

Stomatopods (Crustacea: Hoplocarida) from the Gulf of Tehuantepec, Mexico

I. F., Barbosa-Ledesma, J. A. Gamboa-Contreras and J. A. Aké-Castillo

Departamento de Hidrobiología, Universidad Autónoma Metropolitana Unidad Iztapalapa, Apartado Postal 55-535, México, Distrito Federal, C.P. 09340, México. FAX: (5) 724 4738
e-mail: fabarbos@mar.icmyl.unam.mx

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Abstract: A total of 1 173 specimens of Stomatopoda were captured in 27 localities at different depths (20 to 73 m) during three oceanographic cruises in the Mexican Pacific along the continental shelf of the states of Oaxaca and Chiapas. Seven species were identified of the families Eurysquillidae, Lysiosquillidae and Squillidae. *Squilla hancocki* and *Squilla parva* were the most abundant species and the most frequently found together. The relationships between total length and carapace length were obtained for these species, which show that males of *S. hancocki* have a longer carapace length than females having the same total length, whereas for *S. parva* the opposite occurs. Larger sizes than previously reported were obtained for *Lysiosquilla panamica* and *Squilla mantoides*. *Squilla bigelovi* was recorded for the first time in the Gulf of Tehuantepec. All the species were found in the intermediate platform (25-60 m); *E. veleronis*, *S. hancocki* and *S. parva* extended their distributions to the external platform (60-120 m), and *S. hancocki* and *S. parva* reached the circalittoral zone (10-25 m).

Key words: Stomatopoda, Crustacea, distribution, Gulf of Tehuantepec, Mexican Pacific.

The order Stomatopoda is an important component of the benthic fauna due to its high diversity and predatory behavior. Currently five superfamilies, 13 families, 70 genera and about 350 species are recognized, and the order is distributed world wide from tropical to temperate waters (Manning 1980, 1982, Hendrickx & Salgado-Barragán 1991, Manning & Camp 1993).

Although several studies related to the taxonomy, biology and distribution of stomatopods have been carried out along the Pacific Coast, most of them have been conducted in the Gulf of California and in the central part of the Mexican Pacific along the coasts of Nayarit, Jalisco, Colima, Michoacan and Guerrero (for a review of the literature see: Manning 1961,

Hendrickx 1990, Illescas-Monterroso *et al.* 1991, Hendrickx & Salgado-Barragán 1994, Landa *et al.* 1997, Salgado-Barragán & Hendrickx 1998, Arciniega 1998). The Gulf of Tehuantepec is one of the most productive zones of the tropical Mexican Pacific (Robles-Jarero & Lara-Lara 1993) and only a few studies concerning stomatopods have been carried out in the area (Sosa *et al.* 1980, Hernández & Villalobos 1984, Hendrickx & Salgado-Barragán 1991, Hendrickx *et al.* 1997, Hendrickx & Vázquez-Cureño 1998).

Some stomatopods are considered of commercial importance in several countries of Europe and Asia (Hendrickx & Salgado-Barragán 1991, Hendrickx 1995a) and are fished accordingly. In Mexico these organisms

are not used as a food source, even though they often form part of the by-catch of shrimp of the genera *Farfantepenaeus* and *Litopenaeus* (Rosales-Juárez 1976, Paul & Hendrickx 1980, Chirichigno *et al.* 1982, Hendrickx 1985, Hendrickx & Salgado-Barragán 1989, Robaina 1992, Hendrickx 1995b).

The aim of this work is to study the species composition of Stomatopoda communities from the Gulf of Tehuantepec and to determine the relationships between some morphometric parameters for the most abundant species.

MATERIAL AND METHODS

The Gulf of Tehuantepec is situated in southeastern Mexico, between 15° 39' and 14° 33' N and between 96° 31' and 92° 16' W. This region is characterized by a dry (from November to April) and a rainy season (from May to October). From December to February, winds blowing from the Gulf of Mexico across the Isthmus of Tehuantepec (known as "Tehuanos") are responsible for upwellings in the Gulf of Tehuantepec. Nutrient enriched waters enhance the growth of some commercial species (Roden 1961, Stumpf 1975, Molina-Cruz & Martínez-López 1994, Hendrickx 1995b).

Specimens reported herein were collected in 1989 during three different oceanographic cruises aboard the R/V "El Puma" of the Universidad Nacional Autónoma de México: January (OPC-GT1), May (MIMAR-V) and November (FIQUIMBI-I) (Fig. 1). A total of 51 stations located on the continental shelf were sampled along transects perpendicular to the coast. Organisms were caught with a commercial shrimp trawl (mesh width, 4.44 cm) operating during 30 minutes. Specimens were fixed on board with formaldehyde (8%) and later rinsed with freshwater and preserved in 70% ethyl alcohol.

Identifications were based upon Hendrickx and Salgado-Barragán (1991); males (M) and females (F) were separated for each species and each sampling station (Stn).

Total length (TL: from rostrum to telson) was measured for all specimens and carapace length (CL: length along the median carina) for some. Measurements were made using a vernier and a stereoscopic microscope with a millimetric grid for organisms smaller than 50 mm TL. Correlation coefficients for morphometric relationships between TL and CL (Curtis 1984) were calculated for the most abundant species.

In this paper we provide the following information for the examined material: the name of cruise, sampling station, date, number of specimens, sex, range of total length and sampling depth. We include comments about the distribution and associations of the species.

The specimens are deposited in the Stomatopod Collection at the Laboratorio de Ictiología y Ecología Costera, Universidad Autónoma Metropolitana Iztapalapa, Mexico.

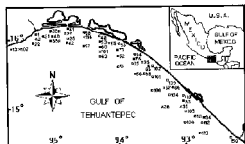


Fig. 1. Location of sampling stations of OPC-GT1 (X), MIMAR-V (□) and FIQUIMBI-I (■) cruises

RESULTS

Family *Eurysquillidae* Manning, 1977

Eurysquilla veleronis (Schmitt, 1940)

Material Examined: MIMAR-V: Stn 54, 7/IV/89, 3 F (TL 13.67-15.54 mm), 31 m; Stn 101, 9/V/89, 1 M (TL 24.23 mm) and 1 F (TL 20.07 mm), 37 m. FIQUIMBI-I: Stn 13, 12/XI/89, 3 F (TL 13.83-26.98 mm), 73 m; Stn 39A, 13/XI/89, 1 M (TL 22.56 mm), 50 m.

Distribution: This species has been reported from the Gulf of California to the Gulf of Panama (Manning 1974, Hendrickx 1984, Salgado-Barragán 1986, Hendrickx & Salgado-Barragán 1991, Vargas *et al.* 1996, Landa *et al.* 1997, Vargas & Cortés 1997, Arciniega 1998) between 29 and 118 m (Hendrickx & Salgado-Barragán 1989).

Comments: This species was collected with *S. hancocki* in one station and with *S. hancocki* and *S. parva* in two stations.

Family Lysiosquillidae Giesbrecht, 1910

Lysiosquilla panamica Manning, 1971

Material Examined: MIMAR-V: Stn 108, 10/V/89, 1 F (TL 26.88 mm), 56 m. FIQUIMBI-I: Stn 39B, 13/XI/89, 3 M (TL 22.15-23.92 mm) and 1 F (TL 22.77 mm), 50 m; Stn 59, 14/XI/89, 1 M (TL 212.7 mm), 28 m.

Distribution: Offshore, from Nayarit to Guerrero and in the Gulf of Tehuantepec, Mexico (Salgado-Barragán & Illescas-Monterroso 1987, Hendrickx & Salgado-Barragán 1991, Illescas-Monterroso *et al.* 1991, Hendrickx *et al.* 1997, Landa & Arciniega 1997, Landa *et al.* 1997, Arciniega 1998), in the Gulf of Panama and Ecuador (Hendrickx & Salgado-Barragán 1991), at depths from 3 to 90 m (Hendrickx & Salgado-Barragán 1989).

Comments: This species was collected with *S. mantoidea* in one station; with *S. bigelowi*, *S. hancocki* and *S. parva* in one station; with *S. hancocki*, *S. panamensis* and *S. parva* in one station.

Family Squillidae Latreille, 1803

Squilla bigelowi Schmitt, 1940

Material Examined: MIMAR-V: Stn 108, 10/V/89, 3 M (TL 24.54-27.61 mm) and 10 F (TL 19.03-30.36 mm), 56 m.

Distribution: Gulf of California (Salgado-Barragán 1986, Hendrickx & Salgado-Barragán 1991) and the coast of Nayarit (Schmitt 1940), Mexico; off the coast of Costa Rica (Boone 1930), at depths between 6 and 150 m (Hendrickx & Salgado-Barragán 1989,

1991). This first recorded finding of the species in the Gulf of Tehuantepec, especially since there were found both males and females in the samples, suggests that there might be an established population there.

Comments: This species was found in only one station with *S. panamensis*, *S. hancocki* and *L. panamica*.

Squilla hancocki Schmitt, 1940

Material Examined: OPC-GT1: Stn 114, 12/I/89, 4 M (TL 74.9-88.47 mm) and 1 F (TL 34.06 mm), 28 m; Stn 115, 13/I/89, 4 M (TL 21.26-73.85 mm), 33 m. MIMAR-V: Stn 1, 2/V/89, 28 M (TL 24.54-46.85 mm) and 30 F (TL 24.07-52.41 mm), 45.3 m; Stn 28, 12/V/89, 47 M (TL 24.02-47.06 mm) and 44 F (TL 25.58-44.46 mm), 60 m; Stn 51, 6/V/89, 41 M (TL 25.53-67.39 mm) and 40 F (TL 27.76-55.9 mm), 64 m; Stn 52, 7/V/89, 4 M (TL 45.44-87.13 mm) and 4 F (TL 26.78-37.75 mm), 35 m; Stn 54, 7/V/89, 103 M (TL 28.28-47.42 mm) and 96 F (TL 19.08-61.83 mm), 31 m; Stn 101, 9/V/89, 16 M (TL 30.84-70.92 mm) and 28 F (TL 29.84-76.49 mm), 37 m; Stn 102, 9/V/89, 1 F (TL 60 mm), 21 m; Stn 104, 10/V/89, 20 M (TL 28.28-40.71 mm) and 32 F (TL 27.14-40.71 mm), 48 m; Stn 108, 10/V/89, 135 M (TL 21.37-76.75 mm) and 163 F (TL 23.03-60.68 mm), 56 m; Stn 109, 10/V/89, 33 M (TL 18.56-55.27 mm) and 21 F (TL 25.58-52.05 mm), 45 m; Stn 110, 10/V/89, 1 M (TL 18.66 mm) and 1 F (TL 20.07 mm), 25 m; Stn 112, 11/V/89, 8 M (TL 36.66-59.69 mm) and 9 F (TL 39-82.68 mm), 40 m; Stn 113, 11/V/89, 5 M (TL 26.2-31.4 mm) and 8 F (TL 27.14-71.7 mm), 67.5 m. FIQUIMBI-I: Stn 13, 12/XI/89, 2 M (TL 29.64-30.68 mm) and 5 F (TL 22.36-34.32 mm), 73 m; Stn 39B, 13/XI/89, 16 M (TL 18.25-37.2 mm) and 12 F (TL 17.42-53.45 mm), 50 m; Stn 42, 13/XI/89, 4 M (TL 66.19-70.82 mm) and 4 F (TL 55.32-75.97 mm), 51 m.

Morphometric relationships: The best correlation coefficient was obtained for a linear model, indicating that for each unit of TL, CL increases 0.212 for males (t-Student $p < .2471$) and 0.207 for females (t-Student $p < .6091$) (Fig. 2).

Distribution: From Sinaloa, Mexico to Paita, Peru (Manning 1972, Reaka & Manning 1980, Hendrickx & van der Heiden 1983a, 1983b, Hendrickx 1984, Hernández & Villalobos 1984, Hendrickx & Salgado-Barragán 1991, Landa *et al.* 1997, Vargas & Cortés 1997, Arciniega 1998), at depths between 29 and 220 m (Hendrickx & Salgado-Barragán 1989, 1991).

Comments: *S. hancocki* was collected with *S. parva* in eight stations; with *S. panamensis* and *E. veleronis* in one station with each one; with *S. mantoidea* and *S. parva* in one station; with *E. veleronis* and *S. parva* in two stations; with *L. panamica*, *S. bigelowi* and *S. panamensis* in one station, and *L. panamica*, *S. panamensis* and *S. parva* in one station.

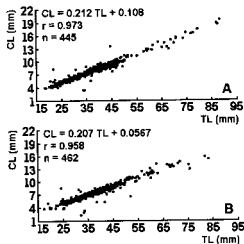


Fig. 2. Total length (TL) - carapace length (CL) relationship for males (A) and females (B) of *Squilla hancocki*.

Squilla mantoidea Bigelow, 1893

Material Examined: MIMAR-V: Stn 103, 9/V/89, 1 M (TL 207.4 mm) and 1 F (TL 192.1 mm), 27 m; Stn 110, 10/V/89, 1 M (TL 104.6 mm), 25 m; Stn 111, 10/V/89, 1 M (TL 160.6 mm), 25 m. FIQUIMBI-I: Stn 59, 14/XI/89, 1 M (TL 159 mm), 28 m; Stn 85, 19/XI/89, 1 M (TL 159 mm) and 1 F (TL 151.1 mm), 25 m; Stn 86, 20/XI/89, 1 F (TL 48.2 mm), 26 m.

Distribution: From Sonora, Mexico, to Tumbes, Peru (Hernández & Villalobos 1984, Salgado-Barragán 1986, Hendrickx & Salgado-

Barragán 1991, Vargas *et al.* 1996, Landa *et al.* 1997, Arciniega 1998), at depths between 4 and 60 m (Hendrickx & Salgado-Barragán 1989, Illescas-Monterroso *et al.* 1991).

Comments: This species was collected with *S. parva* in two stations; with *L. panamica* in one station; with *S. hancocki* and *S. parva* in one station.

Squilla panamensis Bigelow, 1891

Material Examined: MIMAR-V: Stn 1, 2/V/89, 2 M (TL 70.42-89 mm) and 2 F (TL 58.53-72.59 mm), 45.3 m; Stn 108, 10/V/89, 1 M (TL 36.5 mm), 56 m. FIQUIMBI-I: Stn 39B, 13/XI/89, 1 M (TL 35.93 mm) and 3 F (TL 56.68-73.64 mm), 50 m.

Distribution: From Guaymas Bay, Mexico, to Tumbes, Peru (Hernández & Villalobos 1984, Hendrickx & Salgado-Barragán 1991, Illescas-Monterroso *et al.* 1991, Castro & Vargas 1996, Vargas *et al.* 1996, Landa *et al.* 1997, Vargas & Cortés 1997, Arciniega 1998), at depths from 18 to 110 m (Hendrickx & Salgado-Barragán 1989, 1991).

Comments: The species was found with *S. hancocki* in one station; with *L. panamica*, *S. bigelowi* and *S. hancocki* in one station; and with *L. panamica*, *S. hancocki* and *S. parva* in one station.

Squilla parva Bigelow, 1891

Material Examined: OPC-GTI: Stn 114, 12/I/89, 4 M (TL 40.05-49.14 mm) and 3 F (TL 23.4-39.46 mm), 28 m; Stn 115, 13/I/89, 1 M (TL 24.54 mm), 33 m. MIMAR-V: Stn 28, 12/V/89, 1 M (TL 57.87 mm) and 1 F (TL 55.74 mm), 60 m; Stn 51, 6/V/89, 2 F (TL 32.91-52.41 mm), 64 m; Stn 53, 7/V/89, 1 M (TL 49.5 mm), 37 m; Stn 101, 9/V/89, 3 M (TL 27.45-53.24 mm) and 1 F (TL 19.86 mm), 37 m; Stn 103, 9/V/89, 9 M (TL 34.37-59.64 mm) and 5 F (TL 46.9-59.74 mm), 27 m; Stn 104, 10/V/89, 1 F (TL 31.04 mm), 48 m; Stn 109, 10/V/89, 7 M (TL 15.8-38.27 mm) and 3 F (TL 25.94-36.29 mm), 45 m; Stn 110, 10/V/89, 19 M (TL 32.39-57.04 mm) and 32 F (TL 43.16-59.69 mm), 25 m; Stn 111, 10/V/89, 19 M (TL 19.5-64.48 mm) and 25 F (TL 48.56-70.09 mm), 25 m; Stn 112,

11/V/89, 5 M (TL 35.15-57.56 mm) and 7 F (TL 28.91-55.58 mm), 40 m; Stn 113, 11/V/89, 1 M (TL 29.17 mm), 67.5 m. FIQUIMBI-I: Stn 13, 12/XI/89, 1 M (TL 23.19 mm), 73 m; Stn 39B, 13/XI/89, 1 F (TL 30.68 mm), 50 m; Stn 93, 20/XI/89, 3 M (TL 29.27-47 mm) and 2 F (TL 53.35-55.64 mm), 26 m; Stn 94, 20/XI/89, 1 F (TL 55.79 mm), 20 m.

Morphometric relationships: The best correlation coefficient was obtained for a linear model, indicating that for each unit of TL, CL increases 0.207 for males (t-Student $p < .4905$) and 0.215 for females (t-Student $p < .6572$) (Fig. 3).

Distribution: Topolobampo Bay, Mexico, to Tumbes, Peru (Hernández & Villalobos 1984, Hendrickx & Salgado-Barragán 1991, Vargas *et al.* 1996, Landa *et al.* 1997, Arciniega 1998), commonly reported at depths from 7 to 80 m (Hendrickx & Salgado-Barragán 1989, 1991). Schmitt (1940) found this species at a depth of 214 m.

Comments: *S. parva* was collected with *S. hancocki* in eight stations; with *S. mantoidea* in two stations; with *E. veleronis* and *S. hancocki* in two stations; with *S. hancocki* and *S. mantoidea* in one station; with *L. panamica*, *S. hancocki* and *S. panamensis* in one station.

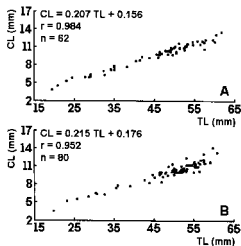


Fig. 3. Total length (TL) - carapace length (CL) relationship for males (A) and females (B) of *Squilla parva*.

DISCUSSION

Species composition: A total of 1 173 specimens were captured, belonging to seven species: *Eurysquilla veleronis* (2 M, 7 F), *Lysiosquilla panamica* (4 M, 2 F), *Squilla bigelowi* (3 M, 10 F), *Squilla hancocki* (471 M, 499 F), *Squilla mantoidea* (5 M, 3 F), *Squilla panamensis* (4 M, 5 F) and *Squilla parva* (74 M, 84 F).

The largest number of specimens was collected (1 088) during the oceanographic cruise MIMAR-V in the rainy season and the smallest (17) during the oceanographic cruise OPC-GTI in the dry season. The number of specimens captured per species and station was variable (Table 1). The genus *Squilla* represented 98.72% of the total, *S. hancocki* was the most abundant species in the three cruises, followed by *S. parva*, thus indicating that both species are well established in the Gulf of Tehuantepec. *Eurysquilla veleronis*, *L. panamica*, *S. mantoidea* and *S. panamensis* were captured only in the oceanographic cruises MIMAR-V and FIQUIMBI-I (rainy and dry seasons) whereas *S. bigelowi* was captured only in the oceanographic cruise MIMAR-V (rainy season), in one station.

TABLE 1

Specimens of stomatopods collected from the Gulf of Tehuantepec (males and females) and number of sampling station

Species	Males	Females	Stations
<i>Eurysquilla veleronis</i>	2	7	4
<i>Lysiosquilla panamica</i>	4	2	3
<i>Squilla bigelowi</i>	3	10	1
<i>Squilla hancocki</i>	471	499	18
<i>Squilla mantoidea</i>	5	3	6
<i>Squilla panamensis</i>	4	5	3
<i>Squilla parva</i>	74	84	17

Association of species: Stomatopods were caught in 27 out of 51 trawls. Species which were found alone are: *E. veleronis*, *S. hancocki*, *S. mantoidea* and *S. parva*, mainly during the cruise FIQUIMBI-I (dry season), whereas *L. panamica*, *S. bigelowi* and *S. panamensis* were found in association with

other species. Associations of two species were found in 15 stations, most commonly during the MIMAR-V cruise (rainy season). The species most frequently found together were *S. hancocki* and *S. parva* (eight stations). Associations among three species were found in three stations: *S. hancocki*, *S. parva* and *E. veleronis* (Stn 101 MIMAR-V); *S. hancocki*, *S. parva* and *S. mantoidea* (Stn 110 MIMAR-V); *E. veleronis*, *S. hancocki* and *S. parva* (Stn 13 FIQUIMBI-I). Only in two stations were four species found together: *L. panamica*, *S. bigelowi*, *S. hancocki* and *S. panamensis* (Stn 108 MIMAR-V); *L. panamica*, *S. hancocki*, *S. panamensis* and *S. parva* (Stn 39B FIQUIMBI-I).

Squilla hancocki and *S. parva* were the species most frequently found together (12) and were abundant in the sampling area. Their wide distribution along the continental shelf, between 20 and 73 m, could indicate that they are representative of the zone, unlike the report by Hendrickx and Salgado-Barragán (1991) for the Gulf of California.

Morphometric data: TL and CL values obtained for most species agree well with those related in previous studies (Hendrickx & Salgado-Barragán 1991). The exceptions are *L. panamica* and *S. mantoidea* in which larger sizes were measured (male specimens, TL of 212.7 and 207.4 mm respectively).

The best correlation coefficient calculated for *S. hancocki* and *S. parva* corresponded, in both cases, to a linear regression. The models show that males of *S. hancocki* have a longer CL than females having the same TL, whereas for *S. parva* the opposite occurs.

There is no fishery for stomatopods in Mexico, although Hendrickx (1985) has pointed out that some species inhabiting the Gulf of California could be commercialized. A similar situation seems to occur in the Gulf of Tehuantepec, where *S. hancocki* and *S. parva* seem to be abundant, and large specimens of *S. mantoidea* and *L. panamica* can be found.

Bathymetric analysis: The specimens collected in this study were obtained at depths

between 20 and 73 m. *Squilla hancocki* was collected at a depth of 21 m, thus extending the lower bathymetric limit previously reported. The largest number of organisms was collected between 25-56 m during the rainy season, and the depth of co-occurrence of the largest number of species (four) was between 50-56 m.

Following Hendrickx & Salgado-Barragán (1991), the species of stomatopods in the Gulf of Tehuantepec can be classified as follows: all the species were found in the intermediate platform (25-60 m); *E. veleronis*, *S. hancocki* and *S. parva* extended their distribution to the external platform (60-120 m); *S. hancocki* and *S. parva* reached the circalittoral zone (10-25 m).

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RESUMEN

Se capturaron un total de 1 173 especímenes del orden Stomatopoda en 27 localidades a diferentes profundidades (20 a 73 m) durante tres cruceros oceanográficos en el Pacífico mexicano a lo largo de la plataforma continental de los estados de Oaxaca y Chiapas. Se identificaron siete especies de las familias Eurysquillidae, Lysiosquillidae y Squillidae. *Squilla hancocki* y *Squilla parva* fueron las especies más abundantes y las más frecuentemente encontradas juntas. Se obtuvieron las relaciones entre la longitud total y la longitud del caparazón para estas dos especies; que indican que con una misma longitud total los machos de *S. hancocki* tienen una longitud del caparazón mayor que las hembras, mientras que para *S. parva* sucede lo contrario. Se registraron longitudes totales más grandes a las reportadas previamente para *Lysiosquilla panamica* y *Squilla mantoidea*. *Squilla bigelowi* se registró por primera vez en el área. Todas las especies se encontraron en la plataforma intermedia (25-60 m); *E. veleronis*, *S. hancocki* y *S. parva* se distribuyeron hasta la plataforma externa (60-120 m) y *S. hancocki* y *S. parva* abarcaron la zona circalitoral (10-25 m).

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