Additional record of *Janetogalathea californiensis* (Anomura: Galatheidae) from the central Gulf of California, Mexico, with notes on its distribution

Registro adicional de *Janetogalathea californiensis* (Anomura: Galatheidae) del Golfo de California central, México, con notas de su distribución

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ABSTRACT

Specimens of galatheids *Janetogalathea californiensis* (Benedict, 1902) were collected in the northern portion of the Central Gulf of California and represent the third record for this species in the area. Illustrations of the material collected in the Gulf of California are provided and some differences are noted when compared to the description of the paralectotypes. Depth range of the species is discussed and set at 87-786 m. The presence of a wide and deep Oxygen Minimum Zone in the area is believed to limit the dispersion of *J. californiensis* to the south and to deeper water of the gulf.

Key words: Anomura, Galatheidae, *Janetogalathea californiensis*, East Pacific.

RESUMEN

Especímenes del galateido *Janetogalathea californiensis* (Benedict, 1902) fueron recolectados en la porción norte del golfo de California central, y representan el tercer registro de esta especie en el área. En base a ilustraciones de material recolectado en el Golfo de California, se indican algunas diferencias con respecto a la redescripción de los paralectotipos. Se discute la distribución batimétrica de la especie de la que se define un intervalo que va de 87 a 786 m de profundidad. Los resultados sugieren que la presencia de una amplia y profunda capa de oxígeno mínimo en el área podría ser la causa que limita la dispersión de *J. californiensis* hacia el sur y en aguas más profundas del golfo.

Palabras clave: Anomura, Galatheidae, *Janetogalathea californiensis*, Pacífico Este.

INTRODUCTION

Deep-water sampling activities in the tropical eastern Pacific have been steadily increasing in recent years, both on the continental platform (in the range of 100-200 m depth) and upper slope (> 200 m). New, interesting information related to many species of crustaceans has been gathered for Costa Rica (Wehrtmann & Nielsen-Muñoz, 2009), Peru (Kameya *et al*., 1997) and Mexico (Hendrickx, 2003). A much larger effort is needed, however, to complete our knowledge of deep-water biodiversity off the tropical west coast of America, particularly if we consider that most species occurring below the Oxygen Minimum Zone (OMZ) have been rarely caught and their biology and ecology is very poorly known (Hendrickx, 2003; Zamorano *et al*., 2006; Méndez, 2007; Hendrickx & Serrano, 2010). Hendrickx & Serrano (2010) have emphasized the importance of the OMZ off the Pacific coast of Mexico. In this

area, a very wide and deep offshore fringe of oxygen-depleted water represents a physiological barrier that prevents contacts between the continental shelf and the slope macrofauna.

Galathea californiensis Benedict, 1902, a species of Galatheidae originally described for California and later reported from the same area by Schmitt (1921) and Wicksten (1982), has been scarcely reported in Mexico (see Wicksten 1987). Based on some unique morphologic features Baba & Wicksten (1997) created a new genus, *Janetogalathea*, to acomodate *G. californiensis*. Additional material of this species from the central Gulf of California is reported here and its bathymetric range is analysed. The discountinuous distribution of this species is discussed based on the possible influence of the OMZ.

MATERIAL AND METHODS

In February and August 1987, two major research cruises (GUAYTEC I and II) were organized in the Central Gulf of California by the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), Mexico, and samples of benthic macrofauna were collected between 65 and 380 m depth aboard the R/V "El Puma" of the Universidad Nacional Autónoma de México (UNAM). The decapod material of the GUAYTEC II cruise has been reported by Hendrickx (1990). In 2005, the remains of the invertebrate collection held at ITESM was rescued and transferred to the Regional Marine Invertebrates Collection (EMU) at UNAM in Mazatlán, Sinaloa, as a permanent donation. Among this material, a few samples collected during the GUAYTEC I cruise were still in good conditions and were examined. Among these, a small series of galatheids called our attention and is reported herein.

Specimens were sampled with an 11.6 m commercial ottertrawl (5.7 cm stretched mesh), separated from the catch and fixed with formaldehyde, washed and preserved in 70% ethanol for permanent conservation. CL, carapace length including rostrum was recorded.

Oxygen concentrations were measured with an autonomous CTD SEABIRD-19 equipped with an O_2 probe. Data used herein

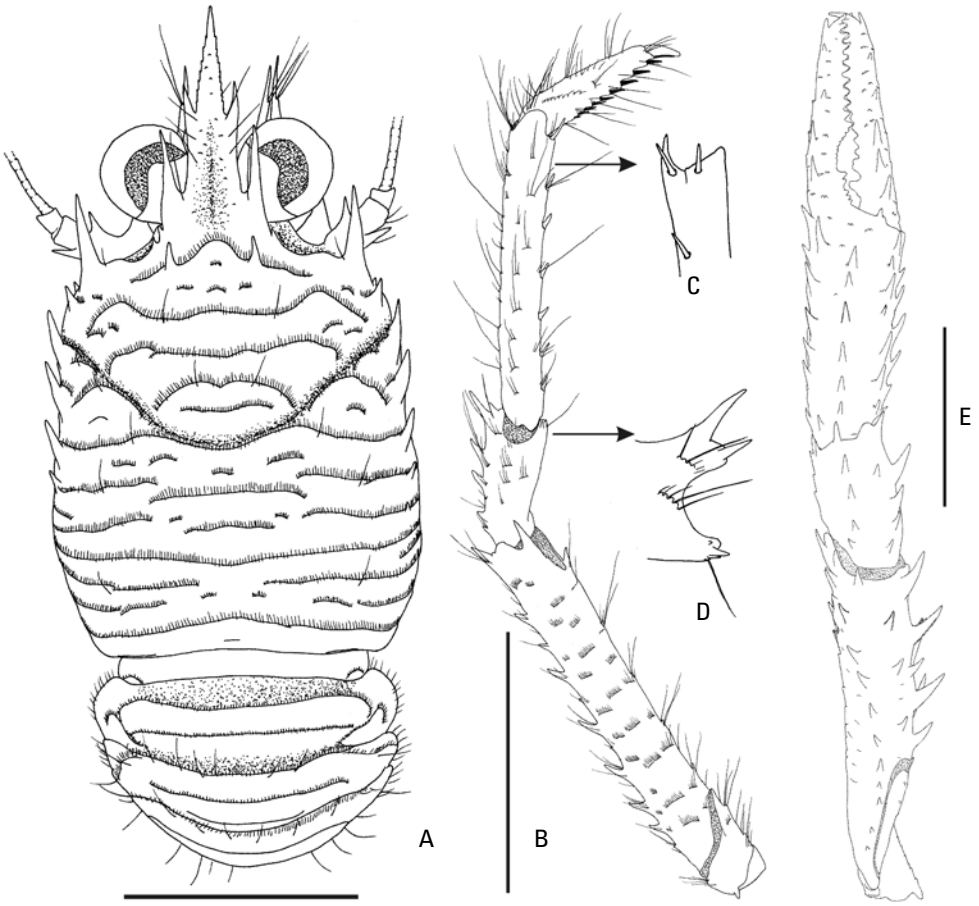

Figure 1A-E. *Janetogalathea californiensis* (Benedict, 1902) (male; CL, 14.0 mm) (EMU-7487). A. Dorsal view, carapace. B. Pereiopod 2, lateral view. C. Distoventral margin of propodus of pereiopod 2. D. Distolateral margin of carpus of pereiopod 2. E. Cheliped, dorsal view. Scale bar, 5 mm.

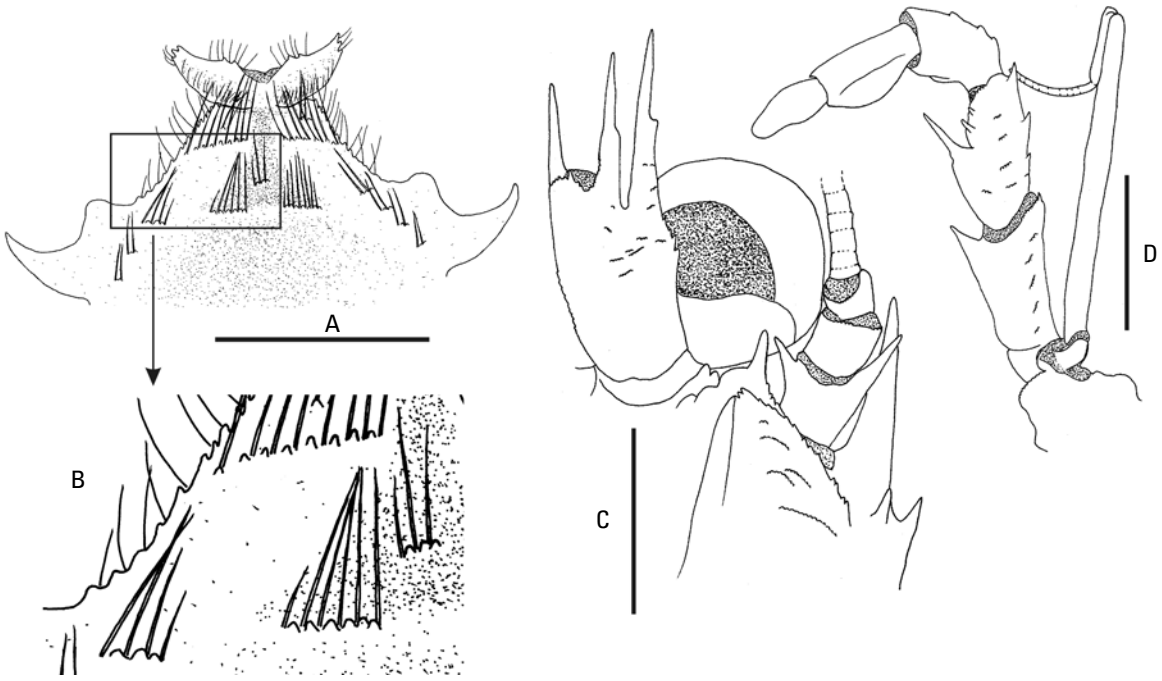

Figure 2A-D. *Janetogalathea californiensis* (Benedict, 1902) (A, B: male CL, 16.6 mm) (C, D: male; CL, 14.0 mm) (EMU-7487). A. Anterior part of sternal plastron; B. Detail of right portion of sternal plate 4. C. Ventral view of antennula, antenna and eye, left side. D. Third maxilliped, ventral view. Scale bar, 2 mm.

were obtained from the data bases elaborated during the TALUD X cruise (Hendrickx & Serrano, 2010). Mapping of the 0.5 ml O_2/l contour zones was performed using NOAA bathymetric grid data with resolution of two minutes. The map was drawn by selecting the depths between 250 and 1380 m and using oxygen profiles with concentrations ≤ 0.5 ml O_2/l and compared to the known distribution of *Janetogalathea californiensis*.

RESULTS

***Janetogalathea californiensis* (Benedict, 1902)** Figs. 1A-E, 2A-D

***Galathea californiensis* Benedict, 1902**: 247, Fig. 1.

***Janetogalathea californiensis*, Baba *et al.*, 2008**: 82 (complete synonymy).

Material examined. GUAYTEC I cruise, St. 11, south of Salsipuedes Canal (28º29'54"N, 112º48'57"W), Central Gulf of California, Mexico, R/V "El Puma", 14/February/1987, two males (CL 14.0 and 16.6 mm), three ovigerous females (CL 10.3-13.9 mm), and one juvenile (CL 7.7 mm), 260 m depth, otter-trawl (coll. L. Findley) (EMU-7487).

General distribution. From Monterey, California, USA, south to the central Gulf of California (Wicksten, 1987; Baba & Wicksten, 1997). Present record slightly increases the northernmost distribution limit within the Gulf of California.

Localities in western Mexico. In addition to the two localities on west coast of the Baja California Peninsula (off Guadalupe and Cedros Islands, off Baja California), the species has been reported from two Gulf of California stations: Velero III, St. 1085-40 (27º58'-59' N, 111º23'-24'W), off San Pedro Nolasco Island, 101-104 m; Velero IV, St. 11838-67 (from 28°38'45"N, 113°00'W, to 28°33'15"N, 112°50'45"W), south of San Lorenzo Island, 794-1015 m (but see remarks on depth range below) (Wicksten, 1987; Baba & Wicksten, 1997).

Depth range. The very wide bathymetric range of *J. californiensis* is rather surprising. The type locality depth reported by Benedict (1902) is 150 fm (273 m; "Albatross" St. 2946). Schmitt (1921: 164) reproduced J.E. Benedict illustration and did not report any new material; nevertheless, he provided a depth range of 57 to 2182 fm (104-3990 m) but fail to indicate to which sampling station the maximum depth corresponded. According to Schmitt (1921), the only citation for this species between 1921 and the year that it was described (1902) is by Rathbun (1904: 166), in her report on decapods of the Harriman Alaska Expedition. Rathbun (loc. cit.) did not cite any new material either, and in the text she only referred to the type locality depth: 150 fm. In a very extensive table presented in pages 8-17, however, M.J. Rathbun provided

distribution and depth ranges for *J. californiensis* (as *Galathea californiensis*) from Monterey to San Diego; 100-500 fm.

Further records of *J. californiensis* (also as *Galathea californiensis*) are by Wicksten (1982), off California, at 165-500 m depth, and by Wicksten (1987), off California and in the Gulf of California, at 101-104 m depth. Finally, the contribution of Baba & Wicksten (1997), where *G. californiensis* was assigned to *Janetogalathea* Baba & Wicksten, 1997, includes a long list of examined material. Among this material, nine stations correspond to a depth range of 87 to 358 m. In addition, Baba & Wicksten (1997) reported on material collected in a 10th station, off San Lorenzo Island ("Velero IV" St. 11838-67), in a depth range of 794-1015 m. Revision of the cruise log of the "Velero IV", however, indicates that the San Lorenzo material was captured during operations at 400-430 fm (732-786 m). There is therefore no trace of the 3990 m and 1015 m depth records for *J. californiensis* and its general depth range should therefore be set at 87-786 m.

In their compilation of squat lobsters of the world, Baba *et al.* (2008) considered a depth range of 89-1015 m. The small discrepancy in the minimum depth value is due to variation in using the conversion factor between fathoms and meters. As stated previously, we believe that the maximum depth range is 786 m.

Remarks. The largest ovigerous female carries about 150 eggs. One of the two other females had apparently initiated spawning and the other (CL 10.3 mm) carries about 60 eggs.

At first sight, *J. californiensis* looks like a species of *Munida* but it was excluded from this genus mainly for the presence of a wide, fleshy, flattened, tridentate rostrum that strongly contrast with the *Munida* spine-like rostrum (Fig. 1). Other characters typical of this monotypic genus are fully described by Baba & Wicksten (1997).

When compared to the redescription of the paralectotype of *G. californiensis* by Baba & Wicksten (1997), the material examined herein fits well with that species (Figs. 1, 2). However, small differences were noted, among which the most important is the presence of transversal rows of tubercles on both sides of sternal plate 4 (Fig. 2 A, B), and denticles on the lateral and frontal margins of sternite 3 (Fig. 2 A). Other differences include: proportion of propodus/dactylus of third maxilliped is 1.30 in the material examined (Fig. 2, D) vs. 1.67 in one of the paralectotype; propodus of pereiopod 2 with a pair of distoventral mobile spines (Fig. 1 B, C) vs. a single spine in the paralectotypes, and all spines on flexor margin longer than in the type material; distal margin of carpus of pereiopod 2 with an accessory spinule (Fig. 1 D). None of the specimens examined features an extra lateral spine on the rostrum, as described by Baba & Wicksten (1997).

The records of *J. californiensis* within the Gulf of California raise another issue. As noted earlier, the OMZ that prevails in the southern and central Gulf of California acts as a physiological barrier that prevents contact between the continental shelf and continental slope macrofauna (Hendrickx, 2001; Zamorano *et al.*, 2006; Hendrickx & Serrano, 2010).

A map representing the area where the values of oxygen concentrations measured at bottom level are ≤ 0.5 ml/l, combined with the localization of *J. californiensis* sampling stations in the central Gulf of California, was generated (Fig. 3). It indicates that records for this species are located at the edge of the moderately hypoxy (values <0.5 ml O_2/l but >0.1 ml O_2/l) zone, on both sides of the area (shaded area on Fig. 3) where O_2 concentrations drastically drops below the 0.5 ml/l limit. The area delimited by grey symbols (A) corresponds to a model based on oxygen concentrations values obtained during the TALUD cruises in that portion of the Gulf of California, while the area delimited with dark symbols (B) is an hypothetical projection obtained using depth profiles and oxygen concentration values prevailing at different depth in area A.

Records obtained with the oxygen probe at bottom level indicate that within these shaded areas, oxygen concentrations gradually drop from 0.5 ml O_2/l to values close to zero (Hendrickx & Serrano, 2010). These shaded areas thus represent a physiological barrier for species unable to withstand moderate to strongly hypoxic conditions (Hendrickx, 2001; Zamorano *et al.*, 2006; Hendrickx & Serrano, 2010); however, records of *J. californiensis* are available on both sides of this barrier.

The shallowest (San Pedro Nolasco Island, 101-104 m) and deepest (San Lorenzo Island, 732-786) records are far apart, and the GUAYTEC material reported herein also comes from the vicinity of San Lorenzo Island (see symbols in Fig. 3). There are only two possible explanations for this: 1) either *J. californiensis* dispersion occurs only as pelagic larvae, above the OMZ, or 2) subpopulations of adults from both sides of the Gulf are able to connect north of area A. In the second option, this would indicate that the area located north of roughly 28.3°N is better oxygenated than it appears in Fig. 3.

DISCUSSION

Although small differences were observed between the original description of *J. californiensis* and the material reported herein, these are not considered of diagnostic value at this point. More freshly collected material and an analysis of DNA would certainly help deciding weather one or two species of this genus occur in the northeast Pacific.

According to Hendrickx & Serrano (2010), OMZ and concentrations <0.5 ml O_2/l appears in increasingly shallow water towards the southern Gulf of California (i.e., values <0.5 ml O_2/l are recorded in the range of 238-1397 m depth at 27°N, and in the range of 69-1270 m at 24°N). Considering the depth range of *J. californiensis* (87-786 m), migration of benthic adult populations to the south seems therefore unlikely, unless they emerge to much

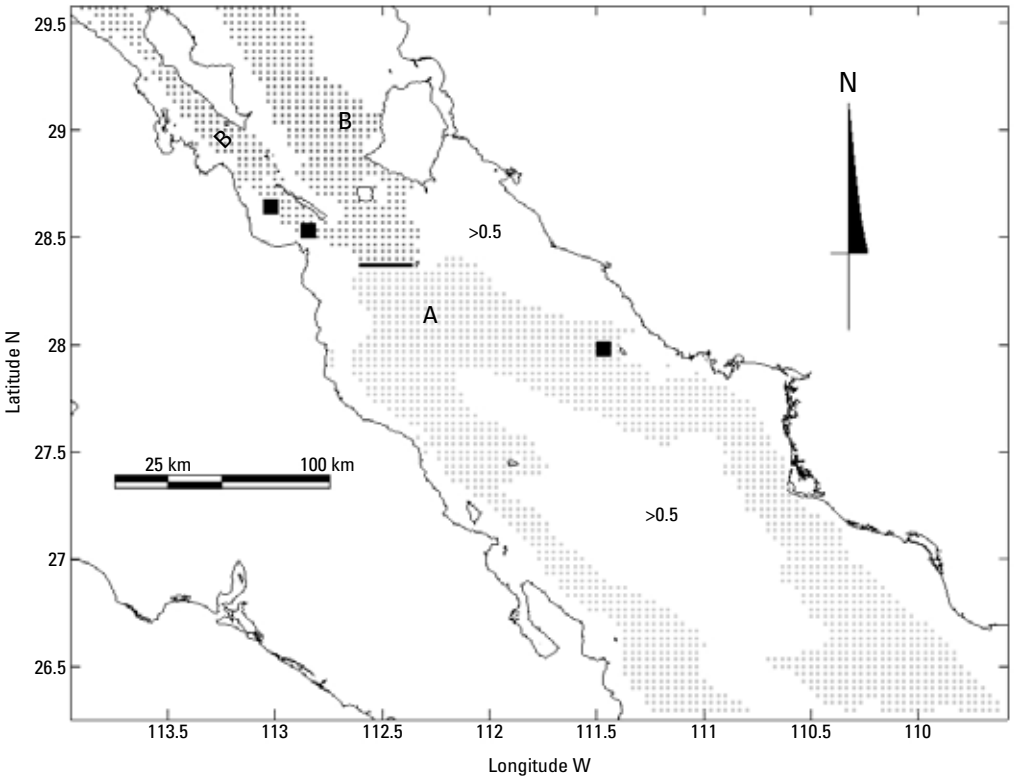

Figure 3. Oxygen Minimum Zone corresponding to values <0.5 ml O_2/l (shaded areas) based on oxygen profiles obtained during the TALUD cruises (Area A; limits are marked with clear squares) or extrapolated using the same set of data (Area B; limits are marked with dark squares). White areas feature oxygen concentration >0.5 ml O_2/l and where oxygen values increase with increasing depth in the central Gulf, and with decreasing depth in the coastal area. Solid square sampling stations of *Janetogalathea californiensis*.

shallower water. However, repeated sampling on the continental shelf of the entire Gulf of California between 1981 and 1985 (SIPCO and CORTES cruises) (Hendrickx & Salgado-Barragán, 1991) failed to reveal the presence of *J. californiensis* between roughly 20 and 130 m depth (unpubl. data).

The Gulf of California population probably features a distribution range restricted to the upper central Gulf of California, with no possibility to connect with the California Current population. However, further sampling in the area is needed to confirm this.

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