were sorted onboard, preserved in diluted formaldehyde or in 70% ethanol. A list of all species is tabulated with accompanying data. Body lengths were measured with vernier calipers, usually to the nearest

0.1 mm. Carapace length was measured in shrimps while total length was used with lobsters and galatheids. The identified specimens form part of the collections of the Mazatlán Marine Station, UNAM.

Only species collected during the TALUD IV cruise and of special interest were treated individually in the systematic section. Biogeographic or ecological data related to species collected during the TALUD III cruise have been reported elsewhere (see HENDRICKX, 1996b). Data on other species captured during these cruises are summarized and included in a general table with their respective collecting data.

Abbreviations used: St., sampling station; CL, carapace length; TL, total length; BS, benthic sledge.

RESULTS

Systematic section

PENAEOIDEA

Family Solenoceridae

***Hymenopenaeus doris* (Faxon, 1893)**

Haliporus doris FAXON, 1893: 214.

Haliporus doris. – FAXON, 1895: 191, pl. 49, Figs. 1-1c.

Hymenopenaeus doris. – BURKENROAD, 1936: 104; 1938: 60. – PÉREZ-FARFANTE, 1977: 283, Figs. 9, 17a, 18a, 19-20. – MÉNDEZ, 1981: 55, Figs. 155, 156, 156a-c. – HANAMURA, 1983: 55, Fig. 2. – WICKSTEN, 1989: 311. – WICKSTEN & HENDRICKX, 1992: 4. – HENDRICKX, 1993: 305; 1995d: 529, Fig. 1b, 530, Fig. 3b, 531, Fig. 8a, 532, Fig. 9a, 534; 1996c: 119, Fig. 60. – HENDRICKX & ESTRADA-NAVARRETE, 1996: 40, Fig. 24.

Aliporus doris. – DEL SOLAR, 1972: 4.

Material examined. – St. 19-IV, 25/VIII/2000, 1 male (CL 13.5 mm) and 1 female (CL 12.0 mm), 1245-1240 m, BS.

Previously known distribution. – From Punta Chivato, Mexico to Guanape, Peru (HENDRICKX, 1996c).

Remarks. – The only records in benthic samples for the Gulf of California are off Punta Arena and Punta Chivato, along the Baja California Peninsula (HENDRICKX, 1996c). The species has also been captured in the water column (see HENDRICKX & ESTRADA-NAVARRETE, 1996) and its presence in bottom trawls might be due to incidental catch during recovery of the gear.

Family Benthesicymidae

***Benthesicymus tanneri* Faxon, 1893**

Benthesicymus tanneri FAXON, 1893: 215.

Benthesicymus tanneri. – FAXON, 1985: 205, Fig. H. – RATHBUN, 1904: 147. – SCHMITT, 1921: 23, Fig. 10. – MÉNDEZ, 1981: 31. – RODRÍGUEZ DE LA CRUZ, 1987: 20. – WICKSTEN & HENDRICKX, 1992: 2. – HENDRICKX, 1993: 305; 1995d: 436, Fig. 4, 437; 1996c: 12, Fig. 5.

Material examined. – St. 13-IV, 24/VIII/2000, 1 male (CL 31.8 mm), 1530-1520 m, BS; St. 19-IV, 25/VIII/2000, 3 females (CL 36.5-37.3 mm), 1245-1240 m, BS; St. 26-IV, 26/VIII/2000, 1 male (CL 30.2 mm) and 2 juveniles (not measured), 1225-1240 m, BS; St. 33-IV, 27/VIII/2000, 2 males (CL 33.2 and 34.8 mm), 1040 m, BS.

Previously known distribution. – From San Diego, California, USA to Ilo, Peru. Southeastern Gulf of California; Galapagos Islands (HENDRICKX, 1996c).

Remarks. – The distribution of this species is synthesized by HENDRICKX (1996c). *Benthesicymus tanneri* is a common species in deep water of the SE Gulf of California. Material captured during this study includes the largest specimens known to date (up to 135 mm TL). Adult specimens are rather heavy (ca. 13.0-16.5 g of individual fresh weight for specimens of 110-135 mm TL) and they most probably live close to the bottom. Often captured with *Heterocarpus affinis*, a potential deep-water resource in the eastern tropical Pacific (HENDRICKX 1995d), *B. tanneri* could represent an interesting by-catch species in pandalids fishery.

CARIDEA

Family Pandalidae

***Pandalus amplus* (Bate, 1886)**

Pandalopsis amplus BATE, 1888: 671, pl. 175, Fig. 3.

Pandalopsis ampla. – FAXON, 1895: 155. – RATHBUN, 1904: 51. – SCHMITT, 1921: 46. – WICKSTEN, 1989: 313. – WICKSTEN & HENDRICKX, 1992: 9.

Material examined. – St. 19-IV, 25/VIII/2000, 2 females, the smallest ovigerous (CL 31.6 and 32.6 mm), 1245-1240 m, BS.

Previously known distribution. – From Sea Lion Rock, Washington, USA to Acapulco, Gro., Mexico. ATL from off Montevideo, Uruguay to Argentina (WICKSTEN & HENDRICKX, 1992).

Remarks. – *Pandalus amplus* is a common species off the coast of California, where it has been reported at least in 28 localities (HENDRICKX & WICKSTEN, 1989) and from a depth range of 132-2000 m. There are only five records along the Pacific coast of Mexico, including two in the Gulf of California. The present record represents a range extension of this species along the east coast of the Gulf of California to 24°15.3' N - 108°24.1'W. The size of the largest female (165 mm TL) is close to the maximum known size (170 mm TL) for the east Pacific. Fresh weight of specimens examined are 22 and 24 g.

Family Crangonidae

***Sclerocrangon atrox* Faxon, 1893**

Sclerocrangon atrox Faxon, 1893: 199.

Sclerocrangon atrox. – FAXON, 1895: pl. 35, Figs. 1, 1a-f. – MÉNDEZ, 1981: 121. – WICKSTEN & HENDRICKX, 1992: 6.

Material examined. – St. 13-IV, 24/VIII/2000, 1 male (CL 27.8 mm), 1530-1520 m, BS; St. 19-IV, 25/VIII/2000, 1 male (CL 25.2 mm), 1245-1240 m, BS.

Previously known distribution. – From near Tres Marias Islands, Nayarit, Mexico to off Mollendo, Peru (WICKSTEN & HENDRICKX, 1992).

Remarks. – A large (up to 162 mm TL; ca. 38 mm CL) and rather rare species of Crangonidae. The present material increases the range northwards by two degrees of latitude, from off Tres Marias Islands to 24º15.3'N - 108º24.1'W.

Family Oplophoridae

***Acanthephyra brevirostris* Smith, 1885**

Acanthephyra brevirostris SMITH, 1885: 504.

Acanthephyra brevirostris. – SMITH, 1886(1887): 670, pl. 14, Fig. 2, pl. 15, Figs. 2, 8, pl. 16, Figs. 1, 6. – FAXON, 1895: 167. – KENSLEY, 1972: 38, Fig. 17m. – CROSNIER & FOREST, 1973: 41, Figs. 8c-d. – HANAMURA, 1983: 75. – CHACE, 1986: 8 (Key), Figs. 2e, 4e, 5e, 6d, 8d. – HENDRICKX & ESTRADA-NAVARRETE, 1989: 113; 1996: 109, Fig. 67.

Material examined. – St. 26-IV, 26/VIII/2000, 1 juvenile (CL 6.5 mm), 1225-1240 m, BS.

Previously known distribution. – From off Baja California and off Ecuador, including the SE Gulf of California; SW Indian Ocean; East and West Atlantic Ocean (HENDRICKX & ESTRADA-NAVARRETE, 1996).

Remarks. – Only two records of this species are available for the east Pacific (off Ecuador, 0.58' S - 115.15' E; Dowd Tablemount, off Baja California, Mexico) (HENDRICKX & ESTRADA NAVARRETE, 1996). The juvenile examined, although slightly damaged, shows features distinctive of this species. This deep-water pelagic species has been collected between 1280 and 5394 m, mostly in mid-water trawls. Examined material was most probably collected in the water column during recovery of the dredge.

***Hymenodora gracilis* Smith, 1887**

Hymenodora gracilis SMITH, 1886 (1887): 680, pl. 12, Fig. 6.

Hymenodora gracilis. – SIVERTSEN & HOLTHUIS, 1956: 16, Figs. 12, 13. – CROSNIER & FOREST, 1973: 83, Fig. 25a. – WASMER, 1986: 49, Figs. 10b-c. – CHACE, 1986: 43 (clave), Figs. 21p-t. – IWASAKI & NEMOTO, 1987a: 20. – KRYGIER & WASMER, 1988: 87. – HANAMURA, 1989: 54, Fig. 2. – HENDRICKX & ESTRADA-NAVARRETE, 1989: 115; 1996: 119, Fig. 73. – ALLEN & BUTLER, 1994: 426, Fig. 5.

Material examined. – St. 35-IV, 27/VIII/2000, 1 male (CL 12.0 mm), 2016-2020 m, BS.

Previously known distribution. – From Oregon, USA to West coast of Baja California; coast of Chile and in subantarctic waters of the South Pacific Ocean (HENDRICKX & ESTRADA-NAVARRETE, 1996).

Remarks. – This is the first record outside the temperate waters of the NE and SE Pacific. A mesopelagic and bathypelagic species, *H. gracilis* is reported from ca. 300 to 5300 m (HENDRICKX & ESTRADA NAVARRETE, 1996). Some of these depth records, however, might be erroneous caused by the use of non-closing, bottom sampling devices. The material reported here was accidentally captured in the bottom sledge and there is no way to assess correctly the depth at which it was collected. *Hymenodora glacialis*, a closely related species, has been previously recorded in the central Gulf of California (HENDRICKX & ESTRADA NAVARRETE, 1996).

Family Pasiphaeidae

***Pasiphaea emarginata* Rathbun, 1902**

Pasiphaea emarginata RATHBUN, 1902: 905.

Pasiphaea emarginata. – RATHBUN, 1904: 22, Fig. 4. – SCHMITT, 1921: 30, Fig. 15. – CHACE, 1937: 110. – WORD & CHARWAT, 1976: 205-206 (Illustration). – HENDRICKX & ESTRADA-NAVARRETE, 1989: 111; 1996: 89, Fig. 55.

Material examined. – St. 25-IV, 26/VIII/2000, 2 males (CL 35.1 and 36.0 mm) and 10 females (CL 27.3-38.3 mm), 870-835 m, BS.

Previously known distribution. – From West coast of Baja California (up to 26° N) and in the Gulf of California (up to 30°11' N); south to the Gulf of Panama and Lobos de Tierra Islands, Peru; Galapagos Islands (HENDRICKX & ESTRADA-NAVARRETE, 1996).

Remarks. – In addition to the type material taken near Concepcion Bay entrance, the only other two records of this species in the Gulf of California are over 60 years old (CHACE, 1937); all these records are from the central Gulf.

***Pasiphaea magna* Faxon, 1893**

Pasiphaeia magna FAXON, 1893: 209.

Pasiphaea magna. – FAXON, 1895: 176, pl. 45, Fig. 2. – WORD & CHARWAT, 1976: 208. – MÉNDEZ, 1981: 64, Figs. 190-192. – KRYGIER & WASMER, 1988: 77. – HENDRICKX & ESTRADA-NAVARRETE, 1989: 111; 1996: 91, Figs. 56, 57.

Material examined. – St. 19-IV, 25/VIII/2000, 1 female (CL 31.1 mm), 1245-1240 m, BS.

Previously known distribution. – From Oregon, USA, and the SE Gulf of California to the Gulf of Panama and Peru (HENDRICKX & ESTRADA-NAVARRETE, 1996).

Remarks. – This is the second record of *P. magna* in Mexican waters (see HENDRICKX & ESTRADA-NAVARRETE, 1996). Maximum recorded size is 185 mm (TL). The examined specimen is 106 mm TL.

Family Hippolytidae

***Lebbeus scrippsi* Wicksten & Méndez, 1982**

Lebbeus scrippsi WICKSTEN & MÉNDEZ, 1982: 106.

Lebbeus scrippsi. – WICKSTEN, 1989: 312. – HENDRICKX, 1996b: 946.

Material examined. – St. 19-IV, 25/VIII/2000, 4 males (CL 6.7-8.2 mm) and 3 ovigerous females (CL 9.5-10.9 mm), 1245-1240 m, BS; St. 26-IV, 26/VIII/2000, 2 males (CL 6.7 and 10.3 mm), 1225-1240 m, BS.

Previously known distribution. – From Peru to Chile; one record in southeastern Gulf of California (WICKSTEN, 1989; HENDRICKX, 1996b).

Remarks. – This rare species is again reported in the area; two females (CL 9.0 and 9.4 mm), including one ovigerous, were reported in 1996. Among the 9 specimens reported here are 3 ovigerous females carrying 32-66 eggs each (Table 2). The largest female from station 26 (CL 10.9 mm) is 42.0 mm TL, slightly longer than the largest paratype (TL 41.2 mm).

TABLE 2

Sizes by sex, eggs number and eggs size in *Lebbeus scrippsi* from the Gulf of California continental slope (M, male; F, female).

Sex	CL/TL(mm)	Eggs Number	Size range (mm)
M	6.7/26.8	---	---
M	7.0/30.1	---	---
M	8.2/35.8	---	---
M	8.2/36.9	---	---
F	9.5/32.0	32	1.35-1.65
F	10.0/36.2	35	2.10-2.55
F	10.9/42.0	66	1.58-2.02
M	10.3/36.5	---	---
M	6.75/30.9	---	---

Family Glyphocrangonidae

***Glyphocrangon sicaria* Faxon, 1893**

Glyphocrangon sicarius Faxon, 1893: 202.

Glyphocrangon sicaria. – Faxon, 1895: pl. 39, Figs. 1, 1a-e. – Wicksten, 1989: 314. – Wicksten & Hendrickx, 1992: 6.

Material examined. – St. 14-IV, 24/VIII/2000, 1 specimen not sexed (CL 6.5 mm), 2160-2150 m, BS; St. 26-IV, 26/VIII/00, 1 specimen not sexed (CL 9.0 mm), 1225-1240 m, BS.

Previously known distribution. – From South of Punta Guiones, Costa Rica to Gulf of Panama (Wicksten & Hendrickx, 1992).

Remarks. – One of the 5 species of the genus reported for the eastern tropical Pacific, *G. sicaria* has so far been reported exclusively below ca. 1454 m (1454-3310 m; Wicksten, 1989).

Family Nematocarcinidae

Nematocarcinus* cf. *ensifer
(Smith, 1882)

Eumiersia ensifera Smith, 1882: 77, pl. 13, Figs. 1-9.

Nematocarcinus ensiferus. – Smith, 1884: 368, pl. 7, Fig. 1.

Nematocarcinus ensifer. – Crosnier & Forest, 1973: 116, Figs, 32a-c, 33a-c. – Wicksten & Hendrickx, 1992: 6.

Material examined. – All specimens unsexed and unmeasured. St. 13-IV, 24/VIII/2000, 6 specimens, 1530-1520 m, BS; St. 26-IV, 26/VIII/2000, 5 specimens, 1225-1240 m, BS; St. 33-IV, 27/VIII/2000, 2 specimens, 1040 m, BS; St. 34-IV, 27/VIII/2000, 1 specimen, 1240-1250 m, BS.

Previously known distribution. – *Nematocarcinus ensifer* is known from off Acapulco, Mexico, to the Galapagos Islands; distributed worldwide (Atlantic, Pacific, Indian Ocean and Mediterranean Sea (Wicksten & Hendrickx, 1992).

Remarks. – The material is assigned to *N. ensiger* with some doubts. It includes specimens with no ventral teeth on the rostrum and others with 1-3 clearly distinguishable small teeth in the distal portion. According to Crosnier and Forest (1973), presence of ventral teeth on some *Albatross* specimens, reported by Faxon (1895) as belonging to an atypical form of "*N. ensifer*" from the east Pacific, should be linked with the presence, in this area, of another species. A revision of W. Faxon material by R. Burukovsky (pers. comm. October 2000) prompted this author to describe a new species (forthcoming manuscript) close to *N. agassizi* Faxon, 1893, the second species of this genus previously reported in the east Pacific. Although our material features a rostrum clearly distinct from *N. agassizi*, a careful revision of the specimens collected during both TALUD cruises (see Hendrickx, 1996b) should be undertaken. Although the dorsal process on the posterior margin of the third abdominal segment is similar in large, adult specimens, the rostrum features either long dorsal spines and a few ventral spines, or short dorsal spines on a longer rostrum and no ventral spines (Fig. 1). As noted by R. Burukovsky, species of *Nematocarcinus* are difficult to identify, mostly because they are generally damaged during sampling (loss of pereiopods).

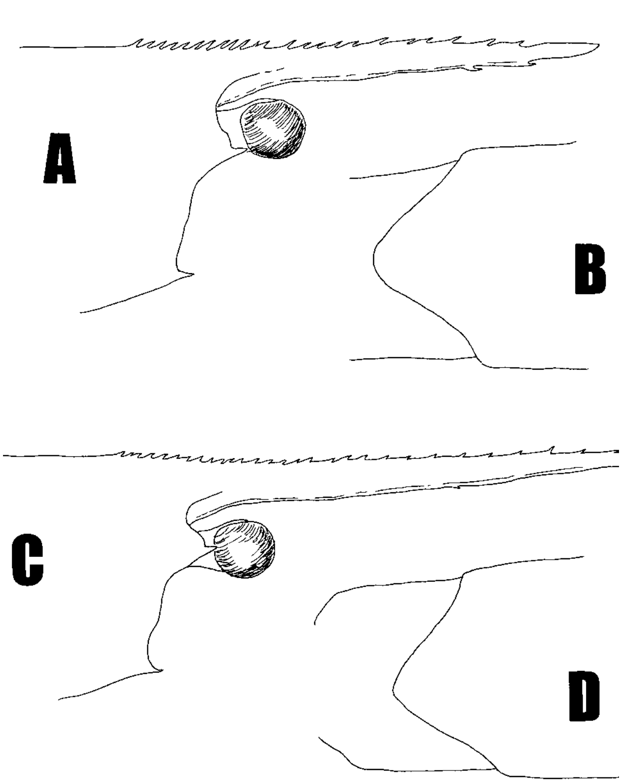

Fig. 1. – A, C) Anterior part of carapace and rostrum of *Nematocarcinus* cf. *ensifer*. B, D) Dorsal view of 3rd abdominal tergite (A, B, St. 34. CL 16.6 mm; C, D, St. 26, CL 22.2 mm).

ERYONOIDEA

Family Polychelidae

Stereomastis pacificus (Faxon, 1893)

Polycheles sculptus pacificus Faxon, 1893: 196.

Polycheles sculptus pacificus. – FAXON, 1895: 122, pl. C, Fig. 1, 1a.

Eryoniscus agassizi. – SCHMITT, 1921: 105, pl. 15, Figs. 1-2.

Stereomastis sculpta pacifica. – WICKSTEN, 1981: 914, Fig. 1; 1989: 311. – HENDRICKX, 1995a: 156.

Material examined. – St. 19-IV, 25/VIII/00, 1 male (TL 118.0 mm), 2 females (CL 105.0 and 108.0 mm) and 1 ovigerous female (CL 129.0 mm), 1245-1240 m, BS.

Previously known distribution. – From San Clemente Island, California, USA, to Valparaiso, Chile. Off Tres Marias Islands (HENDRICKX, 1995a).

Remarks. – There is a total of 41 records of *S. pacificus* from the east Pacific (off the coasts of southern California, USA, Mexico, Panama, Costa Rica, Colombia, Peru and Chile) (see WICKSTEN, 1981), thus indicating that it has been frequently caught within its range. Original records by FAXON (1893) include one from the SE Gulf of California, off Tres Marias Islands; this is believed to be the only published record for this species within the Gulf of California. WICKSTEN (1981) mentioned a series of 32 adults from 20 stations in Costa Rica, Mexico and southern California, but without further details.

ANOMURA

Family Galatheidae

***Munidopsis ciliata* Wood-Mason, 1891**

Munidopsis ciliata WOOD-MASON, 1891: 200.

Munidopsis ciliata. – FAXON, 1895: 84, pl. 18, Fig. 3. – BENEDICT, 1902: 318. – AMBLER, 1980: 19, Fig. 3. – WICKSTEN, 1989: 315. – HENDRICKX & HARVEY, 1999: 376.

Munidopsis brevimana. – HENDERSON, 1885: 414; 1888: 154, pl. 17, Figs. 1, 2.

Munidopsis (*Orophorhynchus*) *ciliata*. – ALCOCK, 1901: 267.

Material examined. – St. 19-IV, 25/VIII/00, 2 males (TL 45.7 and 52.3 mm) and 1 ovigerous female (TL 58.8 mm), 1245-1240 m, BS.

Previously known distribution. – From Oregon, USA to off Panama, including the southern Gulf of California (WICKSTEN, 1989).

Remarks. – Within its geographic range, *M. ciliata* had been reported from a depth range of 2030-2075 m (WICKSTEN, 1989). The present record is from much shallower water. The ovigerous female carried 56 eggs.

***Munidopsis depressa* Faxon, 1893**

Munidopsis depressa FAXON, 1893: 189.

Munidopsis depressa. – FAXON, 1895: 96, pl. 22, figs 2, 2a, 2b. – BENEDICT, 1902: 319. – WICKSTEN, 1989: 315. – HENDRICKX, 1996b: 946. – HENDRICKX & HARVEY, 1999: 376.

Material examined. – St. 25-IV, 26/VIII/2000, 205 males (TL 8.5-37.0 mm), 64 females (TL 12.0-35.0 mm) and 4 ovigerous females (TL 27.0-33.0 mm), 870-835 m, BS; St. 26-IV, 26/VIII/2000, 33 males (TL 12.5-37.0 mm), 13 females (TL 16.0-35.0 mm) and 3 ovigerous females (TL 27.0-35.0 mm), 1225-1240 m, BS. St. 33-IV, 27/VIII/2000, 1 male (TL 36.0 mm) and 1 ovigerous female (TL 38.0 mm), 1040 m, BS.

Previously known distribution. – From off Santa Catalina Island, California, USA, to the Gulf of California, Mexico, from off Ahome Point, Sinaloa, to off Tres Marias Islands (HENDRICKX, 1996b).

Remarks. – Five samples were obtained during the previous cruise (TALUD III) at depths between 820 and 1208 m in the same area (HENDRICKX, 1996b). Considering these records and the new material obtained during this study, *M. depressa* appears to be one of the most common and abundant species of decapod crustacean on the continental slope in the SE Gulf of California.

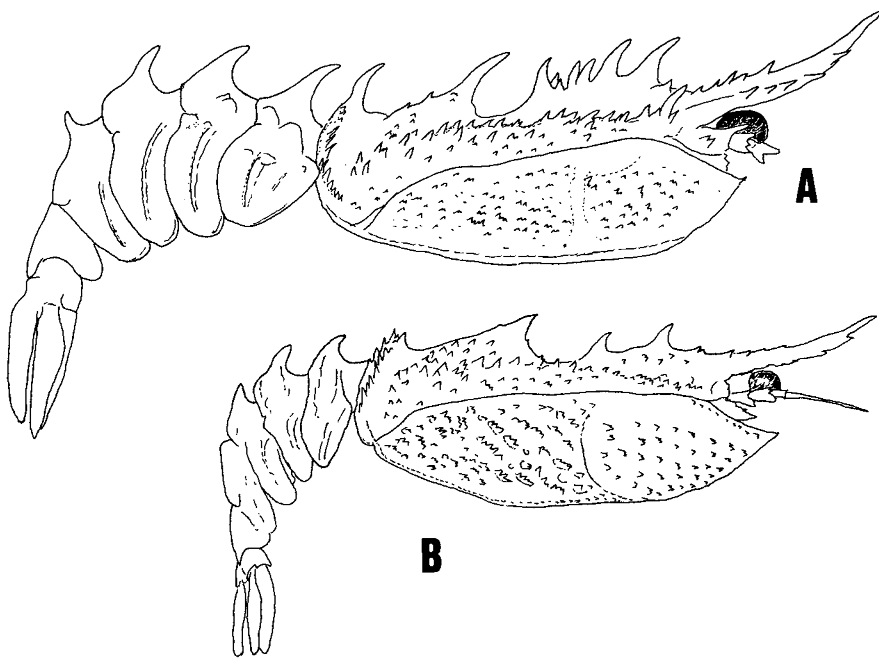

Fig. 2. – Lateral view of *Munidopsis depressa*. A) Specimen with unusually strong and long spines on carapace and a dorsal tooth on 5th abdominal segment (St. 33). B) Type material (after Faxon, 1893).

Specimens from stations 26 and 33 represent a spinose form of *M. depressa*. Spines on the carapace are much stronger and more numerous; also, the dorsal teeth on the abdominal segments are much stronger and there is one dorsal tooth on the fourth segment (Fig. 2), while material from the other stations lack this tooth, as does the type material illustrated by FAXON (1893). Close examination of these spinose specimens, including shape of the third maxilliped, the basal article of the antenna and antennula, the sternum and the chelipeds, indicates that this spinose form corresponds to an extreme variation of *M. depressa*.

Of the total (324 specimens), 239 specimens were males (74%). Only 8 ovigerous females were collected. Number of eggs varied from 21 to 29 in the smallest females (i.e., TL 27.0 to 33.0 mm) to 68 in the larger specimen collected at station 33; three hatching females had only 7 eggs retained on the pleopods.

***Munidopsis palmatus* Khodkina, 1973**

Munidopsis palmatus KHODKINA, 1973:1164-116, Figs 5-6.

Material examined. – St. 19-IV, 25/VIII/00, 1 ovigerous female (TL 22.0 mm), 1245-1240 m, BS; St. 26-IV, 26/VIII/2000, 1 ovigerous female (TL 24.0 mm),1225-1240 m, BS.

Previously known distribution. – Known only from the type locality, off the coast of Chile, north of Valparaiso (32º11'6" S – 71º46'3" W).

Characteristics. – Rostrum triangular in dorsal view, about 1/3 carapace length. Carapace as long as wide; gastric and cardiac regions raised, strong antero-branchial protuberance, granulated, tipped with spine or blunt tubercle. Antennal spine blunt or obsolete; protuberance at antero-lateral angle tipped with strong tooth, curved inside; lateral margin posterior to cervical groove entire, granulated. Dorsal carapace roughly granulated; cervical groove poorly marked, pair of large, strong gastric tubercles and conical median tubercle beyond this pair; posterior margin raised,.

Surface of sternite 4-6 smooth; sternites 5 to 7 with transverse ridges minutely granulate, not raised. Abdominal segments without spines or tubercles, punctate; transverse ridge on segments 2-4 strong.

Eyes small, without pigmentation and without spines, diameter less than 1/2 length of rostrum.

Antennular basal segment broad, bearing large ventro-internal spine with accessory spinules, sharp external spine and two distal spines, dorsal one directed upwards; outer margin granulated. Outer distal spine of basal antennal peduncle strong, sharp, not reaching distal margin of 3rd segment of antennular peduncle. Merus of third maxiliped with two strong spines on flexor margin (no distal spine); extensor margin armed with one distal spine.

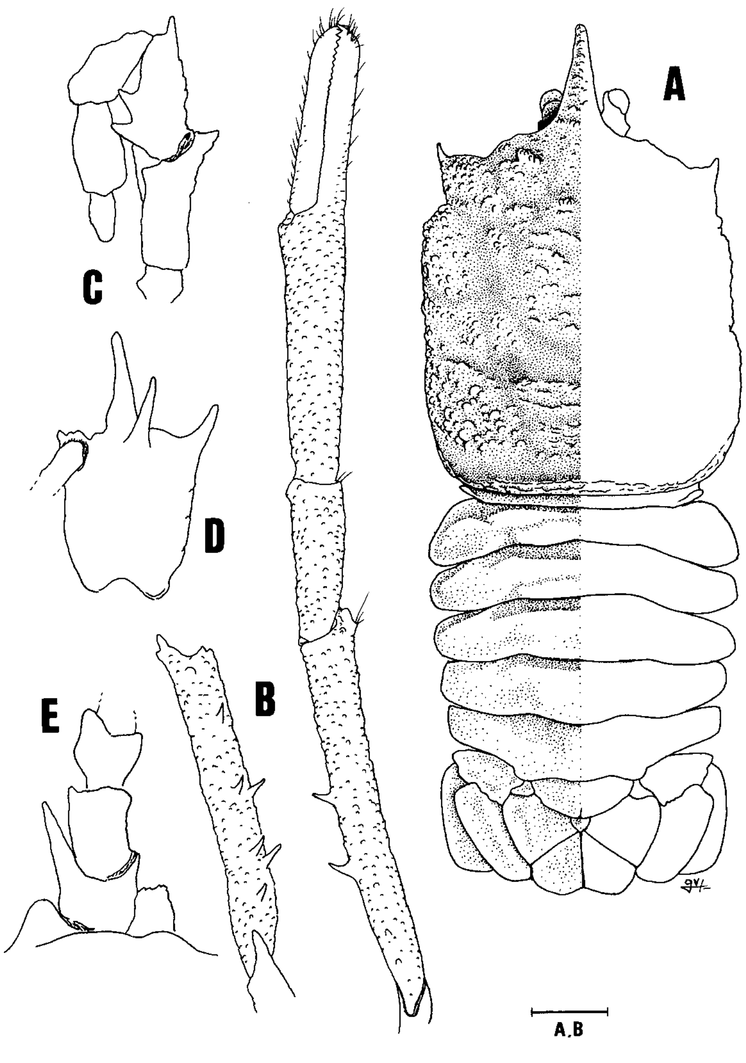

Fig. 3. – *Munidopsis palmatus*. A, Dorsal view. B) Left cheliped, dorsal view, and ventral view of merus. C) Left third maxilliped, lateral view. D) Right basal segment of antennula, dorsal view. E, Left antenna basal segments, dorsal view (scale = 2 mm).

Cheliped about three times as long as carapace, granulated; merus with 5-6 sharp spines on inner margin, one distal. Carpus without spine; chela without spines, longer than merus, flat; palm slightly longer than fingers, wider distally.

Lower and upper margin of manus spineless; fingers flattened, ventral margin of fixed finger and dorsal margin of dactylus spineless. Carpus subcylindrical, about 2/3 length of palm; dactylus shorther than palm.

Pereiopods slender, without spines. Propodus about 3/4 merus length; dactylus falciform, more than half propodus length.

Remarks. – This species, together with three other species described from off the coast of Chile by KHODKINA (1973: *M. verrucosus*, *M. cochlearis* and *M. follirostris*) was overlooked by RETAMAL (1981) and WICKSTEN (1989) in their respective review of the decapod crustaceans of Chile and analysis of the deep-water decapod crustaceans fauna of the east Pacific. The rediscovery of *M. palmatus*, previously known only from the male holotype (8.9 mm CL), in the SE Gulf of California indicates that this species is probably distributed throughout the east Pacific. The original description was in Russian, so the characteristics distinguishing this species from other *Munidopsis* present in the area are presented above.

Both specimens were ovigerous females. The specimen from station 19 carried 7 eggs but had obviously started hatching prior to capture; the female from station 26 carried 12 eggs.

***Munidopsis quadrata* Faxon, 1893**

Munidopsis quadrata FAXON, 1893: 188.

Munidopsis quadrata. – FAXON, 1895; pl. 23, Figs. 1, 1a-c. – BENEDICT, 1902: 325. – HART, 1982: 38. – WICKSTEN, 1989: 315. – HENDRICKX & HARVEY, 1999: 376.

Material examined. – St. 26-IV, 26/VIII/2000, 1 male (TL 31.0 mm), 1225-1240 m, BS.

Previously known distribution. – From Queen Charlotte Islands, Canada to Tres Marias Islands, Gulf of California, Mexico (WICKSTEN, 1989; HENDRICKX & HARVEY, 1999).

Remarks. – The rediscovery of *M. quadrata* in the southern Gulf of California confirms the presence of this temperate species in deep water of tropical Mexico. It is the first record of this species here since it was described by FAXON (1893) from 4 specimens captured at 1220-1225 m off Tres Marias Islands, Mexico. The male specimen reported here is slightly larger than the type material.

Other collected species

In addition to the 16 species treated above in the systematic section, the material from the TALUD IV cruise included nine species (see Table 3) that are briefly treated here. Two species of the strictly pelagic Sergestidae were captured. According to HENDRICKX & ESTRADA-NAVARRETE (1996), *Sergestes halia* Faxon, 1893, is a common species in the southern Gulf of California and extend throughout the eastern tropical Pacific. *Sergia phorca* (Faxon, 1893) shows a similar distribution pattern along the Pacific coast of America, but extends much further southwards, to southern Peru. *Gennadas sordidus* Kemp, 1910, is the only species of *Gennadas* known to the Gulf of California where it occurs abundantly except in the upper Gulf (HENDRICKX & ESTRADA-NAVARRETE, 1996). Adaptation of this species to low oxygen content in the water column consists of a strong increase of branchial surface (HANAMURA, 1983). The rest of the species (*Heterocarpus affinis* Faxon, 1893; *Acanthephyra brevicarinata* Hanamura, 1984; *Glyphocrangon spinulosa* Faxon, 1893; *Munidopsis diomedeae* (Faxon, 1893); *M. hystrix* Faxon, 1893; *Nephropsis occidentalis* Faxon, 1893) were also captured during the TALUD III cruise in the same area (Table 4).

TABLE 3

Species of decapod crustaceans collected during the TALUD IV cruise in the SE Gulf of California. Oxygen measured at bottom level. M = male; F = female; FF = ovigerous female; juv. = juvenile.

Species	Station	Depth	Oxygen content	Material examined (size)
Benthesicymidae				
Gennadas sordidus	13	1530-1520	1,46	1 F (CL 9.8 mm)
Gennadas sordidus	18	856	1,03	2 M (CL 9.0, 9.5 mm); 1 F (CL 9.8 mm)
Gennadas sordidus	19	1245-1240	0,73	1 juv. (CL 8.5 mm)
Benthesicymus tanneri	13	1530-1520	1,46	see text
Benthesicymus tanneri	19	1245-1240	0,73	see text
Benthesicymus tanneri	26	1225-1240	0,76	see text
Benthesicymus tanneri	33	1040	0,51	see text
Solenoceridae				
Hymenopenaeus doris	19	1245-1240	0,73	see text
Sergestidae				
Sergestes halia	4	1260	0,84	
Sergia phorca	26	1225-1240	0,76	1 F (CL 16.0 mm)
Pasiphaeidae				
Pasiphaea emarginata	25	870-835	0,29	see text
Pasiphaea magna	19	1245-1240	0,73	see text

Species	Station	Depth	Oxygen content	Material examined (size)
Oplophoridae				
Acanthephyra brevicarinata	19	1245-1240	0,73	1 M (CL 20.7 mm); 1 F (CL 28.1 mm)
Acanthephyra brevicarinata	20	1510	1,26	1 M (CL 27.8 mm)
Acanthephyra brevicarinata	26	1225-1240	0,76	2 FF (CL 22.0, 22.2 mm)
Acanthephyra brevicarinata	27	1550-1546	1,32	1 juv. (TL 45.0 mm)
Acanthephyra brevicarinata	33	1040	0,51	1 FF (CL 21.5 mm)
Acanthephyra brevicarinata	34	1240-1250	0,79	1 M (CL 11.2 mm)
Acanthephyra brevicarinata	35	2016-2020	1,68	1 F (CL 11.7 mm)
Acanthephyra brevirostris	26	1225-1240	0,76	see text
Hymenodora gracilis	35	2016-2020	1,68	see text
Nematocarcinidae				
Nematocarcinus cf. *ensifer*	13	1530-1520	1,46	see text
Nematocarcinus cf. *ensifer*	26	1225-1240	0,76	see text
Nematocarcinus aff. *ensifer*	26	1225-1240	0,76	see text
Nematocarcinus cf. *ensifer*	33	1040	0,51	see text
Hippolytidae				
Lebbeus scrippsi	19	1245-1240	0,73	see text
Lebbeus scrippsi	26	1225-1240	0,76	see text
Pandalidae				
Heterocarpus affinis	25	870-835	0,29	1 F (CL. 34.8 mm)
Heterocarpus affinis	33	1040	0,51	14 specimens (CL 23.5-38.5 mm)
Pandalus amplus	19	1245-1240	0,73	see text
Crangonidae				
Sclerocrangon atrox	13	1530-1520	1,46	see text
Sclerocrangon atrox	19	1245-1240	0,73	see text
Glyphocrangonidae				
Glyphocrangon sicaria	14	2160-2150	2,44	see text
Glyphocrangon sicaria	26	1225-1240	0,76	see text
Glyphocrangon spinulosa	19	1245-1240	0,73	2 F (CL 22.4, 22.9 mm)
Glyphocrangon spinulosa	26	1225-1240	0,76	3 F (CL 17.1, 17.9 mm); 1 FF (CL 26.6 mm)
Nephropidae				
Nephropsis occidentalis	19	1245-1240	0,73	2 M (CL 32.3, 33.2 mm); 1 F (CL 35.5 mm)
Nephropsis occidentalis	26	1225-1240	0,76	1 F (CL 33.3 mm)
Polychelidae				
Stereomastis pacificus	19	1245-1240	0,73	see text
Paguridae				
Parapagurus foraminosus	14	2160-2150	2,44	1 FF (CL 7.4 mm)
Galatheidae				
Munidopsis ciliata	19	1245-1240	0,73	see text
Munidopsis depressa	25	870-835	0,29	see text
Munidopsis depressa	26	1225-1240	0,76	see text
Munidopsis depressa	33	1040	0,51	see text
Munidopsis diomedeae	19	1245-1240	0,73	1 M (TL 65.0 mm)
Munidopsis diomedeae	20	1510	1,26	1 FF (TL 73.0 mm)
Munidopsis diomedeae	26	1225-1240	0,76	1 juv. (TL 19.9 mm)
Munidopsis hystrix	25	870-835	0,29	4 M (TL 48.4-51.5 mm)
Munidopsis hystrix	26	1225-1240	0,76	1 M (TL 59.0 mm)
Munidopsis palmatus	19	1245-1240	0,73	see text
Munidopsis palmatus	26	1225-1240	0,76	see text
Munidopsis quadrata	26	1225-1240	0,76	see text

TABLE 4

Species of decapod crustaceans collected during the TALUD III cruise in the SE Gulf of California. Species marked with an * have been reported in details elsewhere (see Hendrickx, 1996b).

Species	Station	Depth	Oxygen content (ml/l)
Benthesicymidae			
Benthesicymus tanneri	14A	1016-1020	0,40
Benthesicymus tanneri	14B	1188-1208	0,60
Benthesicymus tanneri	24A	1027-1060	-
Oplophoridae			
Acanthephyra brevicarinata	10A	956-980	0,25
Acanthephyra brevicarinata	14A	1016-1020	0,40
Acanthephyra brevicarinata	20A	880-1052	-
Acanthephyra brevicarinata	24A	1027-1060	-
Hippolytidae			
*Lebbeus scrippsi**	14B	1188-1208	0,60
Nematocarcinidae			
*Nematocarcinus cf. ensifer**	14A	1016-1020	0,40
*Nematocarcinus cf. ensifer**	14B	1188-1208	0,60
*Nematocarcinus cf. ensifer**	24	1224-1380	-
*Nematocarcinus cf. ensifer**	24A	1027-1060	-
Pandalidae			
Heterocarpus affinis	10A	956-980	0,25
Heterocarpus affinis	14A	1016-1020	0,40
Heterocarpus affinis	20A	880-1052	-
Heterocarpus affinis	24	1224-1380	-
Heterocarpus affinis	24A	1027-1060	-
Crangonidae			
*Paracrangon areolata**	14A	1016-1020	0,40
Glyphocrangonidae			
*Glyphocrangon spinulosa**	10A	956-980	0,25
*Glyphocrangon spinulosa**	24A	1027-1060	-
Nephropidae			
*Nephropsis occidentalis**	14B	1188-1208	0,60
Ctenochelidae			
*Callianopsis goniophthalma**	24A	1027-1060	-
Axiidae			
*Calocarides quinqueseriatus**	10A	956-980	0,25
Polychelidae			
Stereomastis nana	14B	1188-1208	0,60
Galatheidae			
*Munidopsis depressa**	10	820-826	-
*Munidopsis depressa**	10A	956-980	0,25
*Munidopsis depressa**	14A	1016-1020	0,40
*Munidopsis depressa**	14B	1188-1208	0,60
*Munidopsis depressa**	24A	1027-1060	-
Munidopsis diomedeae	19	1188-1208	-
*Munidopsis hystrix**	20A	880-1052	-
Atelecyclidae			
*Trachycarcinus corallinus**	14B	1188-1208	0,60

Oxygen content in the water column

Analysis of the dissolved oxygen concentration measured close to bottom (Fig. 4) indicated critical hypoxic conditions at depths between 300 and 800 m. Values higher than 1.0 ml O_2/l are found at ca. 1300 m and there is a clear tendency for oxygen content to increase significantly in deeper water. Values obtained during the TALUD IV cruise in August 2000 are similar, although slightly higher, to those registered at a depth range of ca. 400-1200 m during the TALUD III in August 1991 (Fig. 4). The vertical distribution of oxygen in the area (Fig. 5) indicates the presence

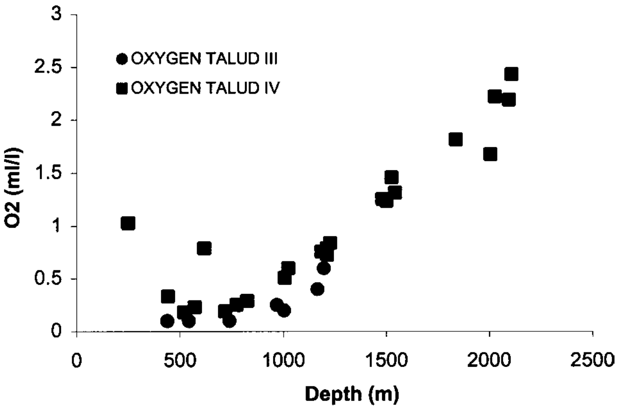

Fig. 4. – Dissolved oxygen concentration measured near bottom during TALUD III and IV cruises.

of three successive environments. The well-oxygenated epipelagic zone ranges from surface to about 80-125 m, with oxygen concentration as high or higher than 2 ml/l. Deeper into the water column, a wide hypoxic to almost anoxic mesopelagic zone is found, extending roughly from 150-200 m to 600-800 m (or to the bottom in stations shallower than 800 m). The deep water benthic-demersal environment is almost anoxic in localities shallower than 600-800 m but oxygen content is higher in deeper localities; oxygen reaches values of 0.5-1.0 ml/l in the depth range of 800-1300 m. In deeper water, there is a strong recovery of the oxygen content, which progressively reaches values above 2.0 ml/l in depths greater than 2000 m (Fig. 4).

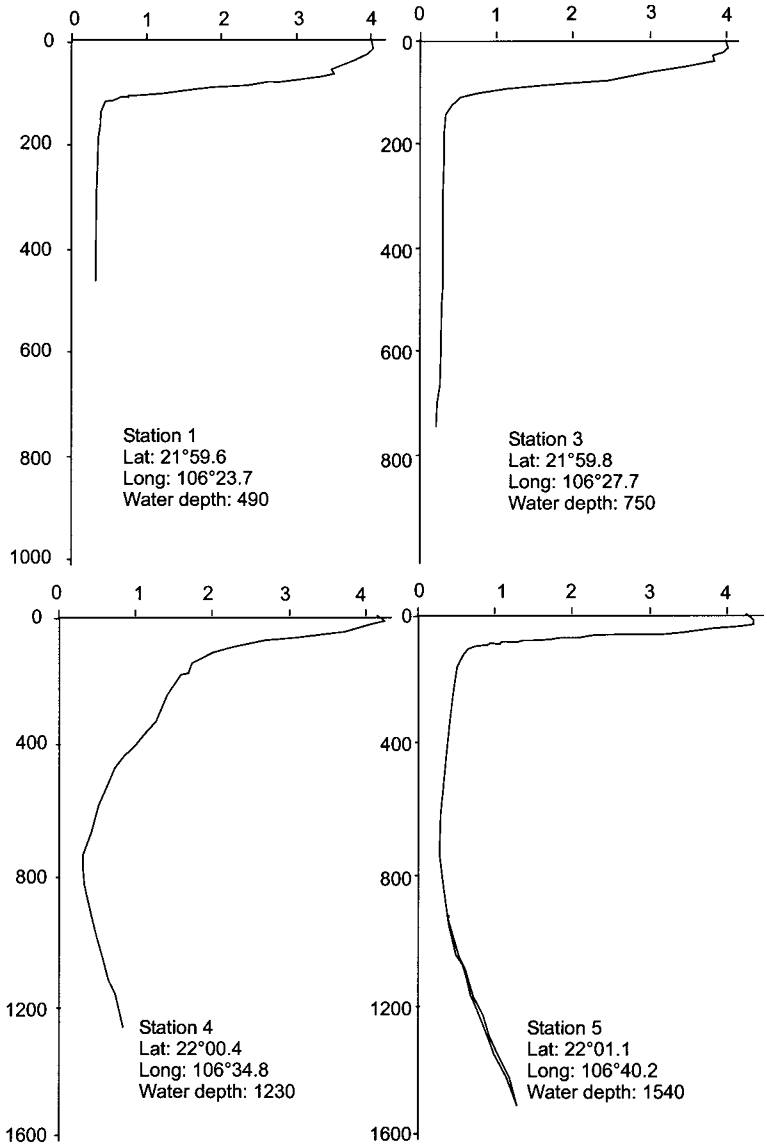

Fig. 5. – Vertical distribution of oxygen at selected stations; TALUD III (St. 9, 10A, 14, 14A, 14B and 15) and TALUD IV (St. 1, 3, 4 and 5) cruises.

Occurrence of deep-water species

A total of 31 species of decapod crustaceans living below 550 m was collected during both cruises (TALUD III, 15 species; TALUD IV, 26 species). Of these, 21 are typically benthic and eight are exclusively pelagic. Three species (*Benthesicymus tanneri*, *Acanthephyra carinata* and *Nematocarcinus* cf. *ensiger*) probably have a benthopelagic habitat as they have been collected with both benthic and pelagic gear; adults of these three species are heavy, and there might be a depth or habitat segregation among juveniles and adults. Six species of the deep water galatheid *Munidopsis* were collected. Considering the number of specimens collected, *M. depressa* appears as the dominant species (324 specimens at four stations) and no other species came near to this abundance. Four species were represented by 9-15 specimens during the entire 2000 survey (*Benthesicymus tanneri*, *Nematocarcinius* cf. *ensifer*, *Heterocarpus affinis* and *Acantephyra brevicarinata*) and the rest were even less abundant (Table 3 and text).

The number of species at each station varied considerably. During TALUD III cruise, the highest number of species obtained at one single station was eight (station depth: 1188-1208 m) and the lowest was one (Table 4). One station, at 820-826 m, yielded only one species of isopod. No strictly pelagic species were recorded. As

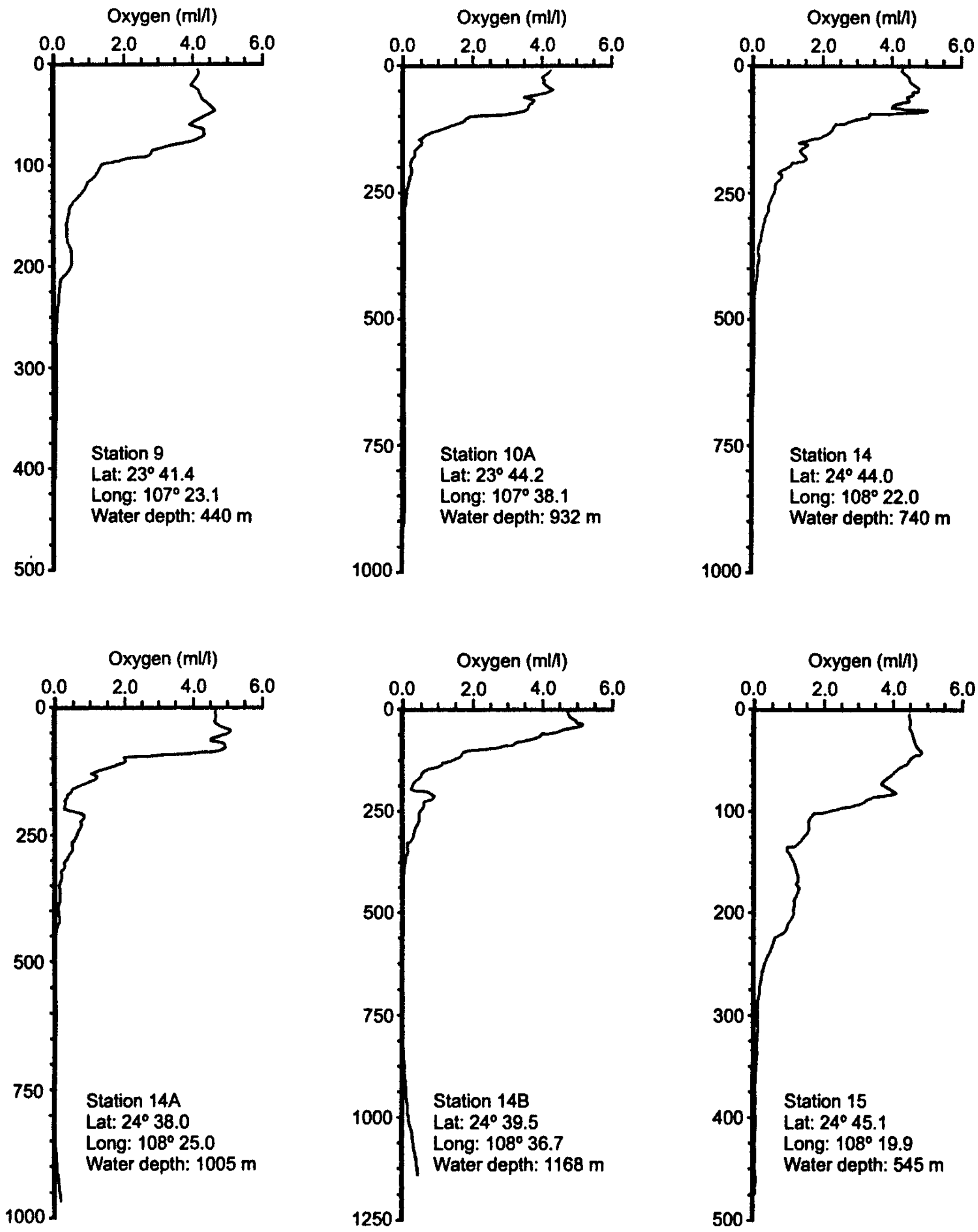

Fig. 6. – Interval of epibenthic oxygen content corresponding to species collected during the TALUD III and IV cruises.

noted previously, the second cruise (TALUD IV) yielded a considerably higher number of species. The highest number of species was obtained at station 19 (15 benthic and one pelagic species), followed by station 26 (12 benthic and one pelagic species) (Table 3). Coincidentally, both samples were obtained in the 1225-1245 m depth range and oxygen content was similar (0.73 and 0.76 ml 0_2/l). The highest number of species during TALUD III cruise was obtained in similar conditions: at 1188-1208 m, with oxygen content of 0.60 ml/l. Comparatively, the other stations feature a low species occurrence (Tables 3, 4). Oxygen content at bottom level does not seem to be a critical factor; indeed, the highest oxygen content during the TALUD IV cruise was measured at station 14 (2.44 ml O_2/l) but only two benthic species were caught. The other two stations where oxygen content was above 1.0 ml/l are stations 13 (1.46 ml/l) and 35 (1.68 ml/l only two benthic species were collected) in both stations. Two stations had four species and both feature a low oxygen content (0.29 ml/l at station 25 and 0.61 ml/l at station 33).

Results obtained during this survey allow us to determine the dissolved oxygen interval at which 21 species occur (Fig. 6), although for some species only one oxygen value is available. These intervals indicate that all these 21 species are occasionally found in hypoxic conditions, below 1.0 ml O_2/l.

Species occurrence with depth

Combined depth occurrence of species for both cruises indicates that all species, except the Pagurid, were collected at least once within the depth range of 835-1240 m (Fig. 7). Only five species (*A. brevicarinata*, *N.* cf. *ensifer*, *H. affinis*, *G. sicaria* and *M. diomedeae*) range to deeper water. The widest bathymetric range corresponded to *A. brevicarinata*. *Pasiphaea emarginata*, together with *P. magna*, and these were recorded in the pelagic realm. Typically benthic species *M. depressa*, *M. hystrix*, *G. spinulosa* and *H. affinis* feature a relatively wide bathymetric distribution and were rather common in samples (see Tables 3, 4 and text); they dominate the 800-1300 m decapod crustacean community.

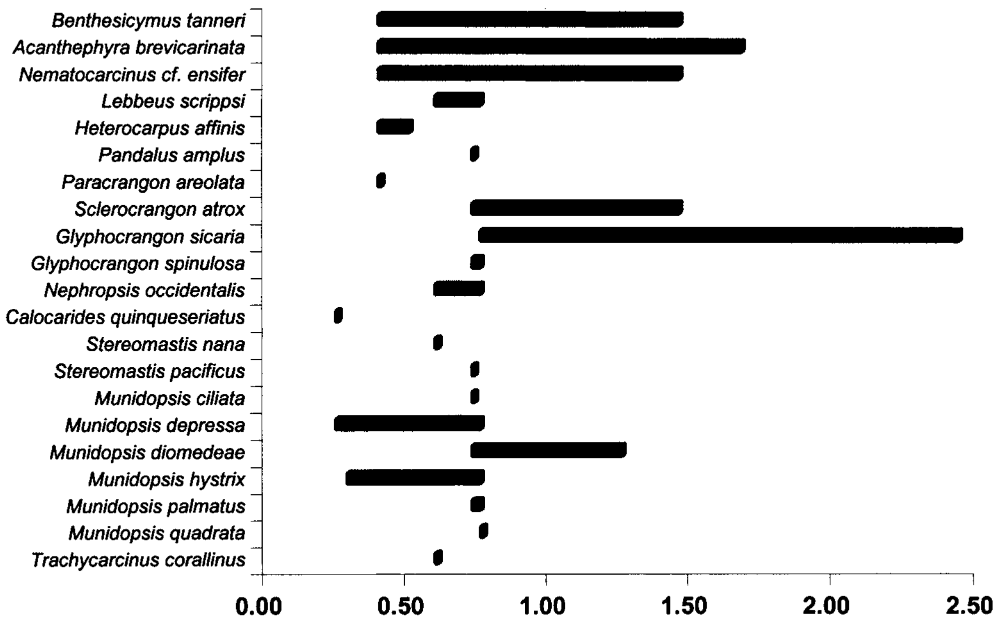

Fig. 7. – Bathymetric range observed for species collected during the TALUD III and IV cruises. (P) probably pelagic species.

DISCUSSION

The total number of species collected during both surveys is 31. Of these, 15 were described by W. Faxon on the basis of material collected by the *Albatross* in 1891. The new results indicate a higher species occurrence in the 1000-1380 m depth range, where hypoxic conditions still prevail, although measurements made near bottom level suggest a recovery in oxygen concentration at ca. 800 m. In the sampling area, oxygen content at bottom level does not seem to be a critical factor controlling species number, as expected. Fewer species were caught at stations with oxygen content in the range of 1.46-2.44 ml/l than at stations with much lower oxygen content. It might be concluded that, although critically low oxygen content (i.e., < 0.5 ml/l) may represent an impediment for the establishment of a rich benthic fauna, a higher oxygen content does not necessarily favour the presence of a richer fauna. Other factors such as availability of food, nature of substrate or strong submarine currents could affect species occurrence.

With epibenthic values close to 0.0 ml O_2/l (see Hendrickx, 1995b), the oxygen minimum zone that extends off the coast of the southeastern Gulf of California represented an insuperable barrier for outer-shelf species. Even species known to tolerate low oxygen content (e.g., *Squilla biformis* Bigelow, 1891, *Solenocera mutator* Burkenroad, 1938, *Pleuroncodes planipes* Stimpson, 1860) are not found in deeper water in the area, despite the fact that there are deep water records of these species in other areas (*S. biformis*, to 518 m; *S. mutator*, to 360-380 m; *P. planipes*, to 366 m and exceptionally to 730 m) (Hendrickx, 1995c, 1995d, 1995e). Not a single species belonging to the southeastern Gulf of California decapod crustaceans shelf community (107 species according to Hendrickx, 1996a) was collected.

The bathymetric fringe extending roughly from 1000 to 1380 m presents a particular interest for its species richness. Food supply and trophic relationships among these species and with large, highly mobile predators (e.g., fishes and squids) that were not sampled during this survey, probably due to the type of sampling gear that was used, are major issues to be addressed. Other major issues include the accessibility to species with fishing potential (e.g., *Heterocarpus affinis*, *Pandalus ampla*, *Benthesicymus tanneri*) and the evaluation of standing stock, for which larger and faster sampling gear will have to be used.

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