

Range extension of five crustacean species in the Gulf of California, Mexico

Juana López-Martínez¹, Carlos H. Rábago-Quiroz², Daniel M. Rangel-Reséndez¹, Eloísa Herrera-Valdivia¹, Gabriel Rivera-Parra³

¹ Centro de Investigaciones Biológicas del Noroeste, S.C., Unidad Guaymas, Guaymas, Sonora, México

² Centro Regional de Investigación Acuícola y Pesquera - La Paz, Instituto Mexicano de Investigación en Pesca y Acuicultura Sustentables, La Paz, Baja California Sur, México

³ Centro Regional de Investigación Acuícola y Pesquera - Mazatlán, Instituto Mexicano de Investigación en Pesca y Acuicultura Sustentables, Mazatlán, Sinaloa, México

Corresponding author: Carlos H. Rábago-Quiroz (carlos.rabago@imipas.gob.mx)

Abstract. Northernmost range extensions in the Gulf of California, Mexico, are reported for five crustacean species, one from the family Portunidae and four to the family Squillidae. These extensions cover the central and northern portions of the Sonora coastline (Agiabampo and Puerto Peñasco) and the eastern coast, off San Luis Gonzaga and San Felipe, Baja California, Mexico. The species exhibiting the greatest range extension was *Cloridopsis dubia* (H. Milne Edwards, 1837), spanning 830 km.

Keywords. Baja California, bycatch, Portunidae, Squillidae, *Euphyllax*, shrimp fishery, Sonora, *Squilla*

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Introduction

Crustaceans are a globally widespread subphylum of arthropods (Saeedi et al. 2019). Within this group, the order Decapoda is one of the most abundant, 5,350 species have been recorded in the American continent, making it the second most abundant group of crustaceans in the Pacific Ocean (López-Martínez et al. 2012). They are also among the most successful aquatic groups in the marine ecosystems, possessing life cycles and behavioural and physiological traits that promote high rates of establishment and success as invasive species (Karatayev et al. 2009; Hänfling et al. 2011; Simões et al. 2021).

In the Gulf of California (GC), assemblages of 825 decapod crustacean species from the Panamic zoogeographic province and 265 species from the Cortés subprovince have been reported, representing 20% of the region's diversity (Boschi 2000). Crustaceans are also a very common component of bycatch in trawl fisheries in several parts of the world, including the GC, where crustaceans account for up to 16.5% of the bycatch (Rábago-Quiroz et al. 2008; López-Martínez et al. 2010; Rodrigues-Filho et al. 2020; Tirado-Ibarra et al. 2020; Susmita et al. 2024).

Among the crustacean species incidentally captured by shrimp trawl bycatch in the GC, only a few are of commercial interest, such as swimming crabs of the genus *Callinectes* Stimpson, 1860 (López-Martínez et al. 2014) and shrimp of the genus *Sicyonia* H. Milne Edwards, 1830 (López-Martínez et al. 2020). In contrast, there is a knowledge gap regarding the biodiversity of most non-commercial crustaceans occurring in these marine ecosystems (Hendrickx and Wicksten 2011). Little is known about their distribution, abundance, and biology, due to their general small size and because research efforts are primarily focused on commercially important species. In this study, we document the geographic range extension of five crustacean species that currently have no commercial interest and are commonly found in shrimp trawls conducted in the GC.



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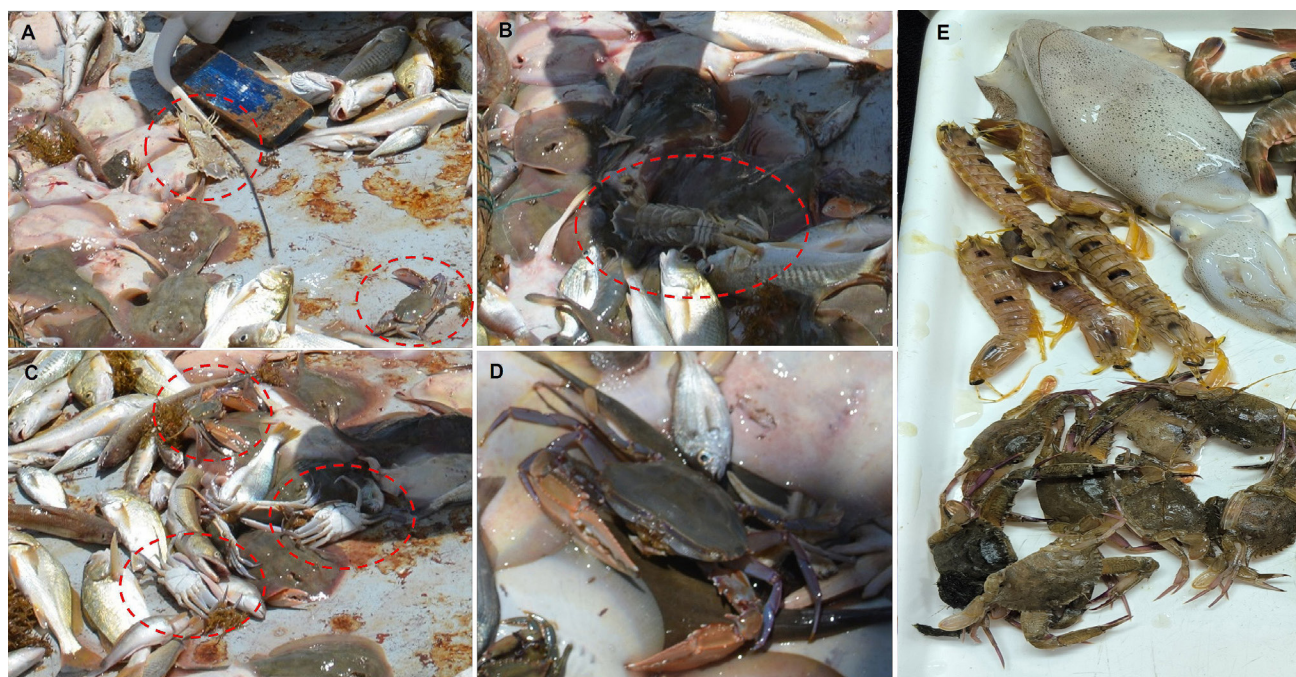


Figure 1. Crustaceans collected from shrimp fishery bycatch along the coasts of Sonora and Baja California, Mexico. **A, B.** Species of the family Squillidae. **C, D.** Species of the family Portunidae. **E.** Species of both families.

Methods

From 2002 to 2018, research cruises were conducted during July and August aboard shrimp trawler-type vessels. Crustaceans comprising the bycatch (Figure 1) were collected during surveys carried out to assess shrimp populations along the coasts of Sonora and Baja California in the GC (26.3°N, 109.2°W to 31.3°N, 114.9°W).

Crustaceans were captured using polyethylene trawl nets with a mouth perimeter (stretched mesh) of 68 m and a headline length of 38 m. Tows were conducted at depths of 10–70 m, for 1 h at a speed of 3.6 km/h. The geographic coordinates of each tow were recorded using the vessels' onboard GPS units (Furuno). For each tow in which crustaceans were present, specimens were sampled, placed in labelled bags, and frozen for subsequent laboratory analysis.

Identification and biometric measurements of each specimen belonging to the families Squillidae and Portunidae were conducted at the Fisheries Laboratory of the Centro de Investigaciones Biológicas del Noroeste S.C. (CIBNOR), Guaymas Unit, Sonora, following the identification keys and guides of Hendrickx (1995) and Salgado-Barragán and Hendrickx (2010). Voucher specimens were fixed in 10% formaldehyde and preserved in 70% ethyl alcohol. This material is housed at the CIBNOR Fisheries Laboratory, Guaymas Campus and can be accessed upon request.

In the laboratory, individuals were counted, measured for total length (from the tip of the rostrum to the tip of the spine telson in Squillidae) or carapace width (in Portunidae), and weighed for total weight (TW) using a measuring tape (0.1 mm precision) and a digital balance (0.1 g precision), respectively. Total length and carapace width data for each species were grouped into 10 mm class intervals to compare size-frequency distributions. Graphics showing size frequencies (absolute abundance) were produced in Excel.

A web search using Google Scholar and other online resources was conducted to locate sources such as scientific articles, books and book chapters, reports, scientific communications, theses and databases related to the latitudinal distribution of crustaceans. These sources were compared with the distribution of the crustaceans examined in this study. Three databases were used as the primary references to establish the distribution of the species included in this work: OBIS (2026), WoRMS (2026), and ENCICLOVIDA (2026).

Maps illustrating previous and new distribution record for each species were produced using QGIS v. 3.40.

Results

Of the 51 crustacean species analysed from 2002 to 2018, five showed a range extensions in the GC (Figure 2A–E), including one species of the family Portunidae and four of the family Scyllidae.

Family Portunidae

Euphyllax dovii Stimpson, 1860

Figure 3A

New records. MEXICO — GULF OF CALIFORNIA • north of El Sahuimaro, Sonora, 28.5860°N, 111.9098°W; 20 m depth; 7.IX.2017; 4 spec, alcohol preservation, CIBNOR-GYMS 2400.

Identification. Eye stalks extremely long, with length at least equal to 1/3 of carapace width. Carapace with 4 or 5 anterolateral teeth, sometimes very small. Propodus and dactyl of pereopods 2, 3, and 4 typically flattened, as in the fifth pereopod. Claw of cheliped ~4× its height (Hendrickx 1995; Salgado-Barragán and Hendrickx 2010).

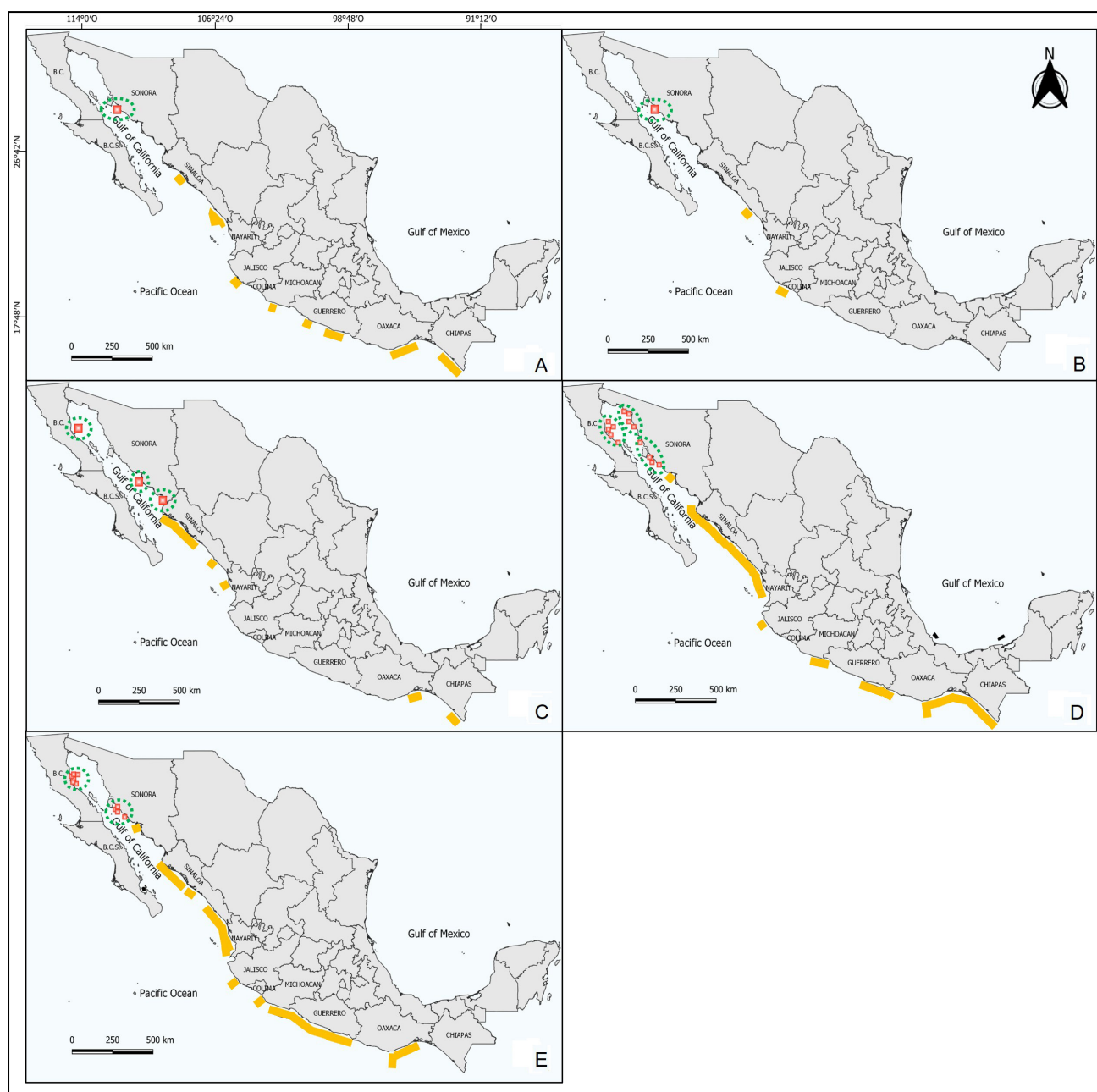


Figure 2. Previously reported geographic distribution (solid orange line) in the Mexican Pacific and range extension (green dashed line and orange squares) in the Gulf of California. **A.** *Euphyllax dovii*. **B.** *Cloridopsis dubia*. **C.** *Squilla aculeata*. **D.** *Squilla mantoidea*. **E.** *Squilla panamensis*.

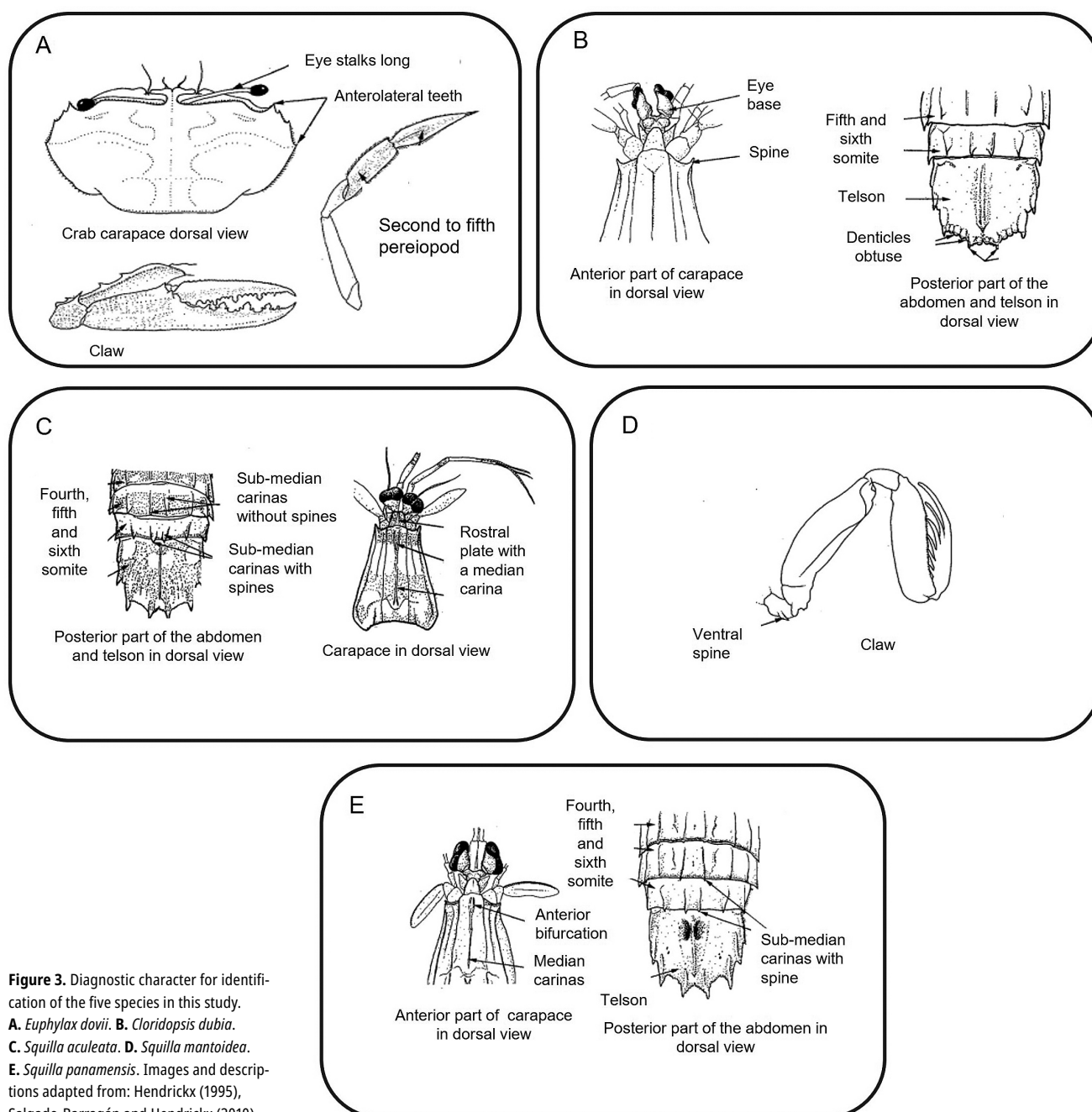


Figure 3. Diagnostic character for identification of the five species in this study. **A.** *Euphyllax dovii*. **B.** *Cloridopsis dubia*. **C.** *Squilla aculeata*. **D.** *Squilla mantoidea*. **E.** *Squilla panamensis*. Images and descriptions adapted from: Hendrickx (1995), Salgado-Barragán and Hendrickx (2010).

Distribution. In the Mexican Pacific Ocean from the Guatemala–Mexico border, along the coasts of Oaxaca, Guerrero, Michoacán, Jalisco, and Nayarit. In the GC, from Teacapán to Isla Altamura, Sinaloa (OBIS 2026; WORMS 2026; ENCICLOVIDA 2026).

Family Squillidae

Cloridopsis dubia (H. Milne Edwards, 1837)

Figure 3B

New records. MEXICO — GULF OF CALIFORNIA • north of El Sahuimaro, Sonora, 28.6006°N, 111.9852°W; 40 m depth; 15.VII.2017; 2 spec, alcohol preservation, CIBNOR-GYMS 2401.

Identification. Submedian telson tooth tips mobile, although tips frequently detach. Maxillary coxa with 2–5 epipodites. Eye and eye stalk shape variable. Anterolateral carapace angles terminating in a spine. Maxillary coxa with 2 or 3 epipodites. Eye base dilated. Claw dactyl with 5 or 6 teeth. Telson denticles obtuse (Hendrickx 1995; Salgado-Barragán and Hendrickx 2010).

Distribution. In the Pacific Ocean from Panama to Costa Rica and El Salvador. In the Mexican Pacific, specifically north of the coast of Colima and in Mazatlán, Sinaloa (OBIS 2026; WORMS 2026; ENCICLOVIDA 2026).

***Squilla aculeata* Bigelow, 1893**

Figure 3C

New records. MEXICO — GULF OF CALIFORNIA • off Puertecitos, Baja California, 30.2415°N, 114.4320°W; 57 m depth; 7.VII.2007; 21 spec, alcohol preservation, CIBNOR-GYMS 2402 • north of Agiabampo, Sonora, 26.3487°N, 109.3485°W; 21 m depth; 19.VII.2016; 6 spec, alcohol preservation, CIBNOR-GYMS 2403 • south of Guaymas, Sonora, 27.2301°N, 110.4763°W; 28 m depth; 4.VIII.2016; 2 spec, alcohol preservation, CIBNOR-GYMS 2404.

Recorded sizes ranged from 96 to 143 mm in total length (Figure 4).

Identification. Apices of submedian teeth of telson fixed. Maxillipedal coxa with 4 or 5 epipodites. Eyes T-shaped, with eyestalk not dilated. Ventral spine present at base of claw. Maxillipedal coxa with 4 epipodites (Hendrickx 1995; Salgado-Barragán and Hendrickx 2010).

Distribution. In the Pacific Ocean from Panama to Honduras and El Salvador. In the Mexican Pacific, it occurs from the Guatemala–Mexico border and has been specifically reported along the coasts of Chiapas and Oaxaca, north of Nayarit, and along the coast of Sinaloa (OBIS 2026; WORMS 2026; ENCICLOVIDA 2026).

***Squilla mantoidea* Bigelow, 1893**

Figure 3D

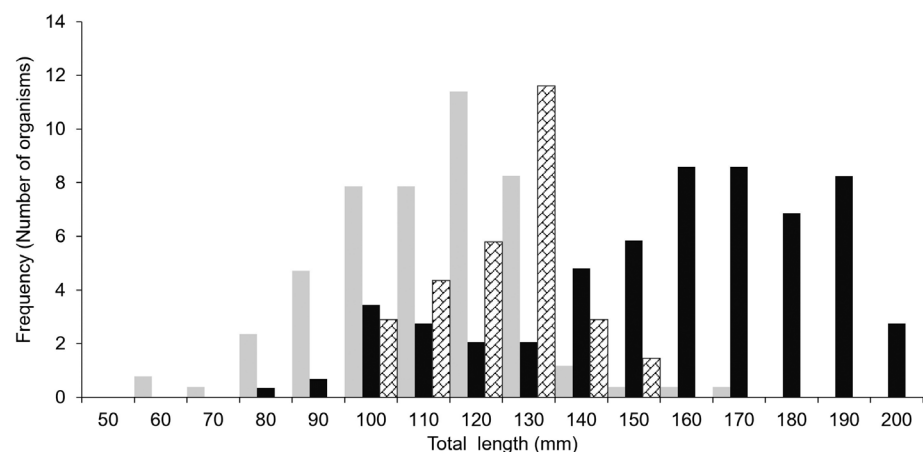
New records. MEXICO — GULF OF CALIFORNIA • off Bahía Kino, Sonora, 28.6811°N, 112.1047°W; 39 m depth; 4.VIII.2017; 6 spec, alcohol preservation, CIBNOR-GYMS 2405 • south of Puerto Peñasco, Sonora, 30.6555°N, 113.1714°W; 62 m depth; 15.VIII.2007; 25 spec, alcohol preservation, CIBNOR-GYMS 2406 • off San Luis Gonzaga, Baja California, 29.8815°N, 114.3242°W; 45 m depth; 16.VIII.2011; 15 spec, alcohol preservation, CIBNOR-GYMS 2407 • San Felipe, Baja California, 30.5552°N, 114.4151°W; 39 m depth; 14.VII.2004; 11 spec, alcohol preservation, CIBNOR-GYMS 2408.

Recorded sizes ranged from 80 to 220 mm in total length (Figure 4).

Identification. Submedian teeth apices of telson fixed. Maxillary coxa with 4 or 5 epipodites. Eyes T-shaped, with eyestalk not dilated. Claw base lacks ventral spine. Maxillary coxa with 5 exopodites. Prelateral lobe of telson absent or present, never terminating in a spine. Telson with or without a post-anal (ventral) keel, the latter never terminating in a spine. Only the sixth abdominal somite with submedian carinas terminating in spines. Median carina of carapace with well-marked bifurcation anterior to cervical groove. Rostral plate with median carina, occasionally presenting a terminal spine in submedian carinas of fifth abdominal segment (Hendrickx 1995; Salgado-Barragán and Hendrickx 2010).

Distribution. In the Pacific Ocean, with records specifically from Ecuador and Panama. In the Mexican Pacific, it occurs from the Guatemala–Mexico border along the coasts of Chiapas, Oaxaca, Guerrero, Michoacán, Jalisco, Nayarit, and Sinaloa. In Sonora, its presence has been specifically reported in Guaymas Bay (OBIS 2026; WORMS 2026; ENCICLOVIDA 2026).

Figure 4. Size-frequency distribution for: *Squilla panamensis* (grey bars), *Squilla mantoidea* (black bars), and *Squilla aculeata* (hatched bars) from 2002 to 2018 in the Gulf of California.



***Squilla panamensis* Bigelow, 1891**

Figure 3E

New records. MEXICO — Gulf of California • south of Bahía Kino, Sonora, 28.7999°N, 112.0578°W; 39 m depth; 10.VII. 2018; 21 spec, alcohol preservation, CIBNOR-GYMS 2409 • off San Felipe, Baja California, 30.5552°N, 114.4151°W; 40 m depth; 14.VII.2004; 25 spec, alcohol preservation, CIBNOR-GYMS 2410.

Recorded sizes ranged from 52 to 166 mm in total length (Figure 4).

Identification. Submedial teeth apices of the telson fixed. Maxillary coxa with 4 or 5 epipodites. Eyes T-shaped, with eyestalk not dilated. Claw base without ventral spine. Maxillary coxa with 5 exopodites. Prelateral lobe of telson absent or present, never terminating in a spine. Telson with or without a post-anal (ventral) keel, the latter never terminating in a spine. Only sixth abdominal somite with submedian carinas terminating in spines. Submedian carinae of abdominal somites 4–6 terminating in a posterior spine (Hendrickx 1995; Salgado-Barragán and Hendrickx 2010).

Distribution. In the Pacific Ocean from Peru, Ecuador, Colombia, Panama, Costa Rica, El Salvador, and Guatemala. In the Mexican Pacific, it occurs from the Guatemala–Mexico border along the coasts of Oaxaca, Guerrero, Michoacán, Colima, Jalisco, Nayarit, and Sinaloa. In Baja California Sur, it has been reported from Isla Espíritu Santo, and in Sonora, it has been reported in Guaymas (OBIS 2026; WORMS 2026; ENCICLOVIDA 2026).

Discussion

This study reports the northernmost range extension of five crustacean species occurring in the Gulf of California, including one species from the family Portunidae and four from the family Squillidae.

The presence of *E. dovii* is confirmed farther north than the previous record at Isla Altamura, Sinaloa, extending its distribution to north of El Sahuimaro, Sonora (Figure 2A). The presence of *C. dubia* is confirmed farther north than the previous record in Mazatlán, Sinaloa, extending its distribution to north of El Sahuimaro, Sonora (Figure 2B). This species exhibited the greatest range extension, spanning 830 km. The presence of *S. aculeata* is confirmed farther north than the previous record at Topolobampo, Sinaloa, extending its distribution to north of Agiabampo, south of Guaymas, Sonora, as well as along the eastern coast of the GC, off Puertecitos, Baja California (Figure 2C). The presence of *S. mantoidea* is confirmed farther north than the previous record at Guaymas, Sonora, extending its distribution to off Bahía Kino, Sonora, south of Puerto Peñasco, Sonora, as well as along the eastern coast of the GC, off San Luis Gonzaga, Baja California, and San Felipe, Baja California (Figure 2D). Likewise, the presence of *S. panamensis* is confirmed farther north than the previous record at Guaymas, Sonora, extending its distribution to south of Bahía Kino, Sonora, as well as along the eastern coast of the GC, off San Felipe, Baja California (Figure 2E) (OBIS 2026; WORMS 2026; ENCICLOVIDA 2026).

The atypical distribution of these five species in the GC may be related to environmental events such as El Niño/ENSO. Several authors have suggested that the occurrence of these events in the GC and other tropical and subtropical regions alter migratory processes involving benthic larvae or juveniles of pelagic species transported by marine currents (Zinsmeister 1974; Díaz and Ortlieb 1993; Arntz and Fahrbach 1996; Paredes et al. 2004). This phenomenon has been documented for several crustacean species, including *Pleuroncodes planipes* Stimpson, 1860 (Hubbs 1948; Lluch-Belda et al. 2005), *Callinectes arcuatus* Ordway, 1863, *Achelous xantusii* Stimpson, 1860, and *Euphyllax dovii* (Gracia et al. 1986; Williams et al. 2001; Sadowski et al. 2018).

Likewise, El Niño/ENSO events have been reported to promote the tropicalization of marine waters, allowing species such as fish, crustaceans, and molluscs to expand into latitudes they may have occupied in the distant past (DeVries 1986; Rollins et al. 1986; DeVries 1987; DeVries and Wells 1990). For crustaceans of the genus *Callinectes*, several northward shifts have been documented (Piers 1920; Hubbs 1948; Perry 1972; Williams et al. 2001; Knott et al. 2003; Kuris et al. 2007; Johnson 2015; Sadowski et al. 2018). It has also been reported that El Niño/ENSO events promote the shoreward intrusion of warm offshore waters, facilitating the formation of protected areas or refugia. This phenomenon has been documented for several mollusc species and portunid crustaceans (Tarazona and Valle 1998; Paredes et al. 2004).

On the other hand, Hendrickx and Wicksten (2011) attributed range extensions of caridean shrimps along the Pacific coast of Mexico, primarily to sampling gaps rather than recent distributional shifts. This may reflect the scarcity of studies specifically focused on the distributional extent of non-com-

mercial macrocrustaceans in the Tropical Eastern Pacific. The few available studies generally originate from broad inventories of bycatch fauna obtained during trawls surveys (Tirado-Ibarra et al. 2020).

Regardless of whether these range extensions are associated with major thermal anomalies or with historical sampling gaps, the geographic expansion of the five crustacean species documented here is of considerable biogeographic significance. These findings highlight the need for continued investigations into the distribution of these species, and the possible driver of their range shift, as well as those of other crustacean species that inhabit the GC.

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Additional information

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

Use of artificial intelligence (AI)

The authors accept full responsibility for the content of the manuscript, including the disclosure of any use of AI. No AI tools were used in the preparation of this manuscript.

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Author contributions

Conceptualization: JLM, CHRQ. Investigation: JLM, EHV, GRP. Data curation and formal analysis: DMRR, EHV, CHRQ. Writing – original draft: JLM, CHRQ. Writing – review and editing: JLM, CHRQ, EHV, GRP.

Author ORCID iDs

Juana López-Martínez  <https://orcid.org/0000-0002-8786-9790>

Carlos H. Rábago-Quiroz  <https://orcid.org/0000-0001-8171-9778>

Eloísa Herrera-Valdivia  <https://orcid.org/0000-0001-8724-4961>

Gabriel Rivera-Parra  <https://orcid.org/0000-0002-0941-8636>

Data availability

All data that support the findings of this study are available in the main text.

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