

## Geographic and bathymetric distribution of species of *Munidopsis* (Crustacea: Decapoda: Galatheaidae) in the SE Gulf of California, Mexico

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**ABSTRACT.**- Six species of Galatheaidae of the genus *Munidopsis* (*M. ciliata*, *M. depressa*, *M. diomedae*, *M. hystrix*, *M. palmata*, and *M. quadrata*) were collected during a deep water benthic survey in the SE Gulf of California, Mexico. *Munidopsis depressa* and *M. quadrata* were found slightly north of their previously known distribution limit within the Gulf of California. All species were caught within their known bathymetric range, except for *M. palmata*, previously known at 600-1245 and now reported from as deep as 1783 m. The most abundant species collected during this survey is *M. depressa*, which was also the most frequently collected species. *Munidopsis quadrata* is the only species collected throughout the entire sampling region. Maximum diversity was five species in the same sampling station. Species of *Munidopsis* captured during this survey are remarkably tolerant to severe hypoxic conditions. Dissolved oxygen ranges associated to each species were as follows: *M. depressa*, 0.07-0.60 ml O<sub>2</sub>/l; *M. diomedae*, 0.50-1.04 ml O<sub>2</sub>/l; *M. hystrix*, 0.15-0.22 ml O<sub>2</sub>/l; and *M. quadrata* (0.50-0.87 ml O<sub>2</sub>/l).

**Key words:** Galatheaidae, *Munidopsis*, distribution, Gulf of California.

**Palabras clave:** Galatheaidae, *Munidopsis*, distribución, golfo de California.

### Introduction

Most data related to the presence and abundance of deep water decapod crustaceans in the Eastern Tropical Pacific were obtained during exploratory surveys of the *Albatross* (see Faxon 1893, 1895) and by occasional sampling (with traps and trawls) during US research vessels surveys (e.g., R/V *T. Washington*, R/V *Agassiz*) (see Luke 1977, Hendrickx 2001a). Recent interest for fishing resources located beyond the edge of the continental platform has motivated exploratory surveys in deep water (see Velez et al. 1992; Kameya et al. 1997, Hendrickx 2001a). The presence of a wide oxygen minimum zone (OMZ) that extends from the lower shelf to the continental slope, or even further offshore, from the central Gulf of California to central Chile and to about 50° N in the northeastern Pacific (Diaz & Rosenberg 1995), represents an adverse environmental factor both in the pelagic and benthic realms. At bottom level, it may act as a physio-

logical barrier between the shelf and the slope benthic fauna. This barrier is particularly wide and efficient in the SE Gulf of California, where critical hypoxic (<0.1 ml O<sub>2</sub>/l) or anoxic epibenthic conditions are found close to bottom, roughly between the 150-200 m and the 750-800 m depth zones (Hendrickx 2001a). Consequently, the benthic invertebrates fauna that lives along the external edge of the OMZ are deep-water species unable to migrate vertically along the mid and upper continental slope due to extremely low dissolved oxygen level.

No systematic survey of decapod crustaceans associated with the continental slope has ever been made in the Gulf of California until very recently. A relatively diverse crustaceans community, dominated by shrimps and Galatheids was detected during a two-years survey in the SE Gulf. Species of *Munidopsis* appear as an important component of this community (see Hendrickx 2001a, 2001b, 2002, 2003).

The genus *Munidopsis* is represented in the

east tropical Pacific (ETP) by 27 species, of which 14 also occur in temperate waters south of the ETP, north of the ETP or both (Hendrickx & Harvey, 1999). Considering the entire east Pacific region, there has been surprisingly very few reports on species of *Munidopsis* since Faxon (1893, 1895), Henderson (1885, 1888) and Benedict (1902) published their contributions. This is certainly related to the fact that virtually all species of *Munidopsis* are found in deep water and are rarely caught in commercial trawls. The most complete information available is a list of species proposed by Wicksten (1989) (34 species in total) for the east Pacific as part of a zoogeographic study which included all species of decapod crustaceans for which the majority of records of occurrence were at 50 m or deeper.

Posterior to the review paper by Benedict (1902), additions to the *Munidopsis* fauna of the east Pacific were introduced by several authors and consisted of new species descriptions (Bahamonde 1964, Khodkina 1973, Ambler 1980, Williams & Van Dover 1983), of range extensions or of records for the east Pacific of species previously reported elsewhere (see Luke 1977, Ambler 1980, Cadien 1997).

A large series of data concerning the benthic macrofauna composition between 785 and 2250 m depth was obtained during a two-years survey (four cruises, TALUD IV, V, VI and VII) in the Southeastern Gulf of California, Mexico. These data, together with measurements of the epibenthic environment characteristics (i.e., water temperature, dissolved oxygen and salinity) performed simultaneously, represent a unique set of data for this region of the Gulf. Crustaceans samples collected during this survey contained a large series of specimens of *Munidopsis*. This material is reported herein together with data related to environmental conditions and species distribution in the area. Additional, unpublished records for most of these species have also been included.

### Material and Methods

Crustacean samples were dredged on the continental slope in the SE Gulf of California, off the coast of Sinaloa. Material was obtained during four cruises aboard the R/V El Puma of

the Universidad Nacional Autonoma de Mexico. A total of 29 stations were visited, many of these four times during the survey. Stations were distributed in five areas (1-5; see Fig. 1A), the southernmost just north of Tres Marias Islands and the northernmost in the area just south and north of 26°N. Bathymetric maps available for the area are not trustable below 100 m deep. Due to irregularity of the bottom and to the presence of submarine depressions and elevations, typical transects (perpendicular to the coast) were often difficult to follow while sampling in deep water; also, due to the nature of the bottom, some stations had to be relocated after the first cruise. 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 lines with ca. 2.0 cm (3/4") mesh net in the mouth area was operated at depths from 785 to 2250 m. Sampling depth was estimated with an analogical Edo Western echo sounder, and epibenthic oxygen concentrations were measured ca. 10 m above bottom level with a Seabird CTD-O<sub>2</sub> probe (TALUD VII) and by the Winkler method (all cruises). Opening-closing bottles were used to obtain near bottom water samples; duplicate samples were run using an automatic titulation system.

Specimens were sorted onboard, preserved in diluted formaldehyde or in 70% ethanol. Carapace length was measured with vernier calipers to the nearest 0.1 mm. Most of the specimens examined were catalogued and deposited in the invertebrate's collection at the Mazatlan Marine Station, UNAM, in Mazatlán, Mexico with their respective catalogue number (EMU – 0000). The following information is included in the systematic section that follows: Synonymy, including original description and subsequent citations for the east Pacific; material examined, including sampling locality or station, date, depth and number of specimens by sex, with their respective measurements; environmental data obtained during the survey (epibenthic dissolved oxygen, depth); depth range provided in literature; recorded distribution range and new records, if applicable; remarks whenever necessary. Material collected during the TALUD IV cruise has been reported extensively elsewhere (Hendrickx 2001a). Distribution of the material collected in the SE Gulf of California is represented by

plotting sampling stations on maps of the area and exact locations are presented in Table 1. In addition to the Gulf of California material reported here, additional specimens examined during a stay at the Los Angeles County Museum of Natural History (LACM), but apparently not reported previously, and received on loan from Scripps Institution of Oceanography, La Jolla, are included under their respective species. When available, the catalog number of the ex-Allan Hancock Foundation (ex-AHF-), the Scripps Invertebrates Collection (SIO C-) or of Los Angeles Museum (LACM-) are provided. Other abbreviations used are: St., sampling station; CL, carapace length; TL, total length; Id., identified by; Coll., collected by.

Table 1. Sampling stations where specimens of *Munidopsis* were caught during the TALUD V-VII cruises.

Cruise	Station	Latitude (N)	Longitude (W)
TALUD V	11	23°14.0'	107°00.0'
	18	24°15.2'	108°17.1'
	25	24°51.8'	108°58.0'
	26	24°56.3'	109°11.8'
TALUD VI	12	23°18.6'	107°26.9'
	18	24°14.9'	108°16.3'
	25	24°51.7'	108°57.9'
	34	25°43.8'	109°54.0'
TALUD VII	4	22°03.3'	106°34.7'
	13B	23°30.3'	107°44.0'
	18	24°14.5'	108°16.4'
	20	24°14.8'	108°35.2'
	25	24°51.8'	108°58.0'
	32B	26°03.0'	109°55.4'
	33B	26°06.5'	110°06.7'

## Results and Discussion

Specimens of *Munidopsis* were obtained at five stations in August 2000 (TALUD IV), three stations in December 2000 (TALUD V), four stations in March 2001 (TALUD VI) and seven stations in June 2001 (TALUD VII). A total of six species were recognized among the collected

material. Material obtained during the first leg (TALUD IV) has been reported elsewhere in details (see Hendrickx 2001a). It is briefly presented in a short table (Table 2) for comparative purposes and to make this final report on *Munidopsis* more complete. Material obtained during the other three legs is presented in the systematic section below.

Table 2. Specimens of *Munidopsis* collected during the first leg of the TALUD project (TALUD IV cruise). Depth range and epibenthic dissolved oxygen content are provided for comparison purposes (from Hendrickx 2001a).

Species	Sampling stations	Depth range (m)	O <sub>2</sub> ml/l range
<i>M. ciliata</i>	19	1240-1245	0.73
<i>M. depressa</i>	25, 26, 33	835-1240	0.29-0.76
<i>M. diomedea</i>	20, 26	1225-1510	0.73-1.26
<i>M. hystrix</i>	25, 26	835-1240	0.29-0.76
<i>M. palmata</i>	19, 26	1225-1245	0.73-0.76
<i>M. quadrata</i>	26	1225-1240	0.76

## Systematic section

*Munidopsis ciliata* Wood-Mason, 1891

*Munidopsis ciliata* Wood-Mason 1891: 200; Faxon 1895: 84, pl. 18, fig. 3; Benedict 1902: 318; Ambler 1980: 19, fig. 3; Wicksten 1989: 315 (listed); Tirmizi & Javed 1993: 13, fig.6 (synonymy for the Indo-Pacific); Hendrickx & Harvey 1999: 376 (listed); Hendrickx 2001a: 100.

**Material examined.-** TALUD IV (Table 1).

**Recorded distribution.-** From off Panama to Oregon, USA, and in the southern Gulf of California to 24°15.3'N, 108°24.1'W (Hendrickx 2001a). Indo-Pacific, from Srilanka, Andaman, the Gulf of Aden, the east Coast of Africa, the Bay of Bengal, between Papua and Admiralty Islands, and off Japan (Baba 1988, Tirmizi & Javed 1993).

*Munidopsis depressa* Faxon, 1893

*Munidopsis depressa* Faxon 1893: 189; 1895:

96, pl. XXII, figs. 2-2b; Benedict 1902: 319; Haig 1956: 79; Wicksten 1989: 315 (listed); Hendrickx 1996: 946; 2001a: 100, fig. 2, tables 3, 4; Hendrickx & Harvey 1999: 376.

**Material examined.-** TALUD IV (Table 1).

TALUD V, St. 11, 18/Dec/00, 123 males (CL 10.1-23.8 mm), 12 females (CL 12.9-20.5 mm), 31 ovigerous females (CL 14.9-20.8 mm), 850-870 m, 0.07 ml O<sub>2</sub>/l (EMU-5385); St. 18, 15/Dec/00, 9 males (CL 17.6-21.4 mm), 940-990 m, 0.15 ml O<sub>2</sub>/l (EMU-5386).

TALUD VI, St. 18, 15/Mar/01, 6 males (CL 13.0-22.2 mm), 1 female (CL 14.9 mm), 8 ovigerous females (CL 17.8-24.0 mm), 890-950 m, 0.29 ml O<sub>2</sub>/l (EMU-5387); St. 25, 16/Mar/01, 3 males (CL 19.2-21.1 mm), 1 ovigerous female (CL 17 mm), 830-850 m, 0.22 ml O<sub>2</sub>/l (EMU-5388).

TALUD VII, St. 18, 07/Jun/01, 38 males (CL 11.7-22.8 mm), 3 females (CL 14.3-23.0 mm), 29 ovigerous females (CL 14.8-25.6 mm), 950-1010 m, dissolved oxygen not available (EMU-5389); St. 25, 08/Jun/01, 5 males (CL 9.9-20.0 mm), 1 female (CL 12 mm), 2 juveniles, 780-850 m, 0.10 ml O<sub>2</sub>/l (EMU-5390); St. 32B, 09/Jun/01, 71 males (CL 11.9-22.2 mm), 3 females (CL 9.1-12.9 mm), 43 ovigerous females (CL 16.6-24.6 mm), 850-860 m, 0.10 ml O<sub>2</sub>/l (EMU-5391A, EMU-5391B); St. 33B, 9/Jun/01, 1 male (CL 18.1 mm), 1260-1300 m, 0.60 ml O<sub>2</sub>/l (EMU-5392).

**Additional material examined.-** Point Vicente, Los Angeles County, California; *Velero IV*, 10/Mar/1976, 1 specimen, 450 ft. (810 m) (Id. M.K. Wicksten) (LACM, ex-AHF 617-1); SSW off Point Fermin Light, California, St. 2500-53, 27/Nov/1953, 1 specimen, 450 ft. (810 m) (Id. J. Haig) (LACM); 6 miles off Point Dume (52°), St. 24039, California, 18/Dec/1975, 4 specimens, 330-460 ft. (600-830 m) (Id. M.K. Wicksten) (LACM); 14.5 miles off Dana Point (R 183°), St. 10863-65, California, 06/Dec/1965, 1 specimen, 425-440 ft. (765-795 m) (Id. Janet Haig) (LACM).

**Depth.-** Known from 185-1255 m (Wicksten 1989). Material from TALUD IV was obtained between 835-870 m and 1240-1245 m. Material examined here was collected between 780-850 m and 1260-1300 m.

**Recorded distribution.-** Off Tres Marias Is-

lands to off Ahome Point (25°45.9'N, 109°48.1'W), Gulf of California, Mexico, and to off Santa Catalina Island, California, USA (Wicksten 1989, Hendrickx, 1996).

**New record.-** The material from St. 33B, TALUD VII (26°06.5'N, 110°06.7'W) represents a new northernmost distribution limit for this species within the Gulf of California.

*Munidopsis diomedea* (Faxon, 1893)

*Galacantha diomedea* Faxon 1893: 180; 1895: 79, pl. XXV, fig. 1; Benedict 1902: 304; Del Solar 1972: 13; Luke, 1977: 28, 29.

*Galacantha diomedea* var. *parvispina* Faxon, 1893: 180.

*Munidopsis diomedea*.- Haig & Wicksten 1975: 101; Luke 1977 28; Wicksten 1989: 315 (listed); Hendrickx & Harvey 1999: 376; Hendrickx 2001a: tables 3, 4.

**Material examined.-** TALUD IV (Table 1).

TALUD V, St. 26, 16/Dec/00, 1 female (CL 29.9 mm), 1280-1310 m, 0.53 ml O<sub>2</sub>/l (EMU-5393).

TALUD VI, St. 12, 14/Mar/01, 1 ovigerous female (CL 32.2 mm), 1050-1160 m, 0.50 ml O<sub>2</sub>/l (EMU-5394); St. 34, 17/Mar/01, 14 males (CL 15.9-29.9 mm), 3 females (CL 22.2 mm), 20 ovigerous females (CL 25.8-33.8 mm) (2 males and 2 females were not measured), 1240-1270 m, 0.87 ml O<sub>2</sub>/l (EMU-5395).

TALUD VII, St. 13B, 06/Jun/01, 3 juveniles, 1400-1450 m, 1.04 ml O<sub>2</sub>/l (EMU-5396).

**Additional material examined.-** Costa Rica, 14 miles off Punta Guiones (R 233°), 12-13/May/1973, two specimens, no depth data (Id. J. Haig) (LACM, ex-AHF 202-24); 6.5 miles north of San Juanito Island, Tres Marias Islands, Nayarit, Mexico, St. 13770-70, 21/Jan/1970, one specimen, 625-850 ft. (1125-1530 m) (Id. J. Haig) (LACM, ex-AHF-899-01); 11 miles off Isla Tortuga (R 119°), Gulf of California, Mexico, St. 11815-67, 12 specimens, 900 ft. (1620 m) (Id. J. Haig) (LACM); 18.5 miles north of San Nicolas Island, California, St. 24589-76, 06/Apr/1976, two specimens, 980-1010 ft. (1765-1820 m) (Id. M.K. Wicksten) (LACM, ex-AHF 604-05).

**Depth.-** Known from 768-3790 m (Wicksten 1989). Material from TALUD IV was obtained

between 1225-1240 m and 1510 m. Material examined here was collected between 1050-1160 m and 1765-1820 m.

**Recorded distribution.-** From off Arica, Chile, to 27°34'N, 110°53'40" W in the Gulf of California and to off San Clemente Island (32° 54'29" – 33° 01'40"N, 118°55' – 119°05'20"W), California (Faxon 1895, Haig & Wicksten 1975, Wicksten 1989).

*Munidopsis hystrix* Faxon, 1893

*Munidopsis hystrix* Faxon 1893: 183; 1895: 89, pl. XIX, figs. 1, 1a; Benedict 1902: 321; Rathbun 1904: 166; Schmitt 1921: 168, fig. 107; Garth & Haig 1971: 66; Luke 1977: 28; Rodriguez de la Cruz 1987: 59; Wicksten, 1989: 315 (listed); Hendrickx 1996: 946; 2001a: tables 3, 4; Hendrickx & Harvey, 1999: 376.

**Material examined.-** TALUD IV (Table 1).

TALUD V, St. 11, 18/Dec/00, 7 males (CL 19-29.2 mm), 2 females (CL 21.3-21.8 mm), 5 ovigerous females (CL 21.2-26.3 mm), 850-870 m, 0.15 ml O<sub>2</sub>/l (EMU-5397).

TALUD VI, St.25, 16/Mar/2001, 1 male (CL 22.8 mm) and 1 ovigerous female (CL 26.0 mm), 830-850 m, 0.22 ml O<sub>2</sub>/l (EMU-5398).

TALUD VII, St. 18, 07/Jun/01, 1 ovigerous female (CL 24.5 mm), 950-1010 m, dissolved oxygen not available (EMU-5399).

**Additional material examined.-** Off Peru, *Anton Bruun* St. 144, Cruise 11, 26/Oct/1965, 6 specimens, 907-935 m (Id. J. Haig) (LACM); 2.75 miles off Pescadero Islands, Baja California, Mexico, St. 61A5-43B, 07/Aug/1961, 2 specimens, 400 ft. (720 m) (Id. J. Haig) (LACM, ex-AHF-1961-15); off Santa Catalina Island (R 250°), California, 09/07/1978, 1 specimen, 440 ft. (795 m) (LACM, ex-AHF-1218-0) (Id. M.K. Wicksten); 15 miles off Dana Point, California, St. 10863-65, 06/Dec/1965, 6 specimens, 425-440 ft. (765-795 m) (Id. J. Haig) (LACM); 6 miles north of Point Dume, California, *Velero IV*, St. 24064, 19/Dec/1975, 1 specimen, 320-405 ft. (580-730 m) (Id. M.K. Wicksten) (LACM).

**Depth.-** Known from 552-1243 m (Wicksten, 1989). Material from TALUD IV was obtained between 835-870 m and 1225-1240 m. Material examined here was collected between 580-730 m and 950-1010 m

**Recorded distribution.-** Off Peru (11°50'S, 77°58'W) (Garth & Haig 1971) to the SE Gulf of California (25°12.6'N, 109°06'W) (Hendrickx 1996), and to off Anacapa Island, California.

*Munidopsis palmata* Khodkina, 1973

*Munidopsis palmatus* Khodkina 1973: 1164-1166, figs. 5-6; Hendrickx 2001a: 101, fig. 3.

**Material examined.-** TALUD IV (Table 1).

**Additional material examined.-** 15.8 miles from Cabo Matapalo (R 173°), Costa Rica, St. 19128-73, 23/Jun/1973, 1 ovigerous female (CL 8.3mm), 1783 m, beam trawl (transect IV) (Id. J. Haig) (LACM).

**Depth.-** Known from 660-700 m (Khodkina 1973). Material from TALUD IV was obtained from 1225-1245 m. The material from Costa Rica examined here was collected at 1783 m, the deepest record for this species.

**Recorded distribution.-** Off Chile (32°11' 06"S, 71°46'03"W) to 24°56.4'N, 109°05.6'W in the southern Gulf of California, Mexico.

**Remarks.-** The specimen from off Costa Rica identified by the late Janet Haig and that had apparently never been formally reported, represented at that time the first record of *M. palmata* for the entire eastern tropical Pacific. The presence of *M. palmata* in deep waters from off Chile, Costa Rica and Mexico (Gulf of California) confirms the wide distribution of this small, easily overlooked species.

*Munidopsis quadrata* Faxon, 1893

*Munidopsis quadrata* Faxon 1893: 188; 1895: pl. 23, figs. 1, 1a-c; Benedict 1902: 325; Rathbun 1904: 167; Schmitt 1921: 170, fig. 109; Luke 1977: 26, 27; Ambler 1980: 17, 29-32 (partim); Hart 1982: 38; Wicksten 1989: 315 (listed); Cadien 1997: 1 (in key), 6 (textfig.); Hendrickx & Harvey 1999: 376; Hendrickx 2001a: 102, table 3.

**Material examined.-** TALUD IV (Table 1).

TALUD VI, St. 12, 14/Mar/01, 1 male (CL 18.8 mm), 1050-1160 m, 0.50 ml O<sub>2</sub>/l (EMU-5400); St. 34, 17/Mar/01, 3 males (CL 13.2-14.9 mm), 1240-1270 m, 0.87 ml O<sub>2</sub>/l (EMU-5401).

TALUD VII, St. 4, 05/Jun/01, 1 ovigerous female (CL 18.1 mm), 1200-1230 m, 0.82 ml O<sub>2</sub>/l

(EMU-5402); St. 20, 07/Jun/01, 1 male (CL 13.9 mm) and 1 female (CL 11.9 mm), 1480-1520 m, 0.79 ml O<sub>2</sub>/l (EMU-5403).

**Additional material examined.-** Off Arica, Chile, (18°44.7'S, 70°40.7'W and 18°40.2'S, 70°35.1'W), R/V *T. Washington*, 07/May/1972, 4 males (CL 15.1-17.4 mm), 1 female (13.2 mm), and 4 ovigerous females (CL 12.2-20.3

mm), 1097-1152 m, otter trawl (Coll. R. Wisner & S. Luke) (SIO C-1048); off Arica, Chile, (18°40.5'S, 70°36.0'W and 18°32.2'S, 70°29.8'W),

R/V *T. Washington*, 07/May/1972, 2 males (CL 10.8-11.7 mm), 1 female (CL 10.0 mm), and 1 ovigerous female (CL 15.2 mm), 768-968 m, otter trawl (Coll. R. Wisner & S. Luke) (SIO C-1038).

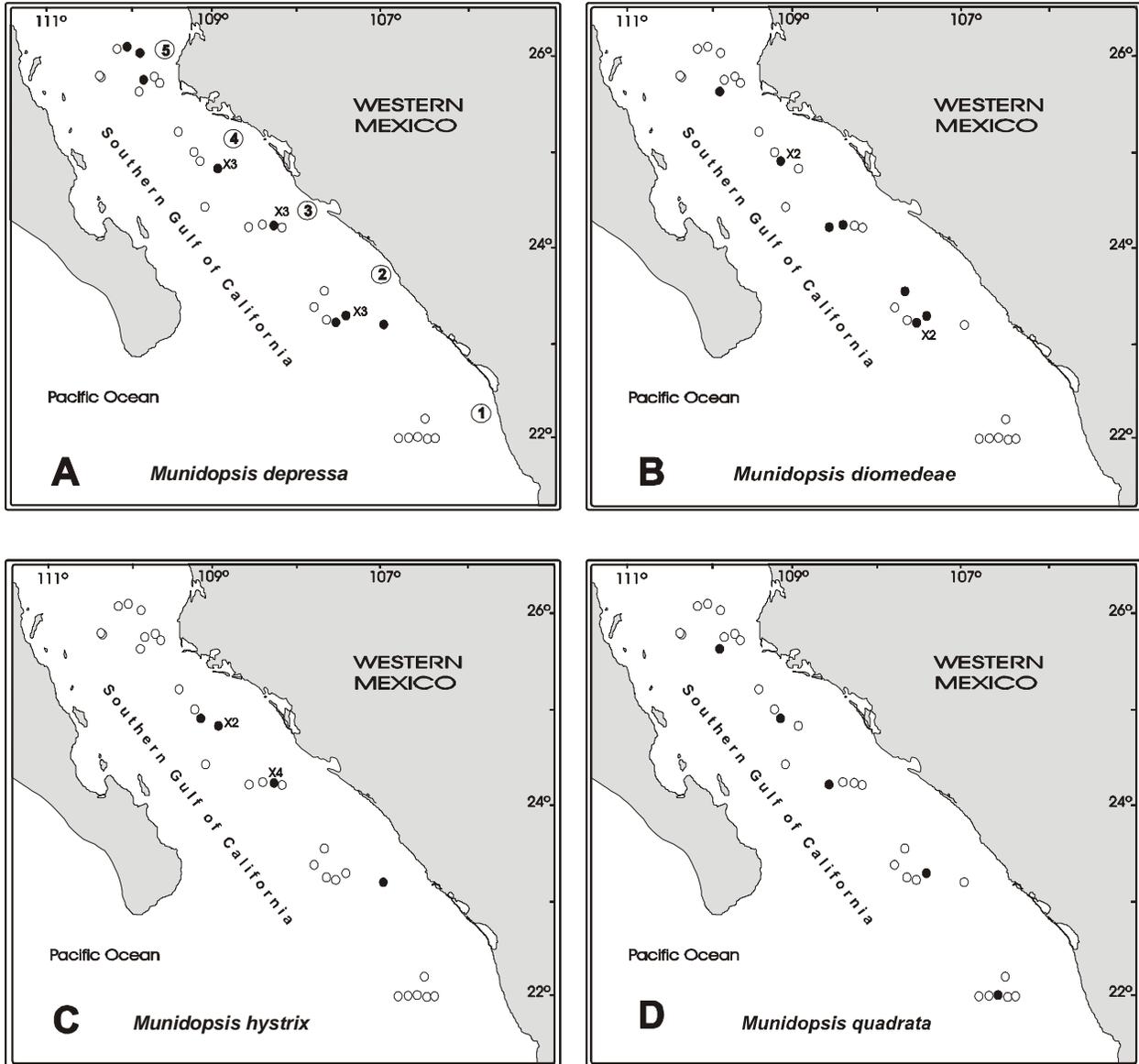


Fig. 1. Distribution of *M. depressa*, *M. diomedea*, *M. hystrix* and *M. quadrata* in the SE Gulf of California (TALUD cruises). Areas where transect were performed are indicated in figure A (transects 1-5). Capture of species of *Munidopsis* are indicated by solid circle; open circles, no *Munidopsis* in samples. Numbers (x2, x3 and x4) indicate repeated capture at same station.

**Depth.-** Known from 245-1574 m (Wicksten, 1989); from 950-2189 m, off Oregon and Washington (Ambler 1980). Material from TALUD IV was obtained at 1225-1240 m. Material examined here was collected between 1050-1160 m and 1480-1520 m. Records for California by Rathbun (1904) are from 86-110 m, but this depth range needs to be confirmed by fresh material.

**Recorded distribution.-** From off Tres Marias Islands to 24°56.4'N, 109°05.6'W, Gulf of California, Mexico; from off Wilmington and Los Coronados Islands, Southern California to Queen Charlotte Islands, Canada (Ambler 1980, Wicksten 1989, Hendrickx 2001a).

**New record.-** The material from Arica, Chile, extends the southern distribution limit of *M. quadrata* to the Chile-Peru temperate province. As much as 13 species of *Munidopsis* have already been reported from Chilean waters (Retamal & Jara 2003). The material from St. 34, TALUD VI (25°43.8'W, 109°54'N), represents a new northernmost distribution limit within the Gulf of California.

#### **Bathymetry and distribution in the area**

Although sampling was performed to nearly 2400 m (a total of five stations at trawling depth of between 1950 and 2390 m were visited), no specimens of *Munidopsis* were collected below 1520 m. This confirms preliminary observations made during the first leg of this project, when no galatheids were observed below 1510 m although sampling was done in depth of >2000 m at three stations (2000-2250 m). As in the first leg, dissolved oxygen values registered close to bottom at depth > 2000 m were consistently higher than 1 ml O<sub>2</sub>/l (1.2-2.5 ml/l) and oxygen should therefore not be considered as a limiting factor for *Munidopsis* at these depths.

Species of *Munidopsis* collected during the TALUD survey were generally found within their known bathymetric range. *Munidopsis palmata*, reported at 1225-1245 m by Hendrickx (2001a), is now known from as deep as 1783 m (Costa Rica material).

Scarcity of material obtained makes difficult to define distribution in the area for *M. palmata*. There is a possibility that specimens of this small species might not have been retained by the

sampling device and that it is more widely distributed that it appears. The most abundant species collected during this survey is *M. depressa*, which was also the most frequently collected species (11 samples, all samples considered). *Munidopsis quadrata* is the only species collected throughout the entire sampling region, from south to north (i.e., at the five sampling areas), although the total number of specimens captured is very low (8 in total). It is also the only species collected in the southernmost area (at St. 4). *Munidopsis depressa* and *M. diomedae* were both found throughout the sampling region except in the southernmost area; *M. hystrix* was collected in areas 2, 3 and 4 (i.e., not collected in the southernmost and northernmost areas). Four species were obtained from areas 2 (i.e., Sts. 11-15) and 3 (i.e., Sts. 17-29), three species from area 5 (the northernmost) and all six species were caught in area 4 (i.e., Sts. 25-29) (see Fig. 1). All samples considered, Station 26 was the most diverse with 5 species of *Munidopsis* (*M. ciliata* excepted) found during the survey.

#### **Tolerance to hypoxic conditions**

Hendrickx (2001a) presented preliminary data related to the remarkable tolerance to severe hypoxic conditions of several species of decapod crustaceans inhabiting the mid and lower slope in the SW Gulf of California. This included the six species of *Munidopsis* collected during the first leg of this project (TALUD IV cruise) (see table 1). Range of dissolved oxygen values reported for *Munidopsis* species was 0.29 - 1.26 ml O<sub>2</sub>/l, with five species found in oxygen concentration values not higher than 0.76 ml O<sub>2</sub>/l (Table 1). Values obtained during the other three legs of the survey (TALUD V-VII) are presented here (see material examined) and indicate a similar or even lower tolerance pattern to hypoxic conditions for *M. depressa* (0.07-0.60 ml O<sub>2</sub>/l), *M. diomedae* (0.50-1.04 ml O<sub>2</sub>/l), *M. hystrix* (0.15-0.22 ml O<sub>2</sub>/l), and *M. quadrata* (0.50-0.87 ml O<sub>2</sub>/l).

#### **Resumen**

Seis especies de Galatheidae del género *Munidopsis* (*M. ciliata*, *M. depressa*, *M. diomedae*, *M. hystrix*, *M. palmata*, y *M. quadrata*) fueron

recolectadas durante una campaña de exploración de la fauna béntica de aguas profundas en el SE del golfo de California, México. *Munidopsis depressa* y *M. quadrata* fueron encontradas un poco al norte de su límite de distribución previo dentro del golfo de California. Todas las especies fueron capturadas dentro de sus límites de distribución batimétrica conocida, con excepción de *M. palmata*, citada anteriormente entre 600 y 1245 m y encontrada a 1783 m. La especie más abundante fue *M. depressa*, que también fue la más frecuentemente capturada. *Munidopsis quadrata* es la única especie encontrada en toda la zona de muestreo. La diversidad máxima fue de cinco especies en una misma estación de muestreo. Las especies de *Munidopsis* capturadas durante el estudio son remarcablemente tolerantes a condiciones de hipoxia severas. Los intervalos de concentraciones de oxígeno disuelto asociados a cada especie fueron: *M. depressa*, 0.07-0.60 ml O<sub>2</sub>/l; *M. diomedea*, 0.50-1.04 ml O<sub>2</sub>/l; *M. hystrix*, 0.15-0.22 ml O<sub>2</sub>/l; y *M. quadrata* (0.50-0.87 ml O<sub>2</sub>/l).

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#### Literature Cited

- Ambler, J.W. 1980. Species of *Munidopsis* (Crustacea, Galatheidae) occurring off Oregon and in adjacent waters.— Fishery Bulletin 78 (1): 13-34.
- Baba, K. 1988. Chirostylid and Galatheid crustaceans (Decapoda: Anomura) of the “Albatross” Philippine Expedition. 1907-1910.— Research on Crustacea (Special number) 2: 1-203.
- Benedict, J.E. 1902. Description of a new genus and forty six new species of crustaceans of the family Galatheidae, with a list of the known marine species.— Proceedings of the United States National Museum 26: 243-334.
- Cadien, D. 1997. California Galatheids. [www.scamit.org/taxonomic\\_tools/galatheid1.pdf](http://www.scamit.org/taxonomic_tools/galatheid1.pdf) and [gala2.pdf](http://www.scamit.org/taxonomic_tools/gala2.pdf). 6 pp.
- Del Solar, E.M. 1972. Addenda al catálogo de crustaceos del Perú.— Informe del Instituto del Mar del Perú 38: 1-21.
- Diaz, R.J., & R. Rosenberg. 1995. Marine benthic hypoxia: A review of its ecological effects and the behavioural responses of benthic macrofauna.— Oceanography and Marine Biology Annual Review 33: 245-303.
- Faxon, W. 1893. Reports on the dredgings operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California,... by the U.S. Fish Commission steamer “Albatross”, during 1891 ... VI. Preliminary...— Bulletin of the Museum of Comparative Zoology Harvard University 24 (7): 149-220.
- . 1895. Reports on an exploration off the west coast of Mexico, Central and South America and off the Galapagos Islands ... by the U.S. Fish Commission steamer “Albatross”, during 1891... XV: The stalk-eyed Crustacea.— Memoirs of the Museum of Comparative Zoology Harvard University 18: 1-922.
- Garth, J.S., & J. Haig. 1971. Decapod Crustacea (Anomura and Brachyura) of the Peru-Chile Trench.— Allan Hancock Foundation Contributions 335: 6.3-6.20.
- Haig, J. 1956. Notes on two anomuran crustaceans new to California waters.— Bulletin of the Southern California Academy of Sciences

- 55(2): 79-82.
- Haig, J., & M.K. Wicksten. 1975. First records and range extensions of crabs in California waters.— Bulletin of the Southern California Academy of Sciences 74: 100-104.
- Hart, J.F.L. 1982. Crabs and their relatives of British Columbia. British Columbia Provincial Museum Handbook 40.
- Henderson, J.R. 1885. Diagnoses of the new species of Galathea collected during the "Challenger" expedition.— Annals and Magazine of Natural History, ser. 5, 16: 407-421.
- . 1888. Report on the Anomura collected by H.M.S. "Challenger" during the years 1873-76.— Report Scientific Research Voyage of the "Challenger", Zoology 27: 1-221.
- Hendrickx, M.E. 1996. New records of deep-water decapod crustaceans in the southeastern Gulf of California, Mexico.— Revista de Biología Tropical 44 (2B): 945-947.
- . 2001a. Occurrence of a continental slope decapod crustacean community along the edge of the minimum oxygen zone in the southeastern Gulf of California, Mexico.— Belgian Journal of Zoology 131 (Suppl. 2): 95-109.
- . 2001b. A new deep water species of *Odontozona* Holthuis (Decapoda, Stenopodidae) from the Southern Gulf of California, Mexico.— Crustaceana 75 (3-4): 405-412.
- . 2003. Size and abundance of deep water shrimp on the continental slope of the SE Gulf of California, Mexico. Pp. 227-234 in Contributions to the Study of East Pacific Crustaceans. 2. [Contribuciones al Estudio de los Crustáceos del Pacífico Este. 2], M.E. Hendrickx, ed., Instituto de Ciencias del Mar y Limnología, UNAM. 303 pp.
- . 2003. Distribution and size of the deep water Pacific lobsterette, *Nephropsis occidentalis* Faxon, 1893 (Crustacea: Decapoda: Astacidea: Nephropidae) in the SE Gulf of California, Mexico.— Crustaceana 76 (2):207-215.
- , & A.W. Harvey. 1999. Checklist of anomuran crabs (Crustacea: Decapoda) from the eastern tropical Pacific.— Belgian Journal of Zoology 129 (2): 363-389.
- Kameya, A., R. Castillo, L. Escudero, E. Tello, V. Blaskovic, J. Córdova, Y. Hooker, M. Gutiérrez, & S. Mayor. 1997. Localización, distribución y concentración de langostinos rojos de profundidad. Publicación Especial, Instituto del Mar de Perú 1-47.
- Khodkina, I.V. 1973. New species of the genus *Munidopsis* (Decapoda, Anomura) from the east Pacific.— Zoologicheskii Zhurnal 52 (8): 1156-1167. (In Russian).
- Luke, S.R., 1977. Catalog of the Benthic Invertebrate Collections. I. Decapod Crustacea and Stomatopoda. SIO. Reference Series, Scripps Institution of Oceanography, 77-9, 72 pp.
- Rathbun, M.J. 1904. Decapod crustaceans of the northwest coast of North America.— Harriman Alaska Expedition, Washington 10: 1-190.
- Rodriguez de la Cruz, M.C. 1987. Crustáceos decápodos del Golfo de California. Secretaría. Pesca (Ed.), México, D.F., 306 pp.
- Schmitt, W. L. 1921. The marine Decapod Crustacea of California.— University of California Publications in Zoology 23: 1-470.
- Tirmizi, N.M. & W. Javed. 1993. Indian Ocean Galatheids (Crustacea: Anomura). University Grants Commission (Reports), Sector H-9, Islamabad, Pakistan, 147 pp.
- Vélez, J., A. Kameya, C. Yamashiro, N. Lostaunau, & O. Valiente, 1992. Investigación del recurso potencial langostino rojo de profundidad a bordo del BIC "Fridtjof Nansen" (25 de abril - 25 de mayo, 1990).— Instituto del Mar del Perú, C.E.E., Informe 104: 3-24.
- Wicksten, M.K. 1989. Ranges of offshore decapod crustaceans in the eastern Pacific Ocean.— Transactions of the San Diego Society of Natural History 21 (19): 291-316.
- Williams, A.B., & C.L. Van Dover. 1983. A new species of *Munidopsis* from submarine thermal vents of the east pacific rise at 21° N (Anomura: Galatheididae).— Proceedings of the Biological Society of Washington 96 (3):481-488.
- Wood-Mason, J. 1891. Note on the results of the last season's deep-sea dredging. In: Wood-Mason & Alcock. Natural history notes from H.M. Indian Marine survey Steamer "Investigator"..., ser. 21.— Annals and Magazine of Natural History, London, ser. 6. 7: 186-202.

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Hendrickx, M.E. 2003. Geographic and bathymetric distribution of species of *Munidopsis* (Crustacea: Decapoda: Galathaeidae) in the SE Gulf of California, Mexico. Pp. 21-30, *in*: M.E. Hendrickx (ed.). Contributions to the Study of East Pacific Crustaceans. 2. [Contribuciones al Estudio de los Crustáceos del Pacífico Este. 2]. Instituto de Ciencias del Mar y Limnología, UNAM. 303 pp.