

## Review and additions to the Eocene decapod Crustacea from Chiapas, Mexico

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### Abstract

Eighteen taxa of decapod crustaceans are described from the Lower Eocene El Bosque and Middle Eocene San Juan formations of the central part of Chiapas, Southeastern Mexico. New taxa for the area are represented by *Karasawaia markgrafi* new combination, *Panopeus veintensis* new species, and *Tehuacana schweitzerae* new species from the Lower Eocene of the El Bosque Formation. A review of previously reported species from these localities result in reclassification and identification of *Neocallichirus* sp. cf. *N. rhinos*, *Raninoides trelденаensis*, *Notopoides exiguus*, and *Orbitoplax nandachare*. *Ranina berglundi*, *Petrochirus* sp. and *Santeella lillyae* are reported for the first time in southern Mexico. Occurrence of *Calappilia hondoensis*, *Verrucoides stenohedra*, and *Viapinnixa alvarezii* is confirmed with new specimens. Due to its poor preservation and incompleteness, specimens of Callianassidae, Diogenidae, *Petrochirus* sp., Portunidae, and *Xaiva?* sp. are only referred to high taxonomic levels. New and reviewed taxa support previous paleobiogeographic interpretations for this assemblage, and add additional information on the dispersion patterns to the Pacific Coast of North America.

**Key words:** Tertiary, Eocene, Crustacea, Chiapas, Mexico.

### Introduction

The crustacean fossil record from Chiapas is one of the most diverse in Mexico. Isopods, tanaidaceans, penaeids, pagurids, palinurids and brachyurans have been previously reported from Early Cretaceous rocks of Chiapas (Serrano et al., 2006; Vega et al., 2006; Vega et al., 2007). Four Late Cretaceous crustaceans have been reported from the Maastrichtian Ocozocoautla Formation (Feldmann et al., 1996; Vega et al., 2001a). Eocene crustaceans from Chiapas were first reported by Vega et al. (2001b), who described and illustrated 12 taxa, six of them new. Paleobiogeographic affinities of the Eocene assemblage suggested a close relationship with the Tethyan region of southern Europe, southern North America and Greenland.

Eocene crustaceans were collected from two localities within the Depresión Central of Chiapas (Fig. 1). Vega et al. (2001b) suggested that the two localities were part of the same stratigraphic unit, known regionally as the Middle Eocene San Juan Formation

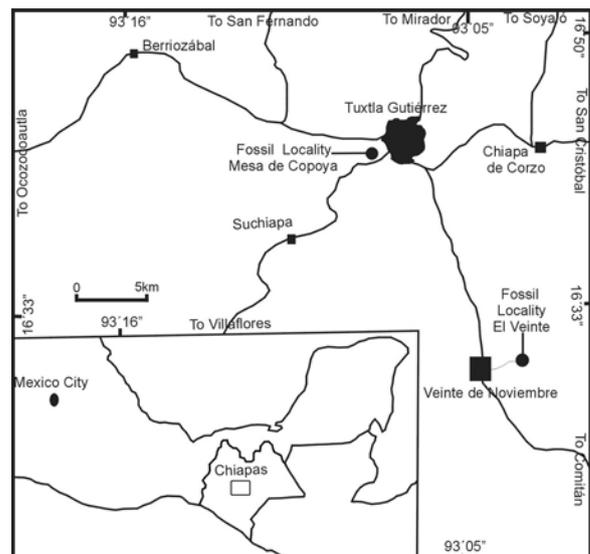


Fig. 1. Location map of the central part of Chiapas, Southeastern Mexico, indicating position of localities reported herein.

(Fost and Langenheim, 1974; Ferrusquía-Villafranca, 1996). However, recent geochronological studies from well preserved nautiloid shells revealed that one of the localities, known as El Veinte (Fig. 1), is represented by sediments deposited during Early Eocene times (Perrilliat et al., 2006). The age obtained by  $^{87}\text{Sr}/^{86}\text{Sr}$  analysis was equivalent to 52 Ma, which falls into the lowermost Eocene Ypresian Standard Stage range (Steurbaut, 2006). Within the study area the Lower Eocene is represented by the El Bosque Formation (Allison, 1967; Frost and Langenheim, 1974; Ferrusquía-Villafranca, 1996), therefore the El Veinte locality, from which several species of mollusks have also been described (Perrilliat et al., 2003; 2006), is part of the El Bosque Formation (Fig. 2). The second fossil crustacean locality previously reported by Vega et al. (2001b) is Mesa de Copoya (Fig. 1), which belongs to the Middle Eocene San Juan Formation (Fig. 2), whose age is confirmed by foraminifera biostratigraphy (Frost and Langenheim, 1974; Ferrusquía-Villafranca, 1996).

Recent field work at El Veinte and Mesa de Copoya localities has yielded numerous new crustacean specimens, adding additional taxa to the first report by Vega et al. (2001b). Based on this material, a study on the evolutionary trends and dispersion of *Lophoranina* Fabiani, 1910, as well as a report on sexual dimorphism in *L. cristaspina* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001 (Middle Eocene, Chiapas) was recently reported (Hernández-Monzón et al., 2007). The remaining specimens include two Callianassidae; *Neocallichirus* sp. cf. *N. rhinos* Schweitzer and Feldmann, 2002; one Diogenidae; *Petrochirus* sp.; *Ranina berglundii* Squires and Demetrian, 1992; *Raninoides trelденаensis* (Collins and Jakobsen, 2003); *Notopoides exiguus* Beschin, Busulini, de Angeli, and Tessier,

1988; *Calappilia hondoensis* Rathbun, 1930; *Karasawaia markgrafi* (Lörentz, 1907[1909]) new combination; *Verrucoides stenoedra* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer and Waugh, 2001; *Santeella lillyae* Blow and Manning, 1996; *Panopeus veintensis* new species; *Orbitoplax nandachare* (Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer and Waugh, 2001) new combination; *Tehuacana schweitzerae* new species; one portunid; *Xaiva?* sp.; and *Viapinnixa alvarezii* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer and Waugh, 2001. From these, eleven taxa are new to the area. A review of *Notopus minutus* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001, reveals that this species is invalid, and the specimens should be considered as *Notopoides exiguus* Beschin, Busulini, De Angeli, and Tessier, 1988. *Stoaplax* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001, is also invalidated based on more complete specimens, and it is suggested that the genus should be a synonym of *Orbitopax* Tucker and Feldmann, 1990. An updated list of the crustacean taxa reported for the Eocene localities of Chiapas is presented (Table 1).

Paleobiogeographic affinity with faunas from the Eocene of Europe, North Africa, Greenland, Southeastern United States and Baja California is confirmed. There is also evidence for a connection with Eocene assemblages from the Eocene Pacific coast of North America.

Specimens are deposited in the Museo de Paleontología "Eliseo Palacios Aguilera", Instituto de Historia Natural y Ecología de Chiapas, Calzada de Los Hombres Ilustres s/n, Parque Madero, 29000, Tuxtla Gutiérrez, Chiapas, México, under acronym IHNFG. Other specimens illustrated herein are deposited in the Colección Nacional de Paleontología, Instituto de Geología, UNAM, Ciudad Universitaria, Coyoacán, México, DF 04510, Mexico, under acronym IGM.

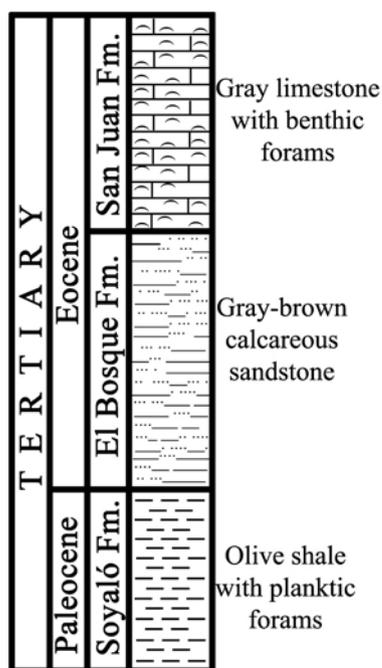


Fig. 2. Stratigraphic table with units that crop out in the study area.

## Systematic Paleontology

Classification follows that of Martin and Davis, 2001, Karasawa and Schweitzer, 2006, and Števcíć, 2005.

New names should be attributed to F. Vega and T. Nyborg.

Order Decapoda Latreille, 1802

Suborder Pleocyemata Burkenroad, 1963

Infraorder Thalassinidea Latreille, 1831

Superfamily Callianassoidea Dana, 1852

Family Callianassidae Dana, 1852

### Callianassidae 1

(Pl. 1, Fig. 1)

*Description*: Small callianassid palm, rectangular, narrower at distal portion; surface reticulated.

*Material*: One specimen, IHNFG-3004, locality Mesa de Copoya, Middle Eocene, San Juan Formation.

*Measurements*: Hypotype IHNFG-3004, palm length = 9 mm,

Table 1. List of crustacean decapod species described for Lower and Middle Eocene (L.E. and M.E. respectively) deposits in central Chiapas. Paleobiogeographic affinities of different taxa are also included: Teth. = Tethyan, N. Atl. = North Atlantic, SE. NA. = Southeast North America, and Pac. = Pacific Coast of North America.

	L.E.	M.E.	Teth.	N. Atl.	SE. NA.	Pac.
Callinassidae 1		X				
Callinassidae 2	X					
<i>Neocallichirus</i> sp. cf. <i>N. rhinos</i>	X					X
Diogenidae		X				
<i>Paguristes mexicanus</i>		X				X
<i>Petrochirus</i> sp.	X	X				
<i>Lophoranina cristaspina</i>		X				X
<i>Ranina berglundi</i>	X					X
<i>Raninoides treldenaesensis</i>	X			X		
<i>Notopoides exiguus</i>	X		X			
<i>Calappilia hondoensis</i>		X				X
<i>Eriosachila</i> sp.	X					X
<i>Karasawaia markgrafi</i> new combination	X		X			
<i>Verrucoides stenohedra</i>	X			X		
<i>Santeella lillyae</i>	X				X	
<i>Panopeus veintensis</i> new species	X					X
<i>Orbitoplax nandachare</i> new combination	X					X
<i>Tehuacana schweitzerae</i> new species	X				X	
Portunidae		X				
<i>Xaiva?</i> sp.		X				
<i>Viapinnixa alvarezii</i>	X			X	X	

height = 6 mm.

*Discussion:* The single specimen represents the first callianassid from the Middle Eocene San Juan Formation. Although the specimen is very fragmentary to offer detailed identification, we consider it important to be included in this report. The shape of the palm is similar to one illustrated by Schweitzer et al. (2005) as *Callianassidae sensu lato* species 3, from the Eocene Bateque Formation.

### Callianassidae 2

(Pl. 1, Figs. 2, 3)

*Description:* Propodus semirectangular, slightly longer than wide; fixed finger triangular, slightly downturned, proximal portion half the height of propodus, with scattered pits; occlusal surface with row of pits, teeth first third distance to tip.

*Material:* Three specimens, IHNFG-3005 to IHNFG-3007, locality El Veinte, Lower Eocene, El Bosque Formation.

*Measurements:* Hypotypes IHNFG-3005, right propodus length = 19 mm, height = 10 mm; IHNFG-3006, right propodus length = 15 mm, height = 10 mm; IHNFG-3007, left propodus length = 14 mm; height = 12 mm.

*Discussion:* Vega et al. (2001b) reported *Callianassa sensu lato* sp. from the El Veinte locality, based on incomplete specimens. The new material represents two right and one left palms with nearly complete fixed fingers, however the information derived from these specimens is not sufficient to offer specific identification.

Subfamily Callichirinae Manning and Felder, 1991

Genus *Neocallichirus* Sakai, 1988

*Type species:* *Neocallichirus horneri* Sakai, 1988, by original designation.

### *Neocallichirus* sp. cf. *N. rhinos* Schweitzer and Feldmann, 2002

(Pl. 1, Fig. 4)

*Description:* Thalassinoid of medium size, merus of right cheliped elongated, curved, lower margin lacks spine but has fine serrations. Carpus subtrapezoidal, as high as propodus and three times as high as merus. Propodus semirectangular, slightly longer than wide; fixed finger slender, triangular.

*Material:* One specimen, IHNFG-3008. Locality El Veinte, Lower Eocene, El Bosque Formation.

*Measurements:* Hypotype IHNFG-3008, right cheliped length (merus, carpus, propodus) = 29 mm, height = 9 mm.

*Discussion:* *Neocallichirus rhinos* Schweitzer ad Feldmann, 2002 was reported from Eocene sediments of California. This species represents another component from the Pacific coast, present in the Lower Eocene of Chiapas.

Infraorder Anomura MacLeay, 1838

Superfamily Paguroidea Latreille, 1802

Family Diogenidae Ortmann, 1892

### Diogenidae

(Pl. 1, Figs. 5, 6)

*Description:* Small right palm, elongated, subrectangular, slightly concave longitudinally, about twice long as high, distal part the highest; ornamentation consists of scale-like granules and scattered larger tubercles.

*Material:* One specimen, IHNFG-3009, locality Mesa de Copoya, Middle Eocene, San Juan Formation.

*Measurements:* Hypotype IHNFG-3009, total palm length = 12 mm, height = 7 mm.

*Discussion:* The specimen is similar to *Eocalcinus* Via, 1959, in particular to *E. cavus* Beschin, Busulini, De Angeli and Tessier, 2002 from the Middle Eocene of Italy, but more complete specimens are necessary to define the systematic affinity of the Mexican specimen.

Genus *Petrochirus* Stimpson, 1859

*Type species:* *Pagurus granulatus* Olivieri, 1811, by original designation.

***Petrochirus* sp.**

(Pl. 1, Figs. 7–12)

*Description:* Left cheliped carpus semirectangular, two times as high as long, outer surface smooth; propodus semirectangular, elongated, triangular in transverse section, slightly curved longitudinally, outer surface covered by tubercles becoming more pronounced towards lower margin; inner surface covered uniformly by strong tubercles. Right palm slightly shorter than left palm, fixed finger curved; outer surface covered by granules.

*Material:* Three specimens, IHNFG-3010, IHNFG-3012 locality Mesa de Copoya, Middle Eocene, San Juan Formation; IHNFG-3011, locality El Veinte, Lower Eocene, El Bosque Formation.

*Measurements:* Hypotypes IHNFG-3010, left propodus length = 10 mm, height = 6 mm; IHNFG-3011, left propodus length = 9 mm, height = 6 mm; IHNFG-3012, left carpus and propodus length = 22 mm, height = 13 mm.

*Discussion:* Based upon a single left palm from the Middle Eocene of the San Juan Formation, Vega et al. (2001b) described *Dardanus mexicanus* (Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001). According to Schweitzer et al. (2005), that specimen represents *Paguristes* Dana, 1851, instead of *Dardanus* Paulson, 1875.

The palms presented herein are incomplete, but differ from *Paguristes* in being longer and more rectangular. *Petrochirus mezi* (Lőrenthey, 1907[1909]) from the Eocene of Italy is very similar to the Mexican species, however, it differs in being covered by smaller tubercles and having an inferior margin that is nearly straight.

Infraorder Brachyura Latreille, 1802

Section Podotremata Guinot, 1977

Subsection Archaeobrachyura Guinot, 1977

Superfamily Raninoidea De Haan, 1839

Family Raninidae De Haan, 1839

Subfamily Ranininae De Haan, 1839

Genus *Ranina* Lamarck, 1801

*Type species:* *Cancer raninus* Linnaeus, 1758, by original designation.

***Ranina berglundi* Squires and Demetron, 1992**

(Pl. 1, Figs. 13–15; Pl. 2, Figs. 1, 2)

*Ranina berglundi* Squires and Demetron, 1992, p. 43, figs. 128, 129; Schweitzer et al., 2006a, p. 27, fig. 2.6.

*Description:* Carapace ovoid, widest at anterior third, one fourth longer than wide, concave in transverse section; anterior margin two thirds the maximum carapace width; rostrum projected, trifold, medially sulcate; fronto-orbital margin with two fissures, outer orbital spine triangular, projected half the length of front; anterolateral margin short, one-sixth the carapace length, with two spines, posterior anterolateral spine long, triangular, its length about one-third the width of anterior margin, small, sharp tip, four needle-like small spines on anterior margin, the two outermost being three-times the length of the two innermost, small spines; anterior anterolateral spine bifid, with posterior cuspid larger than anterior cuspid; posterolateral margin of carapace long, rimmed, anterior fourth parallel to longitudinal axis of carapace, then inclined to posterior margin; posterior margin narrow, straight, one fourth the maximum carapace width; carapace dorsal surface covered by small pits, distributed randomly on upper two thirds of carapace, aligned in rows on posterior portion; gastro-cardiac grooves concave longitudinally, deeply impressed.

*Material:* Three specimens, IHNFG-3013 to IHNFG-3015, locality El Veinte, Lower Eocene, El Bosque Formation.

*Measurements:* Paratypes IHNFG-3013, carapace length = 42 mm, width = 30 mm; paratype IHNFG-3014, carapace length = 20 mm, width = 17 mm; paratype IHNFG-3015, posterior anterolateral spine length = 10 mm, width = 5 mm.

*Discussion:* A direct comparison between the specimens from Chiapas and the ones described by Squires and Demetron (1992) from Baja California (Pl. 1, Fig. 15; Pl. 2, Fig. 2), demonstrated a small difference in the size and distribution of the carapace dorsal pits, being more numerous and much finer in the Baja California specimens. Schweitzer et al. (2006a) added important information in the emended diagnosis for this species, including the sternum.

*Ranina berglundi* represents the fifth species of fossil raninids reported from Chiapas. *Lophoranina precocious* Feldmann, Vega, Tucker, García-Barrera, and Avendaño, 1996, was described from the Maastrichtian Angostura and Ocozocoautla formations (Feldmann et al., 1996). *Lophoranina cristaspina* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001 was reported from the Middle Eocene San Juan Formation (Vega et al., 2001b; Hernández-Monzón et al., 2007). Two additional species from the Lower Eocene El Bosque Formation are reported herein.

According to Nyborg et al. (2003), fossil occurrences demonstrate that the genus *Ranina* was well established in the northeastern Pacific Ocean from at least the early Eocene up until the Miocene. *Ranina berglundi* represents another component from the Pacific Coast, present in Southern Mexico during Early Eocene times.

Subfamily Raninoidinae Lőrenthey and Beurlen, 1929

Genus *Raninoides* H. Milne Edwards, 1837

*Type species: Ranina laevis* Latreille, 1825 by original designation.

***Raninoides treldenaesensis* (Collins and Jakobsen, 2003)**

(Pl. 2, Fig. 3)

*Laeviranina treldenaesensis* Collins and Jakobsen, 2003, p. 71, fig. 4, pl. 3, fig. 5.

*Description:* Raninid of medium size, carapace elongate oval, narrow at posterior third, lateral margins straight; anterolateral spines short, fronto-orbital region narrow, one-fifth the length of carapace; orbital spines short, orbital fissures closed; rostrum triangular, short.

*Material:* One specimen, IHNFG-3016, locality El Veinte, Lower Eocene, El Bosque Formation.

*Measurements:* Hypotype IHNFG-3016, carapace length = 25 mm, width = 15 mm.

*Discussion:* Schweitzer et al. (2006a) synonymized the genus *Laeviranina* and the genus *Raninoides*, the latter being the senior synonym, and included a list of fossil *Raninoides* species. The new specimen is more complete than the one illustrated by Vega et al. (2001b), and morphologic details of the front, carapace shape and anterolateral spines are more clear to define its specific affinity. The shape and features are similar to those described and illustrated by Collins and Jakobsen (2003) for *Raninoides treldenaesensis*, from the Lower Eocene of Denmark.

Tucker (1998) illustrated the three known Eocene species of *Raninoides* from the West Coast of North America, however they all differ from *R. treldenaesensis* in having longer anterolateral and orbital spines. *Raninoides bournei* (Rathbun, 1928) from the Paleocene of Alabama has a more ovoid carapace shape. *Raninoides borealis* (Collins and Rasmussen, 1992) from the Paleocene of Greenland has much longer and oblique anterolateral spines. *Raninoides keyesi* Feldmann and Maxwell, 1990 from the Upper Eocene of New Zealand has a narrower anterior margin, and the anterolateral spines are too short and close to the orbital spines. *Raninoides acanthocolus* Schweitzer, Feldmann, González-Barba, and Čosović, 2006, and *R. proracanthus* Schweitzer, Feldmann, González-Barba, and Čosović, 2006, from the Eocene of Baja California Sur, Mexico (Schweitzer et al., 2006a), have both a more ovate carapace shape, with curved lateral margins. Anterolateral spines in *R. acanthocolus* are positioned more posteriorly when compared to anterolateral spines of *R. treldenaesensis*. The front in *R. perarmata* (Glaessner, 1960) from the Eocene of New Zealand is similar to the one observed in the Mexican specimen, but has a more ovoid carapace shape and the anterolateral spine is longer and more inclined, as observed in specimens illustrated by Feldmann and Duncan (1992).

Genus *Notopoides* Henderson, 1888

*Type species: Notopoides latus* Henderson, 1888, by original designation.

***Notopoides exiguus* Beschin, Busulini, De Angeli, and Tessier, 1988**

(Pl. 2, Figs. 4–6)

*Notopoides exiguus* Beschin, Busulini, De Angeli, and Tessier, 1988, p. 188, fig. 9, pl. 9, figs. 2, 3; De Angeli and Beschin, 2001, p. 17, fig. 10.2.

*Notopus minutus* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001, p. 936, figs. 6.1, 8.

*Description:* Small raninid, carapace ovoid, smooth; gastro-cardiac groove distinct. Fronto-orbital margin two-thirds maximum carapace width. Rostrum triangular, prominent, nearly as long as fronto-orbital region; orbital fissures short, open; outer orbital spines half the length of rostrum, slightly inclined outwards.

*Material:* Five specimens, IHNFG-3017 to IHNFG-3021, locality El Veinte, Lower Eocene, El Bosque Formation.

*Measurements:* Hypotypes IHNFG-3017, carapace length = 9 mm, width = 6 mm; IHNFG-3018, carapace length = 12 mm, width = 8 mm; IHNFG-3019, carapace length = 11 mm, width = 7 mm; IHNFG-3020, carapace length = 10 mm, width = 7 mm; IHNFG-3021, carapace length = 10 mm, width = 7 mm.

*Discussion:* *Notopus minutus* was described by Vega et al. (2001b) based upon a single, incomplete specimen. The more complete five new specimens reported herein clearly show the carapace shape, as well as the fronto-orbital region (Pl. 2, Fig. 6). *Notopus* Serène and Umali, 1972, differs from *Notopoides* in having a more elongated carapace shape, with evident anterolateral spines and outer orbital spines not defined.

*Notopoides exiguus* from the Lower Eocene of Italy (Beschinn et al., 1988) is similar to the Mexican specimens in size and shape of carapace, identical rostrum shape, orbital fissures and outer orbital spines. An image of the holotype is included for comparison with the Mexican specimens (Pl. 2, Fig. 6). The recent species *N. latus* Henderson, 1888, has a symmetrically ovate carapace and a wide distribution in the Indo-Pacific region (Dawson and Yaldwyn, 2002). *Notopoides verbeeki* Böhm, 1922, from the Miocene of Java has a carapace covered with granules, and is slightly larger than the species from the Lower Eocene of Italy and Mexico.

Section Heterotremata Guinot, 1977

Superfamily Calappoidea H. Milne Edwards, 1837

Family Calappidae H. Milne Edwards, 1837

Genus *Calappilia* A. Milne Edwards, 1873

*Type species: Calappilia verrucosa* A. Milne Edwards, 1873, by subsequent designation of Glaessner, 1929.

***Calappilia hondoensis* Rathbun, 1930**

(Pl. 2, Figs. 7–12)

*Calappilia hondoensis* Rathbun, 1930, p. 7, pl.5, figs. 1, 2; Vega et al., 2001b, p. 937, figs. 9, 10; Schweitzer et al. 2002, p. 38; Schweitzer et al. 2006a, p. 31, fig. 2.12.

*Description:* An emended, complete dorsal carapace description

for this species was given in Schweitzer et al. (2006a).

**Material:** Eight specimens, IHNFG-3022 to IHNFG-3029, locality Mesa de Copoya, Middle Eocene, San Juan Formation.

**Measurements:** Hypotypes IHNFG-3022, carapace length = 18 mm, width = 23 mm; IHNFG-3023, carapace length = 13 mm, width = 16 mm; IHNFG-3024, carapace length = 9 mm, width = 7 mm; IHNFG-3025, carapace length = 18 mm, width = 21 mm; IHNFG-3026, left palm length = 12 mm, height = 9 mm, width = 3 mm. The other specimens are fragmentary.

**Discussion:** *Calappilia hondoensis* has been reported from Middle Eocene beds of Tepetate and Bateque formations, Baja California Sur (Rathbun, 1930; Schweitzer et al., 2006a) and from the Middle Eocene San Juan Formation of Chiapas (Vega et al., 2001b). It is important to note that all specimens reported from Baja California Sur, including the holotype, are much smaller than the specimens collected from the San Juan Formation of Chiapas. However the morphology of specimens from both locations is very similar.

Influence of the Pacific coast of North America in southern Mexico during Middle Eocene times is indicated by the presence of this species in both Chiapas and Baja California Sur.

Superfamily Cancroidea Latreille, 1802

Family Cheiragonidae Ortmann, 1893

**Genus *Karasawaia* new genus**

**Type species:** *Plagiolophus markgrafi* Lőrenthey, 1907[1909], by original designation.

**Diagnosis:** Carapace small, pentagonal, slightly wider than long, widest at anterior third, posterior third rectangular; front with four lobes; orbits small, with one fissure; anterolateral margin with four spines, posteriormost larger; posterolateral margin devoid of spines; posterior margin straight; carapace without small tubercles, regions defined by deep grooves and ridges, epigastric, cardiac and metagastric regions with ridges.

**Etymology:** The new generic name is dedicated to Dr. Hiroaki Karasawa, a prominent researcher in the study of systematics and evolution of fossil decapod Crustacea.

**Discussion:** Karasawa and Schweitzer (2004) suggested *Stintonius markgrafi* (Lőrenthey, 1907[1909]) from the Lower Eocene of Egypt, to be referred to a new genus. These authors noted important differences between the two species they provisionally assigned to *Stintonius*, erected by Collins (2002). *Stintonius subovata* (Quayle and Collins, 1981) from the Lower Eocene of England, is most similar to the Mexican specimen in shape and size, however, the largest anterolateral spine is bigger and directed laterally, not anterolaterally, and it possesses tubercles on the metabranchial lobes, not seen in the Mexican specimen. According to Schweitzer and Feldmann (1999; 2000) and Collins (2002), *S. subovata* resembles morphological features of the genus *Montezumella* Rathbun, 1930, whose species are usually larger, have a more elongated carapace and more scabrous ornamentation. Inclusion of *Karasawaia* new genus into the Cheiragonidae is

based upon possession of a front with four lobes, small orbits delimited by small spines, orbital margin with one fissure, four anterolateral spines and posteriormost end of carapace rectangular in shape (Schweitzer and Salva, 2000; Karasawa and Schweitzer, 2004).

***Karasawaia markgrafi* (Lőrenthey, 1907[1909]) new combination**

(Fig. 3; Pl. 2, Fig. 13)

*Plagiolophus markgrafi* Lőrenthey, 1907[1909], p. 137, pl. 1, figs. 5a, 5b; Glaessner, 1929, p. 329.

*Stintonius markgrafi* (Lőrenthey, 1907[1909]). Karasawa and Schweitzer, 2004, p. 146, fig. 1.7.

**Description:** Carapace small, pentagonal, slightly wider than long, widest at anterior third; front with four lobes; orbits small, with single notch; orbital rim delimited by two small spines, innermost being slightly longer, one small orbital fissure; anterolateral margin short, inclined, with three small spines, and a posterior anterolateral larger spine, sharp, projected anterolaterally; posterolateral margin concave, devoid of spines, three-fifths the maximum carapace length; posterior margin straight, half the maximum carapace width; epigastric lobes small, circular, elevated; protogastric region semitriangular, with a prominent small ridge; mesogastric region subovate, with a process that reaches middle portion of epibranchial lobes; metagastric and urogastric regions indistinct; cardiac region rectangular, with strong transverse ridge that follows lateral strong metabranchial ridges; hepatic regions subrhombic, elevated, separated by a shallow ridge from oblique, rectangular epibranchial ridge; mesobranchial region indistinct; posterior third of carapace smooth, gently inclined to posterior margin.

**Material:** One specimen, IHNFG-3030, locality El Veinte, Lower Eocene, El Bosque Formation.

**Measurements:** Hypotype IHNFG-3030, carapace length = 10 mm, width = 10 mm.

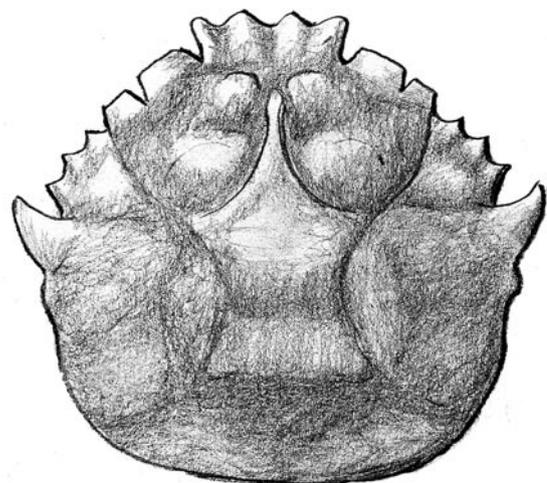


Fig. 3. Line drawing of *Karasawaia markgrafi* new combination.

*Discussion:* In a review of the species related to the genus *Glyphythereus* Reuss, 1859, Karasawa and Schweitzer (2004) placed *Plagiolophus markgrafi* Lőrenthey, 1907[1909] into the genus *Stintonius*, but also suggested that this species may belong to a different genus within the Cheiragonidae. *Karasawaia* new genus is herein erected to include the species *markgrafi* from the Eocene of Egypt (Lőrenthey, 1907[1909]), which is similar to the Mexican specimen in shape and size, the posterior third is rectangular, has four anterolateral spines; it is also widest at position of the posterior anterolateral spine, has the ridged ornamentation on gastric, cardiac and branchial regions.

Presence of *Karasawaia markgrafi* new combination, in the Lower Eocene of Chiapas represents an additional component of Tethyan influence in Southern Mexico during Eocene times.

Superfamily Carpilioidea Ortmann, 1893

Family Paleoxanthopsidae Schweitzer, 2003

Genus *Verrucoides* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001

*Type species:* *Verrucoides stenohedra* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001, by original designation.

***Verrucoides stenohedra* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001**

(Pl. 2, Fig. 14)

*Verrucoides stenohedra* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001, p. 942, figs. 17, 18.

*Description:* Carapace subhexagonal, wider than long; anterolateral margin with four spines, the three most anterior have similar shape and size, posteriormost spine much longer; epigastric, protogastric, mesogastric and cardiac regions defined by strong tubercles.

*Material:* Two specimens, IHNFG-3031, IHNFG-3032, locality El Veinte, Lower Eocene, El Bosque Formation.

*Measurements:* Hypotypes IHNFG-3031, carapace length = 14 mm, width = 14 mm; IHNFG-3032, carapace length = 13 mm, width = 15 mm.

*Discussion:* Presence of *Verrucoides* in the Lower Eocene of Chiapas confirms the influence from Greenland that occurred during Middle Paleocene–Early Eocene times in Mexico. *Verrucoides verrucoides* (Collins and Rasmussen, 1992) is reported from the Middle Paleocene of Greenland, and along with *Viapinnixa nodosa* (Collins and Rasmussen, 1992) represent two genera that migrated south to reach the southern portion of Mexico (see discussion in *Viapinnixa alvarezii* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001).

Superfamily Xanthoidea MacLeay, 1838

Family Pilumnidae Samouelle, 1819

Subfamily Eumedoninae Dana, 1852

Genus *Santeella* Blow and Manning, 1996

*Type species:* *Santeella lillyae* Blow and Manning, 1996, by monotypy.

***Santeella lillyae* Blow and Manning, 1996**

(Fig. 4; Pl. 2, Fig. 15)

*Santeella lillyae* Blow and Manning, 1996, p. 23, pl. 5, fig. 3.

*Description:* Carapace small, hexagonal, transversely flat, slightly wider than long, surface smooth; front wide, subrectangular, bifurcate, represents half the maximum carapace width; orbits large, concave, one third the carapace length each, with two fissures; anterolateral margin nearly straight, parallel to longitudinal axis, with four small lobes, posterior lobe slightly larger than others; posterolateral margin long, curved, half carapace length; posterior margin one-third carapace width. Epigastric regions small, rectangular, oblique; protogastric regions subtrapezoidal inverted; mesogastric region subpentagonal, with anterior process extended to front edge of protogastric regions. Other regions indistinct.

*Material:* One specimen, IHNFG-3033, locality El Veinte, Lower Eocene, El Bosque Formation.

*Measurements:* Hypotype IHNFG-3033, carapace length = 6 mm, width = 7 mm.

*Discussion:* The small specimen from Chiapas is similar in shape and size to *Santeella lillyae* Blow and Manning, 1996, from the Middle Eocene of South Carolina. The genus *Santeella* was considered a Xanthoidea *incertae sedis* by Karasawa and Schweitzer (2006), but we suggest its inclusion into the Pilumnidae, particularly into the Eumedoninae, based on anteriorly-projected, bilobed anterior margin, orbits with two fissures, and lobate anterolateral margin.

Within the Pilumnidae, several genera are similar to the Mexican specimen. *Eumorphactaea scissifrons* Bittner, 1875 from the Middle Eocene of Italy and *Halimede* De Haan, 1835 both have similar carapace shape to *Santeella lillyae*, however, both these genera have a carapace covered with granules, whereas *Santeella lillyae* has a smooth carapace. *Glabropilumnus* Balss, 1932 is also

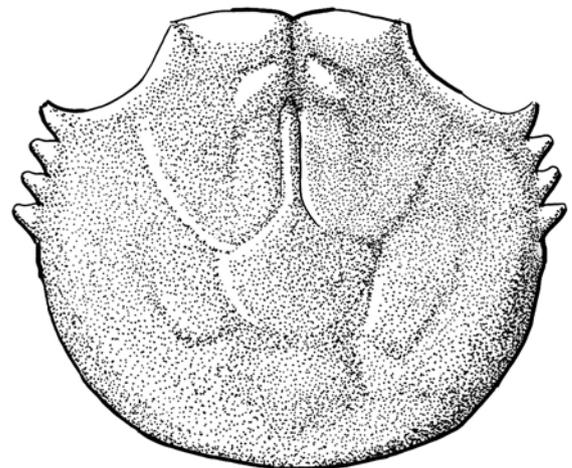


Fig. 4. Line drawing of *Santeella lillyae* Blow and Manning, 1996.

relatively similar to the Mexican specimen, however the carapace is much wider and hexagonal, and the anterolateral margin is more inclined and lacks the small lobes, as seen on recent species figured by Galil and Takeda (1988). The Mexican specimen also resembles a juvenile stage of *Medaeus* Dana, 1851 as illustrated by Crosnier (1967). However, the very small size reported for *S. lillyae* from South Carolina suggests that *S. lillyae* was relatively very small.

The species may have had its origin in the southern part of Mexico during the early Eocene, migrating north to the east coast of North America during middle Eocene times.

Family Panopeidae Ortmann, 1893

Subfamily Panopeinae Ortmann, 1893

Genus *Panopeus* H. Milne Edwards, 1834

*Type species: Panopeus herbstii* H. Milne Edwards, 1834, by subsequent designation ICZN Opinion 1282, 1984.

***Panopeus veintensis* new species**

(Fig. 5; Pl. 2, Fig. 16)

**Diagnosis:** Carapace subhexagonal, maximum width at midlength; front wide, semirectangular; anterolateral margin with four sharp spines; carapace regions separated by deep grooves; epigastric, protogastric, and hepatic regions with weak transverse ridges; posterior third of carapace smooth.

**Description:** Carapace small, subhexagonal, wider than long, widest at midlength, flattened in longitudinal section. Front wide, one-third maximum carapace width, subtrapezoidal inverted, with median ridge. Orbits oblique, with two open notches in supraorbital margin; supraorbital margin rimmed; orbital spine relatively small, triangular, anteriorly projected; fronto-orbital width equivalent to half the maximum carapace length. Anterolateral margin about half carapace length, with four spines; anterior spine short, sharp, immediate posterior spine also sharp and parallel to third spine, two-thirds its length, separated by a space that follows branchial groove, following posterior anterolateral spine tip rounded, last spine the largest, sharp, directed anterolaterally. Posterolateral

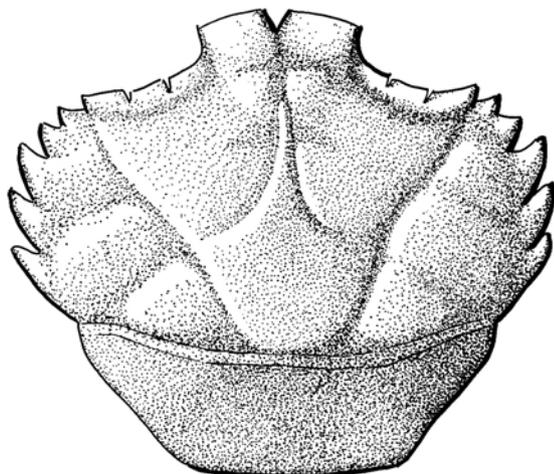


Fig. 5. Line drawing of *Panopeus veintensis* new species.

margin without spines, inclined posteriorly, about one-third carapace length. Posterior margin straight, about half maximum carapace width.

Dorsal surface of carapace smooth, regions defined by deep grooves. Epigastric regions subtrapezoidal, inclined, with anterior oblique ridges parallel to anterior margin of front; protogastric regions subtrapezoidal inverted, with weak ridges on anterior portion; mesogastric region triangular, widest part coincide with axis of maximum carapace width, with strong anterior process that reaches midlength of epigastric lobes; urogastric and cardiac regions separated by transverse ridge; cardiac and intestinal regions not well-defined; posterior third of carapace smooth, trapezoidal-inverted; hepatic region subtriangular, with a weak, posterolaterally-inclined ridge on anterior portion; epibranchial region semirectangular, with a median transverse ridge slightly inclined posterolaterally; branchial lobe triangular, inclined, delimited posteriorly by the transverse ridge that separates posterior third of carapace.

**Material:** One specimen, IHNFG-3034, locality El Veinte, Lower Eocene, El Bosque Formation.

**Measurements:** Holotype IHNFG-3034, carapace length = 11 mm, width = 13 mm.

**Etymology:** Species name refers to the El Veinte locality, an important Lower Eocene (Ypresian) fossiliferous outcrop in Chiapas, Southeastern Mexico.

**Discussion:** Casadío et al. (2005) offered a review of genera similar to *Panopeus*. The shape of carapace, anterolateral spines, distribution and shape of dorsal carapace regions, and shape of front suggests that the Mexican specimen belongs to *Panopeus*. *Panopeus veintensis* new species is different from known fossil species in being smaller, having a relatively strong transverse ridge on the posterior third of carapace, and being wider at midlength of carapace. *Panopeus pyramidensis* Casadío, Feldmann, Parras, and Schweitzer, 2005 from the Miocene of Argentina is also small, but the widest part of carapace is at the anterior third, cardiac and hepatic regions are well-defined, and hepatic region is ovate. *Panopeus bessmanni* Collins and Jakobsen, 2003 from the Lower Eocene of Denmark is also widest at midlength, but it has a dorsal surface ornamented with granules, cardiac and intestinal regions are well-defined, and hepatic region is larger. *Panopeus nanus* Portell and Collins, 2004 from the Miocene of Jamaica has more defined cardiac and intestinal regions, and the posterolateral margin is curved. *Panopeus prosakrolophos* Schweitzer, 2000 from the Oligocene of Washington has similar anterolateral spines, but is wider at the anterior third of carapace, has defined cardiac and intestinal regions, and stronger ridges on hepatic, epigastric and protogastric regions. *Panopeus torus* Schweitzer, 2000 has much stronger anterolateral spines and a carapace covered by strong granules. *Panopeus olearis* (Rathbun, 1926) from the Oligocene of Alaska is wider at the anterior third of carapace, has longer posterolateral margins, and well-defined cardiac and intestinal regions. *Panopeus soldadensis* (Rathbun, 1926) from the Eocene of

California is also wider at the anterior third of carapace, has shorter anterolateral spines, and much longer posterolateral margins. *Panopeus baldwini* (Kooser and Orr, 1973) from the Eocene of Oregon has a carapace widest in the anterior third. *Panopeus* sp. from the Miocene of France (Artal and Gilles, 2007) is similar to the Mexican specimen, however the cardiac region is more defined and the epigastric regions are wider.

The report of *P. veintensis* new species extends the paleobiogeographic range for the genus during early Eocene times, and although the genus had a wide distribution, morphological affinities of the new species are closer with Eocene species from the West Coast of North America.

Superfamily Goneplacoidea MacLeay, 1838

Family Euryplacidae Stimpson, 1871

Genus *Orbitoplax* Tucker and Feldmann, 1990

*Type species: Orbitoplax plafkeri* Tucker and Feldmann, 1990, by original designation.

***Orbitoplax nandachare* (Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001), new combination**

(Fig. 6; Pl. 2, Fig. 17; Pl. 3, Figs. 1–3)

*Stoaplax nandachare* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001, p. 940, figs. 15, 16.

*Description:* Carapace small, subhexagonal, vaulted longitudinally and transversely, one-third wider than long, greatest width on anterior third. Front projected, with a middle sulcus, one fourth the maximum carapace width; orbito-frontal margin two-thirds maximum carapace width, orbital margins concave, one-eighth maximum carapace width; orbital spine strong, projected half the length of front. Anterolateral margin inclined to front, one-fourth maximum carapace length, with small spine near anterolateral spine, which is perpendicular to longitudinal axis; posterolateral margin inclined to posterior margin, slightly curved; posterior margin straight, half maximum carapace width.

Carapace covered by fine granules; cervical groove deep; regions swollen; epigastric lobes small, semicircular; protogastric lobes

suboval, large; mesogastric region subpentagonal, mesogastric process extended to epigastric lobes; metagastric and urogastric regions not well-defined, cardiac region subhexagonal; hepatic lobes semioval, swollen; mesobranchial lobes semirectangular, slightly inclined posterolaterally; metabranchial lobes shallow, subtriangular.

*Material:* Sixteen specimens, IHNFG-3035 to IHNFG-3050, locality El Veinte, Lower Eocene, El Bosque Formation.

*Measurements:* Hypotypes IHNFG-3035, carapace length = 10 mm, width = 13 mm; IHNFG-3036, carapace length = 8 mm, width = 9 mm; IHNFG-3037, carapace length = 9 mm, width = 12 mm; IHNFG-3038, carapace length = 8 mm, width = 10 mm. Remainder specimens deformed or fragmented.

*Discussion:* In the original description for *Stoaplax*, Vega et al. (2001b) acknowledged similarities of that genus with *Orbitoplax*. The main differences were: the position of widest portion of carapace at mid-length; antero and posterolateral margins more convex; the presence of pronounced gastric swellings; frontal margin more projected; and orbits more deeply excavated in *Stoaplax*. The single specimen used to propose the new genus and species is incomplete, when compared with the new specimens, which include all of the diagnostic features described by Tucker and Feldmann (1990) for *Orbitoplax*. The three *Orbitoplax* species described from the West Coast of North America are more wider than long when compared with the Mexican species. *Orbitoplax plafkeri* from the Upper Eocene–Lower Oligocene of Alaska is slightly larger, has a stronger anterolateral spine, and the orbital margins are proportionally wider than in *O. nandachare*. *Orbitoplax weaveri* (Rathbun, 1926) from the Eocene of California and Oregon has a larger, more rectangular carapace, has two anterolateral spines as compared to one anterolateral spine in *O. nandachare*, and the orbital margin is proportionally much wider. One specimen of *O. weaveri* from the Eocene Lookingglass Formation of Oregon is here illustrated (Pl. 2, Fig. 18), in order to compare the morphology with *O. nandachare*. *Orbitoplax tuckerae* Schweitzer, 2000 from the Upper Eocene of Washington is also larger, its anterolateral spine is not perpendicular to the longitudinal axis, and the orbital margins are also proportionally larger.

We agree with Schweitzer (2000) in that *Orbitoplax* evolved during the Eocene and migrated northward along the Pacific Coast of North America. *Orbitoplax nandachare* documents the origin of the genus in the Central America region, and migration to the north by the end of the Eocene.

*Orbitoplax* was classified into the subfamily Euryplacinae by Karasawa and Kato (2003), and subsequently Karasawa and Schweitzer (2006) elevated the Euryplacinae to the family rank.

Superfamily Portunoidea Rafinesque, 1815

Family Mathildellidae Karasawa and Kato, 2003

Genus *Tehuacana* Stenzel, 1944

*Type species: Tehuacana tehuacana* Stenzel, 1944, by original designation.

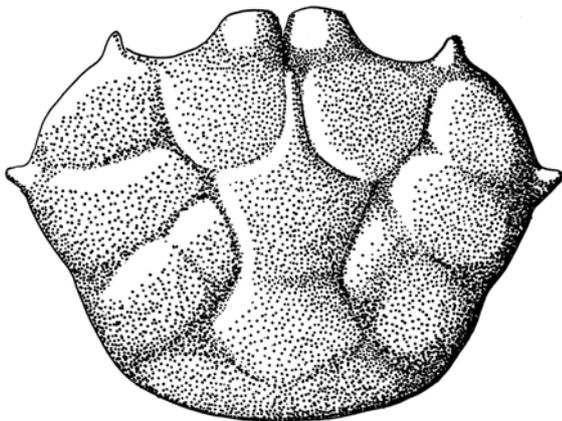


Fig. 6. Line drawing of *Orbitoplax nandachare* new combination.

***Tehuacana schweitzeriae* new species**

(Fig. 7; Pl. 3, Figs. 4–6, 8, 9)

**Diagnosis:** Carapace small, suboval, widest at anterior third; front wide, one-third maximum carapace width; orbits relatively small, concave; anterolateral margin short, with three small lobes; posterolateral margin devoid of spines, smooth; posterior margin narrow, bilobed; dorsal carapace regions well-defined by prominent bosses, with smooth interspaces; mesogastric, cardiac, meso and metabranchial bosses most prominent.

**Description:** Carapace small, suboval, slightly longer than wide, widest at anterior third, concave in transverse section; front with median fissure, slightly projected from orbits; orbits relatively small, concave, outer orbital spine small; anterolateral margin with three small round-tipped spines, all about same size; posterolateral margin as long as anterolateral, devoid of spines; posterior margin bilobed, projected, one third maximum carapace width and one sixth its length; carapace regions distinct, marked by strong and prominent bosses with small granules at top; intermediate spaces smooth; protogastric region marked by pronounced, oval, bosses inclined toward carapace front; mesogastric boss the strongest, circular, with anterior process extending to anterior portion of protogastric bosses; metagastric and urogastric regions indistinct, positioned at depression between mesogastric and cardiac bosses; prominent, transversely ovate boss on cardiac region; hepatic boss relatively small, semitriangular; intestinal area depressed to a low platform than continues posteriorly to the bilobed projection of posterior margin; mesobranchial boss slightly smaller than mesogastric boss, circular, positioned at central third of carapace; metabranchial lobe semicircular, continued with posterolateral margin.

**Material:** Five specimens, IHNFG-3051 to IHNFG-3055, locality El Veinte, Lower Eocene, El Bosque Formation.

**Measurements:** Holotype IHNFG-3051, carapace length = 13

mm, width = 12 mm. Paratypes IHNFG-3052, carapace length = 10 mm, width = 6 mm; IHNFG-3053, carapace length = 9 mm, width = 9 mm; IHNFG-3054, carapace length = 10 mm, width = 9 mm; IHNFG-3055, carapace length = 5 mm, width = 5 mm.

**Etymology:** The new species is dedicated to Dr. Carrie E. Schweitzer, prominent paleontologist and specialist in Tertiary decapod crustaceans.

**Discussion:** The new species from Chiapas is similar in shape and distribution of regions to *Tehuacana tehuacana* Stenzel, 1944 from the Paleocene of Texas, Alabama and Northeastern Mexico (Vega et al. 2003; 2007) (Pl. 3, Fig. 7). However, the specimens from Chiapas tend to be much smaller, and although the carapace is slightly compressed laterally, it is slightly longer than wide. The anterolateral lobes are stronger in *T. tehuacana*, and there are four, instead of three as in *T. schweitzeriae* new species. Another similar species is *Marydromilites americana* (Rathbun, 1935) from the Paleocene of Alabama, placed within uncertain familial affinity by Števčić (2005), which has similar carapace shape and size, and strong bosses on dorsal carapace. However, its three anterolateral spines are much stronger, and the posterior margin appears to be narrower. This species should be reviewed, as it is different from members of the Dromiidae De Haan, 1833. Based on the identical shape and distribution of the dorsal carapace regions, it could be placed into the Mathildellidae, as possibly a new genus. Lateral compression seen in specimens of *T. schweitzeriae* new species is also noticeable on specimens of *Marydromilites americana* figured by Rathbun (1935, pl. 17, figs. 3–5), but the shape of the carapace for both species appears to be longitudinally oval.

Presence of *T. schweitzeriae* new species in Lower Eocene beds of Southeastern Mexico, confirms the paleobiogeographic influence of the Southeast coast of North America. The genus may have had its origin in the Paleocene coasts of Texas and Alabama, and then migrated south to develop in the early Eocene coast of Chiapas.

## Family Portunidae Rafinesque, 1815

**Portunidae**

(Pl. 3, Fig. 10)

**Description:** Left palm of medium size, outer surface reticulated, with two longitudinal ridges; lower margin with a longitudinal ridge that extends from the proximal part of palm to the base of fixed finger.

**Material:** One specimen, IHNFG-3056, locality Mesa de Copoya, Middle Eocene, San Juan Formation.

**Measurements:** Hypotype IHNFG-3056, left palm length = 23 mm, height = 8 mm.

**Discussion:** This is the first report of portunids from the Eocene localities of Chiapas, Southeastern Mexico. The shape of the palm is similar to one found in species of *Portunus*, but more complete material is needed to define its systematic placement beyond the family level. The Mexican specimen is similar to the one reported by Schweitzer et al. (2006b) as *Portunus* sp. 1 (fig. 4D), from the

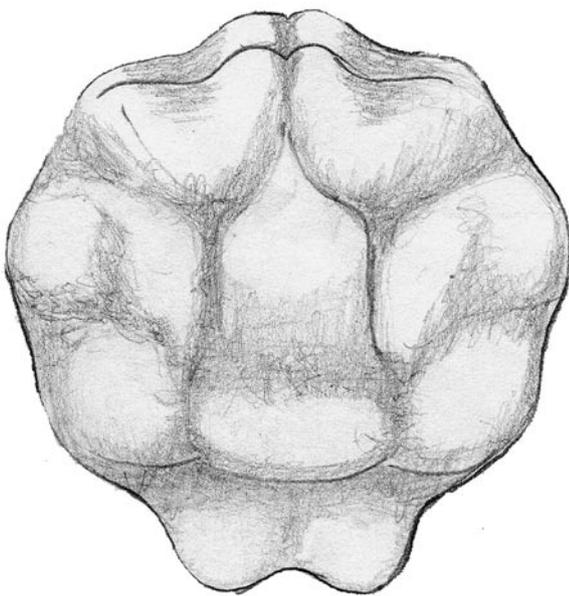


Fig. 7. Line drawing of *Tehuacana schweitzeriae* new species.

Miocene of Dominican Republic.

Subfamily Carcininae MacLeay, 1838

Genus *Xaiva* MacLeay, 1838

***Xaiva?* sp.**

(Pl. 3, Figs. 11, 12)

**Description:** Carapace small, subpentagonal, nearly as wide as long, flat transversely; anterolateral margin inclined, with four small spines; posterior third rectangular; posterior margin straight, half the maximum carapace width; dorsal surface ornamented with small tubercles of uniform size as well as deep grooves.

**Material:** One specimen, IHNFG-3057, locality Mesa de Copoya, Middle Eocene, San Juan Formation.

**Measurements:** Hypotype IHNFG-3057, carapace length = 9 mm, width = 11 mm.

**Discussion:** The poor preservation of the single specimen prevents placement beyond genus level. The four, sharp anterolateral spines, and the general shape of the carapace suggest that it may belong to the Portunidae. The shape of the carapace and four anterolateral spines make this specimen similar to "*Xaiva*" *bachmayeri* Müller, 1984 from the Miocene of Hungary. However, the granulose dorsal surface is not observed in species of this genus, and thus the Mexican specimen is questionably assigned to the genus *Xaiva*. We consider important to include it as it represents an additional component to the Middle Eocene assemblage from Chiapas.

Superfamily Pinnotheroidea De Haan, 1833

Family Pinnotheridae De Haan, 1833

Genus *Viapinnixa* Schweitzer and Feldmann, 2001

**Type species:** *Pinnixa (Paleopinnixa) nodosa* Collins and Rasmussen, 1992, by original designation and monotypy.

***Viapinnixa alvarezii* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001**

(Pl. 3, Figs. 13–15)

*Viapinnixa alvarezii* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001, p. 943, figs. 19, 20.

**Description:** Carapace subtrapezoidal, wider than long, flattened transversely. Maximum carapace width within lower third. Anterolateral margins represent one-fourth carapace length, straight and inclined towards fronto-orbital margin, which is half maximum width of carapace. Eyes pedunculated, ovoid, fill four-fifths orbits, with median, small notch on upper margin; rostrum bifid, semiquadrate, wider at its distal portion. A small spine divides anterolateral from posterolateral margins; posterolateral margin straight, slightly inclined towards anterior margin; posterior margin separated from posterolateral margin by short, concave margin; straight posterior margin represents four-fifths maximum carapace width. Carapace regions defined in original description.

**Material:** Five specimens, IHNFG-3058 to IHNFG-3062,

locality El Veinte, Lower Eocene, El Bosque Formation.

**Measurements:** Hypotypes IHNFG-3058, carapace length = 12 mm, width = 18 mm; IHNFG-3059, carapace length = 11 mm, width = 17 mm; IHNFG-3060, front width = 14 mm. Remainder of specimens are incomplete.

**Discussion:** Differences between *Viapinnixa alvarezii* and *V. nodosa* (Collins and Rasmussen, 1992) from the Paleocene of Greenland were explained by Vega et al. (2001b). Specimens of *Viapinnixa perrillii* Vega, Nyborg, Fraaije, and Espinosa, 2007, from the Paleocene of Northeastern Mexico (Pl. 3, Fig. 16) are widest at carapace middle, and anterolateral margins are curved (Vega et al., 2003; 2007). *Viapinnixa alvarezii* represents the youngest occurrence for the genus. *Viapinnixa* had its origin during early Paleocene in Greenland, then migrated to the southeast coast of North America by late Paleocene times, and finally reached the coasts of southern Mexico during the early Eocene.

**Paleobiogeography**

Dispersal patterns and possible places of origin for fossil decapod crustacean taxa during Eocene times were explained by Schweitzer et al. (2002), in particular for what they called the central Americas, including present day Chiapas. New data of occurrences presented herein confirm migratory pattern routes as suggested by these authors. We will only emphasize the inferred migratory patterns, based on the new data presented in this work.

**Lower Eocene:** The most diverse assemblage reported herein comes from the El Bosque Formation, El Veinte locality, with sediments deposited during early Eocene times (Perrilliat et al., 2006). Four main paleobiogeographic influences can be recognized during this time for this locality. The Tethyan components include *Notopoides exiguus* and *Karasawaia markgrafi* new combination, from Italy and Egypt, respectively. The North Atlantic component is represented by *Raninoides treldenaesensis*, *Verrucoides stenoedra*, and *Viapinnixa alvarezii*, from Denmark and Greenland, respectively. Species from the Paleocene of Greenland migrated south, to reach the Paleocene coast of Northeastern Mexico by late Paleocene times, and finally arriving in southern Mexico by early Eocene times (Schweitzer et al., 2002). The Pacific Coast component is represented by *Neocallichirus* sp. cf. *N. rhinos*, *Ranina berglundii*, *Panopeus veintensis* new species, and *Orbitoplax nandachare* new combination, both with affinities to species from the Eocene and Oligocene of Baja California Sur (Mexico), California, Oregon and Alaska. Two other components are related with southeast North America; *Tehuacana schweitzeriae* new species is related to the Paleocene *Tehuacana tehuacana* from Texas, Alabama, and Coahuila, Northeastern Mexico, and *Santeella lillyae* from the Middle Eocene of South Carolina. According to the new data, *S. lillyae* had its origin in southern Mexico, and then migrated northeast, while the genus *Tehuacana* may have originated in Southeastern North America and subsequently migrated southwest.

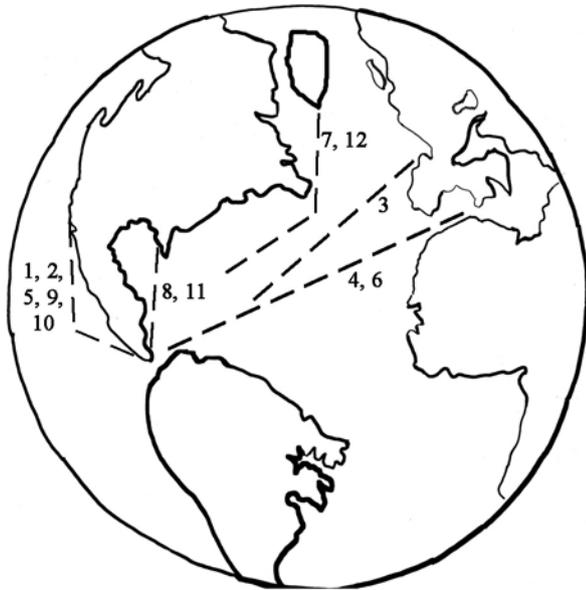


Fig. 8. Early Eocene paleogeography with probable migratory routes, based on taxa reported in this study: 1 = *Neocallichirus* sp. cf. *N. rhinos* 2 = *Ranina berglundii*, 3 = *Raninoides tredenaesensis*, 4 = *Notopoides exiguus*, 5 = *Calappilia hondoensis*, 6 = *Karasawaia markgrafi* new combination, 7 = *Verrucoides stenoedra*, 8 = *Santeella lillyae*, 9 = *Panopeus veintensis* new species, 10 = *Orbitoplax nandachare* new combination, 11 = *Tehuacana schweitzerae*, 12 = *Viapinnixa alvarezii*.

Middle Eocene: The crustacean remains found at the Mesa de Copoya locality, San Juan Formation, Middle Eocene, are usually fragmentary and not as diverse as the ones found at El Veinte. Here, the main paleobiogeographic affinity is with the Pacific Coast, with *Calappilia hondoensis* from the Lower Eocene of Baja California Sur, and *Lophoranina cristaspina*, whose morphology is close to *L. bishopi* Schweitzer, Feldmann, Gonzáles-Barba, and Vega, 2002, also from Baja California Sur. A paleogeographic map with suggested migratory routes for the taxa described herein is presented in Fig. 8.

### Acknowledgments

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### References

- Allison, R. C. (1967), *The Cenozoic stratigraphy of Chiapas, México, with discussions on the classification of the Turrillidae and selected Mexican representatives*. Unpublished Ph. D. dissertation, University of California, Berkeley, 225 p.
- Artal, P. and A. Gilles (2007), New Miocene crabs from Pignan (France). *Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, 35(2), 8–11.
- Balss, H. (1932), Über einige systematisch interessante Xanthidae (Custacea Decapoda Brachyura) der Harmsschen reisen nach dem Sundaarchipel. *Zeitschrift der Wissenschaftliche Zoologie*, 142, 510–519.
- Beschin, C., A. Busulini, A. De Angeli, and G. Tessier (1988), Raninidae del Terziario Berico-Lessineo (Italia settentrionale). *Lavori, Società Veneciana di Scienze Naturali*, 13, 155–215.
- Beschin, C., A. Busulini, A. De Angeli, and G. Tessier (2002), Aggiornamento ai crostacei eocenici di Cava "Main" di Arzignano (Vicenza – Italia Settentrionale) (Crustacea, Decapoda). *Studi e Ricerche – Associazione Amici del Museo – Museo Civico "G. Zannato" Montecchio Maggiore (Vicenza)*, 7 –28.
- Bittner, A. (1875), Die Brachyuren des Vicentinischen Tertärgebirges. *Denkschriften der Kaiserlichen Akademie der Wissenschaften in Wien*, 34, 63–106.
- Blow, W. C. and R. B. Manning (1996), Preliminary descriptions of 25 new decapod crustaceans from the Middle Eocene of the Carolinas, U. S. A. *Tulane Studies in Geology and Paleontology*, 29, 1–26.
- Böhm, J. (1922), Arthropoda, Crustacea, In Martin, K (ed.), *Die Fossilien von Java. 1 Bildung. 2 Abteilung. Sammlungen des Geologischen Reichs-Museums in Leiden*. p. 521–538, pl. 63.
- Burckenroad, M. D. (1963), The evolution of the Eucarida (Crustacea, Eumalacostraca), in relation to the fossil record. *Tulane Studies in Geology*, 2, 3–17.
- Casadío, S., R. M. Feldmann, A. Parras, and C. E. Schweitzer (2005), Miocene fossil Decapoda (Crustacea: Brachyura) from Patagonia, Argentina, and their paleoecological setting. *Annals of Carnegie Museum*, 74(3), 151–188.
- Collins, J. S. H. (2002), A taxonomic review of British decapod Crustacea. *Bulletin of the Mizunami Fossil Museum*, 29, 81–92.
- Collins, J. S. H. and S. L. Jakobsen (2003), New crabs (Crustacea, Decapoda) from the Eocene (Ypresian/Lutetian) Lillebælt Clay Formation of Jutland, Denmark. *Bulletin of the Mizunami Fossil Museum*, 30, 63–96.
- Collins, J. S. H. and W. Rasmussen (1992), Upper Cretaceous–Lower Tertiary decapod crustaceans from West Greenland. *Grønlands Geologiske Undersøgelse, Bulletin*, 162, 1–46.
- Crosnier, A. (1967), Remarques sur quelques crustacés décapodes benthiques ouest-africains. Description de *Heteropanope acanthocarpus* et *Medaeus rectifrons* spp. nov. *Bulletin du Muséum National d'Histoire Naturelle, 2<sup>e</sup> Série*, 39(2), 320–344.
- Dana, J. D. (1851), Conspectus Crustaceorum quae in Orbis Terrarum circumnavigatione, Carolo Wilkes e Classe Republicae Foederatae Duce, lexit et descripsit. *Proceedings of the Academie of Natural Sciences of Philadelphia*, 5, 267–272.
- Dana, J. D. (1852), Crustacea. Part 1. In *United States exploring expedition during the years 1838, 1839, 1840, 1841, 1842 under command of Charles Wilkes U. S. N.*, 13, I–VIII, 1–685.
- Dawson, E. W. and J. C. Yaldwyn (2002), Extension of range of

- Notopoides latus* Henderson, 1888 (Brachyura: Raninidae) to the eastern South Pacific, with a correction to its original figured shape. *Journal of Crustacean Biology*, 22(1), 201–205.
- De Angeli, A. and C. Beschin (2001), I Crostacei fossili del territorio Vicentino. *Natura Vicentina*, 5, 5–54.
- Fabiani, I. (1910), I crostacei terziarii del Vicentino. *Bolletino del Museo Civico de Vicenza*, I(1), 1–40.
- Feldmann, R. M. and P. W. Duncan (1992), Eocene decapod crustaceans from Snowdrift Quarry, South Otago, New Zealand. *New Zealand Journal of Geology and Geophysics*, 35, 455–461.
- Feldmann, R. M. and P. A. Maxwell (1990), Late Eocene decapod Crustacea from North Westland, South Island, New Zealand. *Journal of Paleontology*, 64(5), 779–797.
- Feldmann, R. M., F. J. Vega, A. B. Tucker, P. García-Barrera, and J. Avendaño (1996), The oldest record of *Lophoranina* (Decapoda: Raninidae) from the Late Cretaceous of Chiapas, Southeastern Mexico. *Journal of Paleontology*, 70(2), 303–311.
- Ferrusquía-Villafranca, I. (1996), Contribución al conocimiento geológico de Chiapas – el área de Istapa-Soyaló, México. *Universidad Nacional Autónoma de México, Instituto de Geología, Boletín*, 109, 1–130.
- Frost, S. H. and R. L. Langenheim (1974), *Cenozoic Reef Biofacies; Tertiary larger Foraminifera and scleractinian corals from Chiapas, México*. Northern Illinois University Press, De Kalb, 388 p.
- Galil, B. and M. Takeda (1988), A revision of the genus *Glabropilum* (Crustacea, Decapoda, Brachyura). *Bulletin of the National Science Museum, Tokyo, Series A*, 14(2), 67–90.
- Glaessner, M. F. (1929), *Fossilium Catalogus I: Animalia, pars 41. Crustacea decapoda*. 464 p. Berlin.
- Glaessner, M. F. (1960), The fossil decapod Crustacea of New Zealand and the evolution of the Order Decapoda. *New Zealand Geological Survey paleontological bulletin*, 31, 1–78.
- Guinot, D. (1977), Propositions pour une nouvelle classification des Crustacés Décapodes Brachyours. *Compte Rendu Académie des Sciences Paris, série D*, 285, 1049–1052.
- Haan, W. de. (1833–1850), Crustacea. In P. F. Von Siebold, *Fauna Japonica sive descriptio animalium, quae itinere in Japoniam, jussu et auspiciis superiorum, qui summum in India Batava Imperium tenent, suscepto, annis 1823–1830, collegit, notis, observationibus et adumbrationibus, illustravit*, ix–xvi, I–xxxi, vii–xvii + 243 p., pl. A–Q, 1–55, circ. 2, A. Arnz, Lugdunum Batavorum.
- Henderson, J. R. (1888), Report on the Anomura collected by H. M. S. Challenger during the years 1863–1876. *Report on the Scientific Results of the Exploration. Voyage HMS Challenger. Zoology*, 27(1), 1–221.
- Hernández-Monzón, O., F. J. Vega, and M. A. Coutiño (2007), A review of *Lophoranina cristaspina* from the Middle Eocene of Chiapas, México and evolutionary implications. *Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, 35(2), 56–58.
- Karasawa, H. and H. Kato (2003), The family Goneplacidae MacLeay, 1838 (Crustacea: Decapoda: Brachyura): systematics, phylogeny, and fossil records. *Paleontological Research*, 7(2), 129–151.
- Karasawa, H. and C. E. Schweitzer (2004), Revision of the genus *Glyphithyreus* Reuss, 1859 (Crustacea, Decapoda, Brachyura, Xanthoidea) and recognition of a new genus. *Paleontological Research*, 8(3), 143–154.
- Karasawa, H. and C. E. Schweitzer (2006), A new classification of the Xanthoidea *sensu lato* (Crustacea: Decapoda: Brachyura) based on phylogenetic analysis and traditional systematics and evaluation of all fossil Xanthoidea *sensu lato*. *Contributions to Zoology*, 75(1–2), 23–73.
- Kooser, M. A. and W. N. Orr (1973), Two new decapod species from Oregon. *Journal of Paleontology*, 47, 1044–1046.
- Lamarck, J. B. P. A. de. (1801), *Système des animaux sans vertèbres, ou tableau générale des classes, des ordres, et des genres de ces animaux; présentant leurs caractères essentiels et leur distribution, d'après la considération de leurs rapports naturels et de leur organisation, et suivant l'arrangement établi dans les galeries du Muséum d'Histoire Naturelle, parmi leurs dépouilles conservées; précédé du discours d'ouverture du cours de zoologie, donné dans le Muséum national d'Histoire naturelle l'an 8 de la République*. Paris, 432 p.
- Latreille, P. A. (1802–1803), *Histoire naturelle, general et particulière des crustacés et des insectes*. Volume 3. F. Dufart, Paris, 468 p.
- Latreille, P. A. (1825), *Histoire Naturelle, générale et particulière, des crustacés et des insectes*. Vol. 6. F. DuFart. Paris, 391 p.
- Latreille, P. A. (1831), *Cours d'Entomologie, ou de l'histoire naturelle des Crustacés, des Arachnides, des Myriapodes et des Insectes; à l'usage des élèves de l'école du Muséum d'histoire naturelle Annales I*. Paris, Roret, 568 p.
- Linnaeus, C. (1758), *Systema Naturae per Regna Tria Naturae, Secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis*. Edition 10, 1, 824 p.
- Lórenthey, E. (1907[1909]), Beiträge zur Kenntnis der cozän Dekapoden fauna Aegyptens. *Mathematisch-Naturwissenschaftliche Berichte aus Ungarn (Budapest)*, 25, 106–152.
- Lórenthey, E. and K. Beurlen (1929), Die fossilen decapoden der Länder der Ungarischen Krone. *Geologica Hungarica, Series Palaeontologica, Fasciculus*, 3, 1–420.
- MacLeay, W. S. (1838), On the Brachyurous Decapod Crustacea brought from the Cape by Dr. Smith. In, *Illustrations of the Annulosa of South Africa; being a portion of the objects of Natural History chiefly collected during an expedition into the interior of South Africa, under the direction of Dr. Andrew Smith, in the years 1834, 1835 and 1836; fitted out by "The Cape of Good Hope Association for Exploring Central Africa"*. London, 53–71.
- Manning, R. B. and D. L. Felder (1991), Revision of the American Callianassidae (Crustacea: Decapoda: Thalassinidea). *Proceedings of the Biological Society of Washington*, 104, 764–792.
- Martin, J. W. and G. B. Davis (2001), An updated classification of the recent Crustacea. *Natural History Museum of Los Angeles County, Scientific Series*, 39, 1–124.
- Milne Edwards, A. (1873), Descriptions desquelques crustacés nouveaux ou peu connus provenant du Musée de M. C. Godeffroy. *Journal du Muséum Godeffroy*, 1, 77–88.
- Milne Edwards, H. (1834–1840), *Histoire naturelle des Crustacés comprenant l'anatomie, la physiologie et la classification des ces animaux*. Roret's Suite à Buffon, 1 (1834), 1–468; 2 (1837), 1–532; 3 (1840), 1–638.
- Müller, P. (1984), Decapod Crustacea from the Badenian. *Geologica Hungarica, Series Palaeontographica*, 42, 1–317.
- Nyborg, T., L. M. Garibay-Romero, F. Vega, J. Fam, and A. Bland (2003), Assessment and expansion of the fossil decapod crustacean genus *Ranina* of the Northeastern Pacific Ocean. *Geological Society of America Abstracts with Programs*, 35, 6, p. 57.
- Olivier, G. A. (1811), Histoire Naturelle. Insectes. VIII. In, *Encyclopédie Méthodique (Dictionnaire Encyclopédique Méthodique)*.

*Zoology* 8. Liège, Paris, 722 p.

- Ortmann, A. E. (1892), Die Dekapoden-Krebse des Strassburger Museums, V Teil. Die abtheilungen Hippidae, Dromiidae, und Oxytomata. *Zoologische Jahrbucher, Abteilung für Systematik, Geographie un Biologie der Tiere*, 6, 532–588.
- Ortmann, A. E. (1893), Die Dekapoden-Krebse des Strassburger Museums, VII Teil. Abteilung: Brachyura (Brachyura genuine Boas). II. Unterabtheilung: Cancroidea, 1. Gruppe: Cyclometopa. *Zoologische Jahrbucher, Abteilung für Systematik, Geographie un Biologie der Tiere*, 7, 411–495.
- Paulson, O. (1875), *Studies on the Crustacea of the Red Sea with notes regarding other seas. Pt. I. Podophthalmata and Edriophthalmata (Cumacea)*. S. V. Kul'zhenko, 83, Malo-Zhitomirskaya St., Kiev. Translation published for the National Science Foundation, Washington, D. C., and The Smithsonian Institution, USA, by the Israel Program for Scientific Translations, 1961, 164 p.
- Perrilliat, M. C., J. Avendaño, and F. J. Vega (2003), Middle Eocene Cypraeoideans from the San Juan Formation, Chiapas, Mexico. *Revista Mexicana de Ciencias Geológicas*, 20(1), 41–51.
- Perrilliat, M. C., J. Avendaño, F. J. Vega, and J. Solé (2006), Lower Eocene gastropods from El Bosque Formation, central Chiapas, México. *The Veliger*, 48(3), 37–55.
- Portell, R. W. and J. S. H. Collins (2004), Decapod crustaceans of the Lower Miocene Montpelier Formation, White Limestone Group of Jamaica. *Cainozoic Research*, 3(1–2), 109–126.
- Quayle, W. J. and J. S. H. Collins (1981), New Eocene crabs from the Hampshire Basin. *Palaeontology*, 24, 733–758.
- Rafinesque, S. C. S. (1815), *Analyse de la Nature, ou tableau de l'univers et des corps organisés. L'Imprimerie de Jean Barravecchia*. Palermo, Italy, 1–224.
- Rathbun, M. J. (1926), The fossil stalk-eyed Crustacea of the Pacific Slope of North America. *United States National Museum, Bulletin*, 138, 1–155.
- Rathbun, M. J. (1928), Two new crabs from the Eocene of Texas. *Proceedings of the United States National Museum*, 73(6), 1–6.
- Rathbun, M. J. (1930), Fossil decapod crustaceans from Mexico. *Proceedings of the United States National Museum*, 78, 1–10.
- Rathbun, M. J. (1935), Fossil Crustacea of the Atlantic and Gulf Coastal Plain. *Geological Society of America, Special Papers*, 2, 1–160.
- Reuss, A. (1859), Zur Kenntnis Fossiler Krabben. *Denkschriften der Kaiserlichen Akademie der Wissenschaft in Wien*, 17, 1–90.
- Sakai, K. (1988), A new genus and five new species of Callianassidae (Crustacea: Decapoda: Thalassinidea) from northern Australia. *The Beagle, Records of the Northern Territory Museum of Arts and Sciences*, 5, 51–69.
- Samouelle, G. (1819), *The entomologist's useful compendium, or an introduction to the knowledge of British insects*. London. 1–486.
- Schweitzer, C. E. (2000), Tertiary Xanthoidea (Crustacea: Decapoda: Brachyura) from the West Coast of North America. *Journal of Crustacean Biology*, 20(4), 715–742.
- Schweitzer, C. E. (2003), Utility of proxy characters for classification of fossils: an example from the fossil Xanthoidea (Crustacea: Decapoda: Brachyura). *Journal of Paleontology*, 77, 911–932.
- Schweitzer, C. E. and R. M. Feldmann (1999), Fossil decapod crustaceans of the late Oligocene to early Miocene Pysht Formation and late Eocene Quimper Sandstone, Olympic Peninsula, Washington. *Annals of Carnegie Museum*, 68, 215–273.
- Schweitzer, C. E. and R. M. Feldmann (2000), New fossil Portunids from Washington, USA, and Argentina, and a re-evaluation of generic and family relationships with the Portunoidea Rafinesque, 1815 (Decapoda: Brachyura). *Journal of Paleontology*, 74(4), 636–653.
- Schweitzer, C. E. and R. M. Feldmann (2001), Differentiation of the fossil Hexapodidae Miers, 1886 (Decapoda: Brachyura) from similar forms. *Journal of Paleontology*, 75(2), 330–345.
- Schweitzer, C. E. and R. M. Feldmann (2002), New Eocene decapods (Thalassinidea and Brachyura) from southern California. *Journal of Crustacean Biology*, 22(4), 938–967.
- Schweitzer, C. E., R. M., Feldmann, G. González-Barba, and V. Čosović (2006a), New Decapoda (Anomura, Brachyura) from the Eocene Bateque and Tepetate formations, Baja California Sur, México. *Bulletin of the Mizunami Fossil Museum*, 33, 21–45.
- Schweitzer, C. E., R. M. Feldmann, G. González-Barba, and F. J. Vega (2002), New crabs from the Eocene and Oligocene of Baja California Sur, Mexico, and an assessment of the evolutionary and paleobiogeographic implications of Mexican fossil decapods. *Journal of Paleontology*, 76 (Supplement to number 6), 43 p.
- Schweitzer, C. E., G. González-Barba, R. M. Feldmann, and D. A. Waugh (2005), Decapoda (Thalassinidea and Paguroidea) from the Eocene Bateque and Tepetate formations, Baja California Sur, México: Systematics, Cuticle microstructure and Paleocology. *Annals of Carnegie Museum*, 74(4), 275–293.
- Schweitzer, C. E., M. Iturralde-Vinent, J. L. Hetler, and J. Vélez-Juarbe (2006b), Oligocene and Miocene decapods (Thalassinidea and Brachyura) from the Caribbean. *Annals of Carnegie Museum*, 75(2), 111–136.
- Schweitzer, C. E. and E. W. Salva (2000), First recognition of the Cheiragonidae (Decapoda) in the fossil record and a comparison of the family with the Ateleyclidae. *Journal of Crustacean Biology*, 20, 285–298.
- Serène, R. and A. F. Umali (1972), The family Raninidae and other new and rare species of brachyuran decapods from the Phillipines and adjacent regions. *The Phillipine Journal of Science*, 99(1–2), 21–105.
- Serrano-Sánchez, M. L., F. J. Vega, and N. Bruce (2006), Isopod (Crustacea, Peracarida) from the Cretaceous (Albian) of Chiapas, southern Mexico: systematic and paleoecologic implications. *Geological Society of America, Annual Meeting, Abstracts and Program, CD, Paper 23–27*.
- Squires, R. L. and R. A. Demetron (1992), Paleontology of the Eocene Bateque Formation, Baja California Sur, Mexico. *Los Angeles County Museum, Contributions in Science*, 434, 1–55.
- Stenzel, H. B. (1944), A new Paleocene catometope crab from Texas, Tehuacana tehuacana. *Journal of Paleontology*, 18, 546–549.
- Steurbaut, E. (2006), Ypresian. *Geologica Belgica*, 9(1–2), 73–93.
- Števcíć, Z. (2005), The reclassification of brachyuran crabs (Crustacea: Decapoda: Brachyura). *Natura Croatica*, 14 (Suppl. 1), 1–159.
- Stimpson, W. (1859), Notes on North American Crustacea, 1. *Annals of the Lyceum of Natural History of New York*, 7, 49–93.
- Stimpson, W. (1871), Preliminary report on the Crustacea dredged in the Gulf Stream in the Straits of Florida, by L. F. de Pourtales, Assist. U.S. Coast Survey. *Bulletin of the Museum of Comparative Zoology, Harvard College*, 2, 109–160.
- Tucker, A. B. (1998), Systematics of the Raninidae (Crustacea: Decapoda: Brachyura), with accounts of three new genera and two new species. *Proceedings of the Biological Society of Washington*, 111(2), 320–371.
- Tucker, A. B. and R. M. Feldmann (1990), Fossil decapod crustaceans

- from the Lower Tertiary of the Prince William Sound region, Gulf of Alaska. *Journal of Paleontology*, 64, 409–427.
- Vega, F. J., F. Alvarez, and G. Carbot-Chanona (2007), Albian Penaeoidea (Decapoda: Dendrobranchiata) from Chiapas, southern Mexico. *Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, 25(2), 97–100.
- Vega, F. J., T. Cosma, M. A. Coutiño, R. M. Feldmann, T. G. Nyborg, C. E. Schweitzer, and D. A., and Waugh (2001b), New Middle Eocene decapods (Crustacea) from Chiapas, México. *Journal of Paleontology*, 75(5), 929–946.
- Vega, F. J., B. Espinosa, V. M. Dávila, and T. Nyborg (2003), Paleocology and preservation styles of K/T decapod Crustacea from the Difunta Group, northeastern Mexico. *Geological Society of America, Annual Meeting, Abstracts*, p. 57.
- Vega, F. J., R. M. Feldmann, F. Pimentel, H. F. Filkorn, P. García-Barrera, and J. Avendaño (2001a), Maastrichtian Crustacea (Brachyura: Decapoda) from the Ocozocoautla Formation in Chiapas, southeast México. *Journal of Paleontology*, 75, 319–329.
- Vega, F. J., P. García-Barrera, M. C. Perrilliat, M. A. Coutiño, and R. Mariño-Pérez (2006), El Espinal, a new plattenkalk locality from the Lower Cretaceous Sierra Madre Formation, Chiapas, Southeastern Mexico. *Revista Mexicana de Ciencias Geológicas*, 23(3), 323–333.
- Vega, F. J., T. G. Nyborg, R. H. B. Fraaije, and B. Espinosa (2007), Paleocene decapod Crustacea from the Rancho Nuevo Formation (Parras Basin – Difunta Group), Northeastern Mexico. *Journal of Paleontology*, 81(6), 1442–1451.
- Via, L. (1959), Decápodos fósiles del Eoceno español. *Boletín del Instituto Geológico y Minero de España*, 70, 331–402.

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**Plate 1**

Fig. 1. Callianassidae 1. Hypotype IHNFG-3004, locality Mesa de Copoya, Middle Eocene, San Juan Formation,  $\times 4$ .

Figs. 2, 3. Callianassidae 2.

Fig. 2. Right palm, note tooth on occlusal surface of fixed finger. Hypotype IHNFG-3005, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 3$ .

Fig. 3. Incomplete right palm, note tooth on occlusal surface of fixed finger. Hypotype IHNFG-3007, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 3$ .

Fig. 4. *Neocallichirus* sp. cf. *N. rhinos* Schweitzr and Feldmann, 2002. Merus, carpus, and propodus of right cheliped. Hypotype IHNFG-3008, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 3$ .

Figs. 5, 6. Diogenidae.

Fig. 5. Right palm. Hypotype IHNFG-3009, locality Mesa de Copoya, Middle Eocene, San Juan Formation,  $\times 4$ .

Fig. 6. Detail of cuticle, same specimen,  $\times 16$ .

Figs. 7–12. *Petrochirus* sp.

Fig. 7. Inner view of right palm. Hypotype IHNFG-3010, locality Mesa de Copoya, Middle Eocene, San Juan Formation,  $\times 4$ .

Fig. 8. Lower margin of the same specimen,  $\times 4$ .

Fig. 9. Outer view of left palm. Hypotype IHNFG-3011, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 4$ .

Fig. 10. Outer view of left palm. Hypotype IHNFG-3012, locality Mesa de Copoya, Middle Eocene, San Juan Formation,  $\times 2$ .

Fig. 11. Lower margin of the same specimen,  $\times 2$ .

Fig. 12. Inner view of carpus and palm of same specimen,  $\times 2$ .

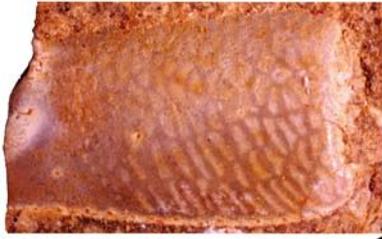
Figs. 13–15. *Ranina berglundi* Squires and Demetrio, 1992.

Fig. 13. Dorsal view of carapace. Hypotype IHNFG-3014, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 3$ .

Fig. 14. Dorsal view of carapace. Hypotype IHNFG-3013, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 1.5$ .

Fig. 15. Dorsal view of carapace. Holotype IGM-5912, Baja California Sur, Mexico, Lower Eocene, Bateque Formation,  $\times 1.5$ .

Plate 1



1



2



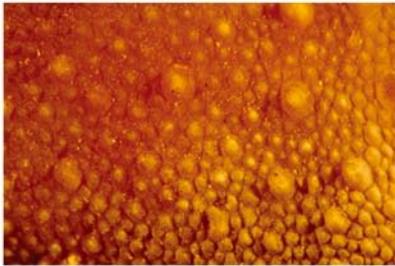
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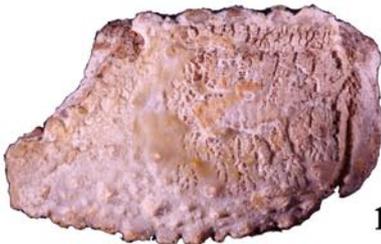
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**Plate 2**

Figs. 1, 2. *Ranina berglundi* Squires and Demetron, 1992.

Fig. 1. Detail of left posterior anterolateral spine. Hypotype IHNFG-3015, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 2$ .

Fig. 2. Detail of right posterior anterolateral spine. Paratype IGM-5913, Baja California Sur, Mexico, Lower Eocene, Bateque Formation,  $\times 4$ .

Fig. 3. *Raninoides treldenaesensis* (Collins and Jakobsen, 2003). Dorsal view of carapace. Hypotype IHNFG-3016, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 2$ .

Figs. 4–6. *Notopoides exiguus* Beschin, Busulini, De Angeli, and Tessier, 1988.

Fig. 4. Dorsal view of carapace. Hypotype IHNFG-3017, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 4$ .

Fig. 5. Dorsal view of carapace. Hypotype IHNFG-3018, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 3$ .

Fig. 6. Dorsal view of carapace with right cheliped. Holotype 11879, deposited in the Museo di Storia naturale in Venezia, Italy, Lower Eocene levels in Chiampo Valley (Vicenza - Northern Italy),  $\times 3$ .

Figs. 7–12. *Calappilia hondoensis* Rathbun, 1930.

Fig. 7. Dorsal view of carapace. Hypotype IHNFG-3022, locality Mesa de Copoya, Middle Eocene, San Juan Formation,  $\times 2$ .

Fig. 8. Dorsal view of carapace. Hypotype IHNFG-3023, locality Mesa de Copoya, Middle Eocene, San Juan Formation,  $\times 3$ .

Fig. 9. Dorsal view of carapace. Hypotype IHNFG-3024, locality Mesa de Copoya, Middle Eocene, San Juan Formation,  $\times 4$ .

Fig. 10. Dorsal view of carapace, plaster cast from steinkern. Hypotype IHNFG-3025, locality Mesa de Copoya, Middle Eocene, San Juan Formation,  $\times 2$ .

Fig. 11. Outer surface of left palm. Hypotype IHNFG-3026, locality Mesa de Copoya, Middle Eocene, San Juan Formation,  $\times 3$ .

Fig. 12. Inner surface of left palm, same specimen,  $\times 3$ .

Fig. 13. *Karasawaia markgrafi* (Lőrenthey, 1907[1909]) new combination. Dorsal view of carapace. Hypotype IHNFG-3030, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 4$ .

Fig. 14. *Verrucoides stenoedra* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001. Mirror image of dorsal view of carapace. Hypotype IHNFG-3031, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 3$ .

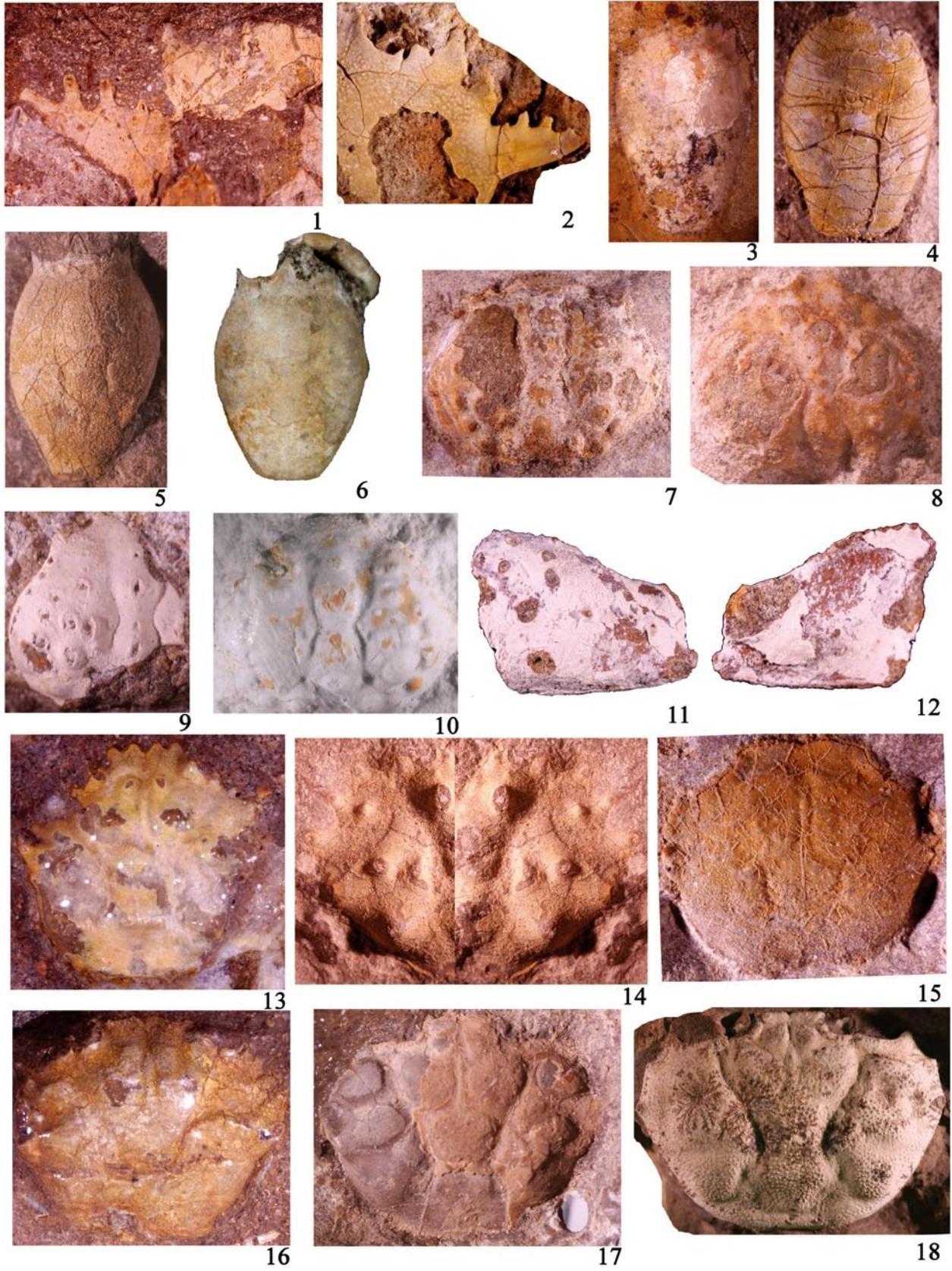
Fig. 15. *Santeella lillyae* Blow and Manning, 1996. Dorsal view of carapace. Hypotype IHNFG-3033, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 5$ .

Fig. 16. *Panopeus veintensis* new species. Dorsal view of carapace. Hypotype IHNFG-3034, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 4$ .

Fig. 17. *Orbitoplax nandachare* (Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001). Dorsal view of carapace. Hypotype IHNFG-3035, locality El Veinte, Lower Eocene, El Bosque Formation,  $\times 4$ .

Fig. 18. *Orbitoplax weaveri* (Rathbun, 1926). Dorsal view of carapace. Hypotype IGM-7655, 30 miles east of Gold Beach, Oregon, USA, Lookingglass Formation, Eocene,  $\times 3$ .

Plate 2



**Plate 3**

Figs. 1–3. *Orbitoplax nandachare* (Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001).

Fig. 1. Dorsal view of carapace. Hypotype IHNFG-3036, locality El Veinte, Lower Eocene, El Bosque Formation, ×4.

Fig. 2. Dorsal view of carapace. Hypotype IHNFG-3037, locality El Veinte, Lower Eocene, El Bosque Formation, ×4.

Fig. 3. Dorsal view of carapace. Hypotype IHNFG-3038, locality El Veinte, Lower Eocene, El Bosque Formation, ×4.

Figs. 4–6, 8, 9. *Tehuacana schweitzerae* new species.

Fig. 4. Dorsal view of carapace, plaster cast from steinkern. Paratype IHNFG-3052, locality El Veinte, Lower Eocene, El Bosque Formation, ×3.

Fig. 5. Dorsal view of carapace. Holotype IHNFG-3051, locality El Veinte, Lower Eocene, El Bosque Formation, ×3.

Fig. 6. Dorsal view of carapace. Paratype IHNFG-3053, locality El Veinte, Lower Eocene, El Bosque Formation, ×5.

Fig. 8. Dorsal view of carapace. Paratype IHNFG-3054, locality El Veinte, Lower Eocene, El Bosque Formation, ×4.

Fig. 9. Left lateral view, same specimen, ×8.

Fig. 7. *Tehuacana tehuacana* Stenzel, 1944, Dorsal view of carapace. Hypotype IGM-9106, Coahuila, Northeastern Mexico, Paleocene, Rancho Nuevo Formation, ×4.

Fig. 10. Portunidae. Left palm of cheliped. Hypotype IHNFG-3056, locality Mesa de Copoya, Middle Eocene, San Juan Formation, ×2.

Figs. 11, 12. *Xaiva?* sp.

Fig. 11. Dorsal view of carapace. Hypotype IHNFG-3057, locality Mesa de Copoya, Middle Eocene, San Juan Formation, ×5.

Fig. 12. Detail of anterolateral margin, same specimen, ×10.

Figs. 13–15. *Viapinnixa alvarezi* Vega, Cosma, Coutiño, Feldmann, Nyborg, Schweitzer, and Waugh, 2001.

Fig. 13. Anterior view of carapace, note eye peduncle casts. Hypotype IHNFG-3060, locality El Veinte, Lower Eocene, El Bosque Formation, ×6.

Fig. 14. Dorsal view of carapace. Hypotype IHNFG-3058, locality El Veinte, Lower Eocene, El Bosque Formation, ×3.

Fig. 15. Dorsal view of carapace. Hypotype IHNFG-3059, locality El Veinte, Lower Eocene, El Bosque Formation, ×3.

Fig. 16. *Viapinnixa perrilliatii* Vega, Nyborg, Fraaije, and Espinosa, 2007. Dorsal view of carapace. Hypotype IGM-9107, Coahuila, Northeastern Mexico, Paleocene, Rancho Nuevo Formation, ×2.

Plate 3

