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Early Cretaceous (Albian) decapods from the Glen Rose and Walnut formations of Texas, USA

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Abstract

Early Cretaceous (Albian) decapod crustaceans from the Glen Rose Limestone and the Walnut Formation include the new taxa *Palaeodromites xestos* new species, *Rosadromites texensis* new genus, new species, *Karyosia apicava* new genus new species, *Aetocarcinus* new genus, *Aetocarcinus muricatus* new species, and the new combinations *Aetocarcinus roddai* (Bishop, 1983), *Necrocarcinus pawpawensis* (Rathbun, 1935) and *Necrocarcinus hodgesi* (Bishop, 1983). These two formations have yielded a much less diverse decapod fauna than the nearly coeval and proximally deposited Pawpaw Formation. Paleoenvironment is suggested as a controlling factor in the decapod diversity of these units.

Key words: Brachyura, Nephropidae, Dromiacea, Raninoida, Etyioidea, North America

Introduction

Late Early Cretaceous decapod faunas from the Gulf Coastal Plain of North America have been well reported and described since the early part of the twentieth century (Rathbun, 1935; Stenzel, 1945). Bishop (1983) described a fauna of decapods from the Albian Glen Rose Formation, and a large collection of new and newly examined material contributed significantly to that diversity. Four new species and three new genera are described herein from the Albian carbonate units of Texas, USA, including the Glen Rose and Walnut formations. The faunas of those units differ significantly from the previously reported faunas from geographically proximal siliciclastic units of nearly the same age.

Geologic Setting

In central Texas, the Glen Rose Formation is the upper unit of the Lower Cretaceous Trinity Group and is of latest Aptian to early Albian age (Fig. 1). It overlies the Hensel Shale Member of the Pearsall Formation and underlies the Walnut Formation of the Fredericksburg Group or the Paluxy Sand, where present. The Glen Rose Formation was deposited in the shallow waters of a broad carbonate platform. Deposition occurred on the southeastern flank of the Llano Uplift and, on the seaward margin to the northwest, behind the Stuart City Reef Trend. Coral and rudist reefs, algal beds, extensive ripple marks, evaporites, and dinosaur tracks all indicate deposition in shallow water.

The Glen Rose Formation is composed predominantly of limestone, dolostone, marlstone, and calcareous shale. The Glen Rose thickens from less than 50 m in the northern part of the outcrop to more than 300 m in the vicinity of the Balcones Fault Zone (Stricklin *et al*., 1971). The formation has been divided into an Upper Member and a Lower Member. The two members are separated by the "*Corbula* Bed," an extensive, approximately one meter-thick interval that contains one or more thin beds of internal molds of the small, burrowing corbulid pelecypod *Eoursivivas harveyi* (Hill).

The Lower Member of the Glen Rose Formation has been divided into two informal units based on differences in lithology (Stricklin *et al*., 1971). In central Texas, the basal unit (Unit 1) crops out along rivers and creeks from Hays and Blanco counties southwestward into Medina County. The "Lower Reef Interval" occurs within this unit. Small rudist bioherms and larger, tabular coral or rudist bioherms are found within this interval (Stricklin *et al*., 1971).

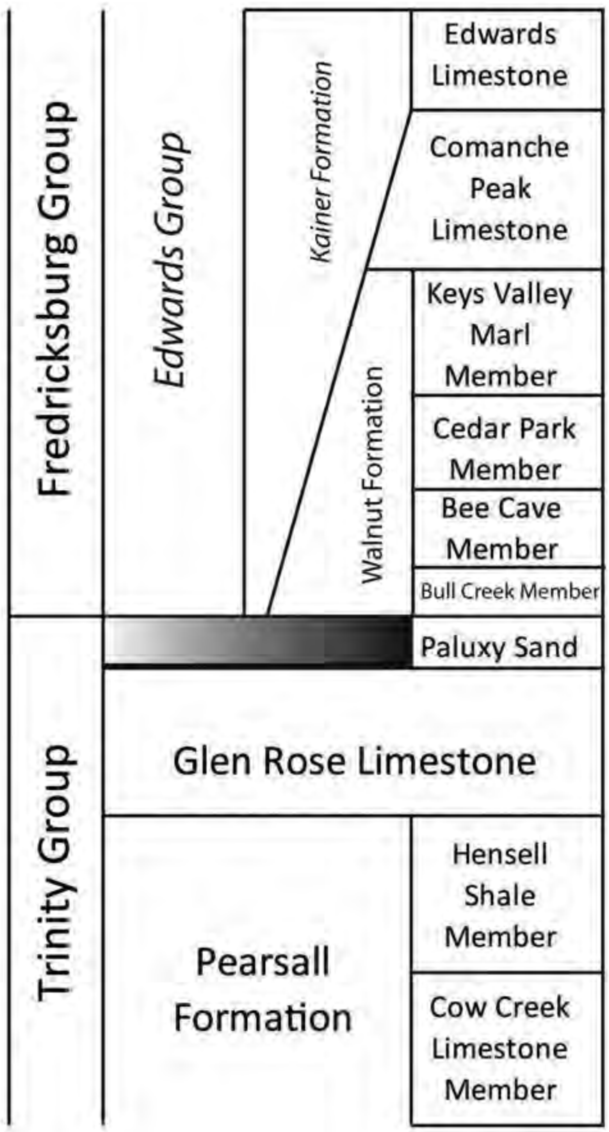


Fig. 1. Stratigraphic column of the Albian units in central Texas. Modified after Moore, Jr. (1964: fig. 5) and Baker, Jr. (1995: fig. 10).

The "Upper Reef Interval" occurs within Unit 2 of the Lower Member. Small rudist bioherms, composed primarily of *Monopleura*, and larger rudist bioherms that consist of caprinids, such as *Coalcomana*, are found within this interval. In Comal County, the "Upper Reef Interval" overlies the "Echinoid Marker Bed." The "Echinoid Marker Bed" is an approximately 10 meter-thick bed that is composed of *Orbitolina* packstone (O. *texana* [Roemer]). Echinoids, asteroids, and at least one crinoid occur within the bottom meter of this bed, as do the teeth of fish and sharks. In addition, disarticulated decapod remains, particularly chelae, are abundant. The "*Salenia texana* Bed" is located near the top of Unit 2. It derives its name from the regular echinoid *Leptosalenia texana* (Credner). The "*Salenia texana* Bed" is laterally extensive and highly fossiliferous.

The Upper Member of the Glen Rose Formation consists of alternating resistant and nonresistant beds that form a "stair-step" topography. This unit has been informally divided into seven units (Stricklin *et al*., 1971). Units 1 and 5 are collapsed breccia zones from which gypsum has been removed subaerially (Stricklin *et al*., 1971). Units 3, 6, and 7 include marker beds composed of packstone or marlstone that contain a diverse fauna (Ward and Ward, 2007). Of particular interest are the "*Orbitolina* Marker Bed" (named for the conical foraminifer *O. minuta* Douglass) in Unit 3, the "Lower *Loriolia* Marker Bed" (named for the regular echinoid *L. rosana* Cooke) at the top of Unit 6, and the "Upper *Loriolia* Marker Bed" in Unit 7. Not only are gastropods, pelecypods, echinoids, and bryozoans abundant in these beds, disarticulated crabs are also present. Occasional complete to near-complete carapaces occur in each bed.

The Glen Rose Formation is overlain by the Walnut Formation of the Fredericksburg Group in the study area. The contact consists of dolomite in the underlying Glen Rose Formation and nodular limestone in the overlying Walnut Formation (Moore, 1964; Stricklin *et al*., 1971). In central Texas (the southern half of Travis County, and Hays, Blanco, and Comal counties), the Walnut Formation consists primarily of the two basal members, the Bull Creek Member and the Bee Cave Member (Moore, 1964).

The Bull Creek Member of the Walnut Formation is made up of hard, nodular limestone that is interpreted as having been deposited subtidally in a lagoon (Moore, 1961). In the Austin area of Travis County, the Bull Creek Member varies in thickness between approximately 11.5 m to 13 m (Young *et al*., 1977). The top of this unit is a pholad-bored, iron-stained hardground.

The Bull Creek Member of the Walnut Formation underlies the Bee Cave Member. The Bee Cave Member is comprised primarily of marlstone that is very fossiliferous. This unit was deposited in a marine marsh to mudflat environment (Moore, 1964). It ranges from approximately 10 m to 15 m in thickness in the Austin area (Young, *et al*., 1977). The pelecypods *Texigryphaea mucronata* (Gabb) and *Ceratostreon texanum* (Roemer) are abundant throughout the Bee Cave Member. The fauna also consists of other pelecypod taxa, gastropods, echinoids, and crustaceans, as well as the dasyclad alga *Porocystis*, the solitary coral *Parasimilia*, and the engonoceratid ammonite *Metengonoceras*. Crab chelae occur commonly; however, complete and near-complete carapaces are much less frequent.

Localities

Localities are displayed in Fig. 2.

Glen Rose Formation

Mystic Shores Subdivision: Specimens were collected in Unit 2 of the Lower Member of the Glen Rose Formation at five localities within the Mystic Shores Subdivision, both north and south of FM 306 on the north side of Canyon Lake, Comal County. These localities include the north side of Astral Point northwest of its intersection with North Cranes Mill Road (approximately lat. 29° 57′39.95″ N, long. 98° 17′34.51″ W); Dodder Lane northwest of its intersection with Burr Lane (approximately lat. 29° 57′39.73″ N, long. 98° 19′6.85″ W); Mexican Hat Drive west of its intersection with Mystic Parkway (approximately lat. 29° 57′15.62″ N, long. 98° 19′44.36″ W); the west side of Wizard Way north of its intersection with Mystic Shores Boulevard (approximately lat. 29° 55′28.04″ N, long. 98° 17′48.91″ W); and a hillside cut above Gull Lane south of Mystic Shores Boulevard (approximately lat. 29° 55′43.80″ N, long. 98° 18′42.26″ W). All localities fall within the "Echinoid Marker Bed," a 33-foot-thick bed of *Orbitolina* (*O. texana* [Roemer]) packstone of which the basal three feet contains abundant calcite septarian nodules together with the fossils of at least 14 species of echinoids, three ophiuroids, one to two crinoids, and one belemnite.

Rocky Creek Ranch Subdivision: Specimens were collected in Unit 3 of the Upper Member of the Glen Rose Formation in a drainage ditch on the south side of Rocky Ranch Road just west of its intersection with Rocky Ridge Loop in the Rocky Creek Ranch Subdivision south of Fischer, Comal County, Texas, at approximately lat. 29° 57′1.45″ N, long. 98° 15′47.23″ W. Unit 3 in this area consists of a weathered buff-colored *Orbitolina packstone* (*O. minuta* Douglass).

Mansfield Dam: Specimens were collected in Unit 6 of the Upper Member of the Glen Rose Formation on the north side of RM 620 northwest of Mansfield Dam in Travis County, Texas, at approximately lat. 30° 23′48.66″ N, long. 97 ° 55′11.35″ W. Gray miliolid marlstone of the "Lower *Loriolia* Interval" at the top of Unit 6 crops out at this locality.

Lakeway: Specimens were collected in Unit 6 of the Upper Member of the Glen Rose Formation below a water tower that is situated northwest of the intersection of RM 620 and Kollmeyer Drive in Lakeway, Travis County, Texas, at approximately lat. 30° 22′ 23.65″ N, long. 97° 56′ 48.00″ W. Buff-colored to gray miliolid marlstone of the "Lower *Loriolia* Interval" at the top of Unit 6 crops out at this locality.

Summit North Subdivision: Specimens were collected in Unit 3 of the Upper Member of the Glen Rose Formation during construction of North Cranes Mill Road in the Summit North subdivision southwest of Fischer, Comal County, Texas, at approximately lat. 29° 58′8.98″ N, long. 98° 17′1.05″ W. Unit 3 in this area consists of a gray *Orbitolina* packstone (*O. minuta* Douglass) that contains the zonal marker ammonite *Hypacanthoplites comalensis* Young.

The Hollows Subdivision: Specimens were collected in Unit 6 of the Upper Member of the Glen Rose Formation at construction site at the southwest corner of Ming Trail and Destination Way in The Hollows Subdivision east of Lago Vista, Travis County, Texas, at approximately lat. 30° 27′42.92″ N, long. 97° 58′1.42″ W. Buff-colored to gray miliolid marlstone of the "Lower *Loriolia* Interval" at the top of Unit 6 crops out in several places at this locality.

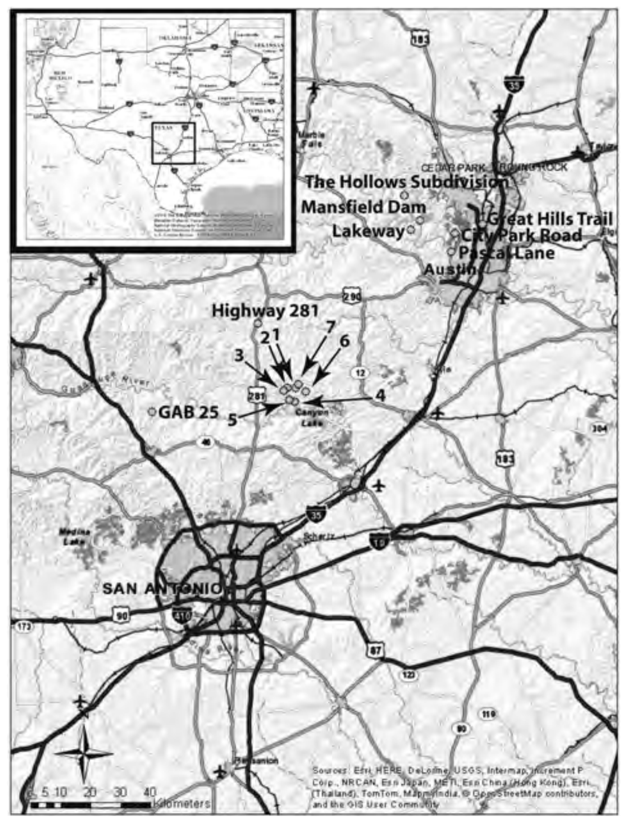


Fig. 2. Locality map. 1, inset map of Texas, USA, box showing enlarged area of main map with decapod localities. 2, main locality map of Austin and San Antonio, Texas, area. Numbered localities are part of Mystic Shores Subdivision locality and nearby localities. 1 = Astral Point; 2 = Dodder Lane; 3 = Mexican Hat Drive; 4 = Wizard Way; 5 = Mystic Shores Boulevard; 6 = Rocky Creek Ranch; 7 = Summit North Subdivision. Base Map for Fig. 2.1 generated in ArcMap 10.2.2, USGS National, with sources generated by ArcMap and cited on map. Base Map for Fig. 2.2 generated in ArcMap 10.2.2, Streets, with sources generated by ArcMap and cited on map.

Highway 281: Specimens were collected in Unit 6 of the Upper Member of the Glen Rose Formation in a large road cut northeast of Blanco on Highway 281 just south of Rolling Hills Road, Blanco County, Texas, at approximately lat. 30° 7´´42.79´´ N, long. 98° 24´´28.70´´ W. Gray miliolid marlstone of the "Lower *Loriolia* Interval" at the top of Unit 6 crops out in this road cut.

Gale A. Bishop locality GAB 25: Glen Rose Formation locality of Bishop (1983), road cut on Texas Farm Road 1376, 12 km north of Boerne, Kendall County, Texas.

Bee Cave Member, Walnut Formation

City Park Road: Specimens were collected from a road cut on the west side of City Park Road northeast of Westminster Glen Avenue, Travis County, Texas, at approximately 30° 21´49.51´´ N, long. 97° 48´47.43´´ W. The Bee Cave Member in the area consists of gray fossiliferous marlstone with a clay content that is generally 30% by weight and 15 to 20% fossil fragments (Moore, 1964).

Highway 360 at Pascal Lane: Specimens were collected from a road cut on the southeastern side of Highway 360 immediately north of its intersection with Pascal Lane, Austin, Travis County, Texas, at approximately lat. 30° 18´55.71´´ N, long. 97° 49´32.05´´ W. The Bee Cave Member at this locality consists of buff-colored fossiliferous marlstone.

Highway 360 near Great Hills Trail: Specimens were collected from a road cut at the base of a hill on the northwest side of Highway 360 west of Great Hills Trail, Austin, Travis County, Texas, at approximately lat. 30° 23´16.92´´ N, long. 97° 43´53.75´´ W. The basal Bee Cave Member at this locality consists of gray fossiliferous marlstone.

Systematics

Taxonomic note: Our systematics follow the phylogenetically derived classification of Karasawa *et al*. (2011) and Karasawa *et al*. (2014) for podotrematous crabs and raninoid crabs.

Abbreviations: BSP, Bayerische Staatsammlung für Paläontologie und Historische Geologie, München (Munich), Germany; SDSNH, San Diego Society of Natural History, San Diego Natural History Museum, California, USA; KSU D, Kent State University decapod cataloged collection, Department of Geology, Kent, Ohio, USA; TMM NPL, Texas Memorial Museum, Non-vertebrate Paleontology, Jackson School of Geosciences, The University of Texas at Austin, USA.

Infraorder Astacidea Latreille, 1802
Superfamily Nephropoidea Dana, 1852
Family Nephropidae Dana, 1852
Homarus Weber, 1795

Homarus travisensis Stenzel, 1945
(Fig. 3.1, 3.2)

Homarus travisensis Stenzel, 1945, p. 423, pl. 41, figs. 14–16, text fig. 10. Schweitzer *et al*., 2010, p. 28.

Description of material: Manus of left chelipeds longer than high, becoming higher distally; proximal margin rounded, lower margin weakly convex, upper margin nearly straight, with two rows of forward directed spines.

Material examined: Two mani, TMM NPL 69641 and 69642.

Occurrence: Summit North Subdivision locality.

Discussion: The long manus and spines on the upper margin are very similar to the morphology illustrated by Stenzel (1945) for *Homarus travisensis*, collected from the Walnut Formation of Travis County, Texas. The new specimens were collected from the underlying Glen Rose Formation, of similar lithology.

Infraorder Anomura MacLeay, 1838
Superfamily Paguroidea Latreille, 1802
Family Paguridae Latreille, 1802
Pagurus Fabricius, 1775

Pagurus banderensis Rathbun, 1935
(Fig. 3.3–3.6)

Pagurus banderensis Rathbun, 1935, p. 39, pl. 9, figs. 7, 8. Stenzel, 1945: 435, pl. 45, figs. 7–15; Bishop, 1983: 41, pl. 2, figs. 1–31; Schweitzer *et al*., 2010, p. 56.

Palaeopagurus banderensis (Rathbun, 1935): Roberts, 1962: 175.

Material examined and occurrence: TMM NPL 69643 and 69650 on Dodder Lane; TMM NPL 69644 and 69647 on Astral Point; TMM NPL 69645 off Mystic Shores Boulevard; TMM NPL 69646 on Wizard Way; 69648 on Mexican Hat Drive; TMM NPL 69649 in Mystic Shores subdivision; all in the Mystic Shores Subdivision Locality.

Discussion: The species has been well illustrated previously (Rathbun, 1935; Stenzel, 1945; Bishop, 1983). The right chelae in general seem to be larger than the left, so Paguridae is the best placement for the material at this time. Extant members of *Pagurus* exhibit a broad range of morphologies, including the thickened rim and cup-like tip on the fixed finger seen in *P. banderensis*. Thus, *Pagurus* seems a reasonable placement for the species.

Infraorder Brachyura Linnaeus, 1758
Section Dromiacea De Haan, 1833
Superfamily Homolodromioidea Alcock, 1900
Family Goniodromitidae Beurlen, 1932

Included genera: *Cycloprosopon* Lőrenthey in Lőrenthey and Beurlen, 1929; *Cyclothyreus* Remeš, 1895; *Distefania*

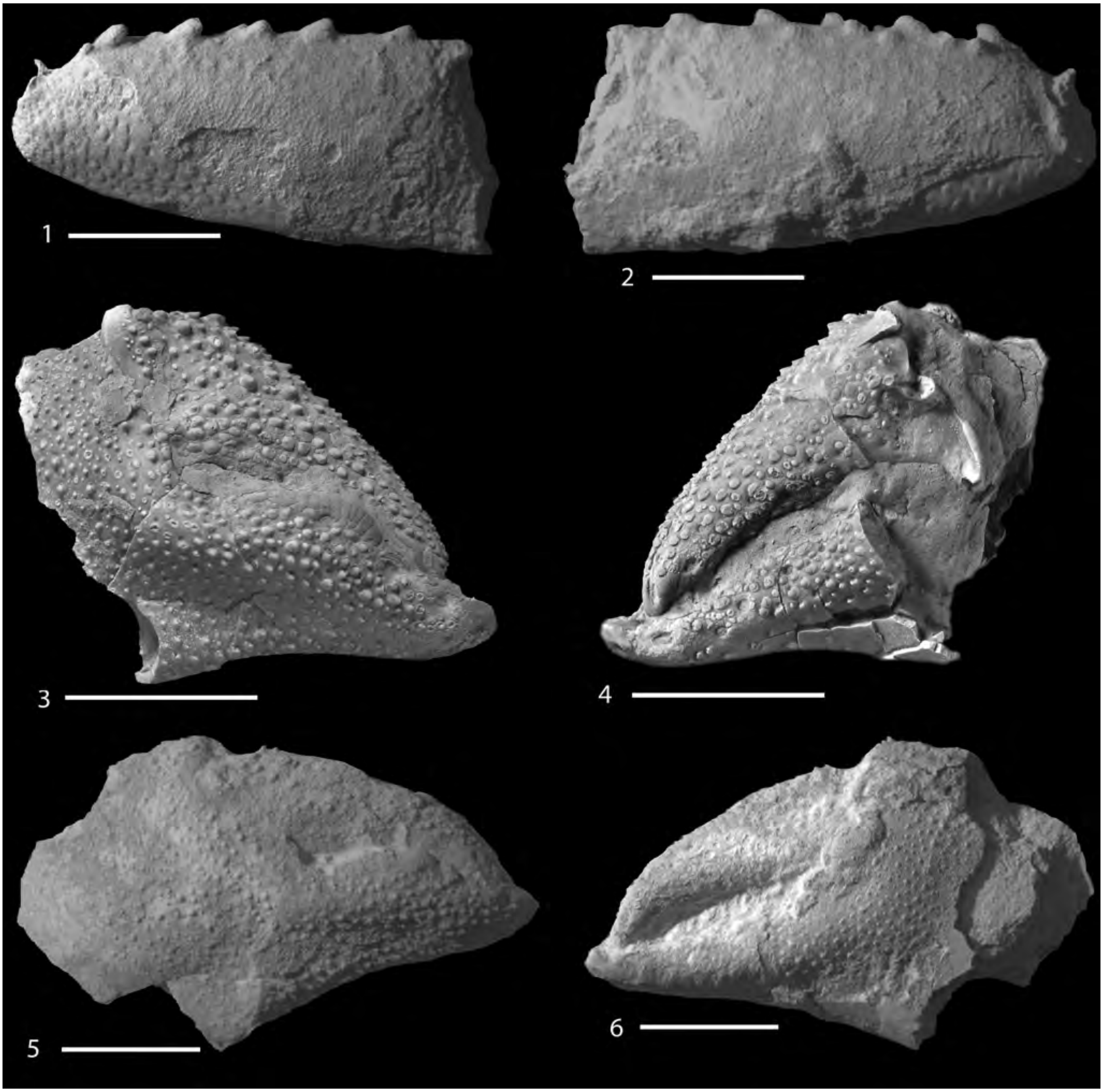


Fig. 3. Miscellaneous chelae. 1–2, *Homarus travisensis* Stenzel, 1945, outer surface (1) and inner surface (2) of right chela, TMM NPL 69641. 3–6, *Pagurus banderensis* Rathbun, 1935, outer surface (3) and inner surface (4) of TMM NPL 69644; outer surface (5) and inner surface (6) of TMM NPL 69643. Scale bars = 1.0 cm.

Checchia-Rispoli, 1917; *Eodromites* Patrulius, 1959; *Goniodromites* Reuss, 1858 [imprint 1857]; *Maurimia* Martins-Neto, 2001; *Microcorystes* Frič, 1893; *Navarradromites* Klompmaker, Schweitzer, and Feldmann, 2012; *Palaeodromites* A. Milne-Edwards, 1865; *Pithonoton* Von Meyer, 1842; *Plagiophthalmus* Bell, 1863; *Sabellidromites* Schweitzer and Feldmann, 2008 [imprint 2007]; *Trachynotocarcinus* Wright and Collins, 1972; *Trechmannius* Collins and Donovan, 2006.

Palaeodromites A. Milne-Edwards, 1865

Type species: *Palaeodromites octodentatus* A. Milne-Edwards, 1865, by original designation.

Other species: *Palaeodromites xestos* new species.

Diagnosis: Anterolateral margins thin, divided into four small spines (excluding outer-orbital angle), separated by broad reentrants; posterolateral margins thick and rounded; orbits appearing to have been wide, directed obliquely, with flared rim with inflection medially; cervical and postcervical grooves present but weak; branchiocardiac groove not visible; posterolateral margins well developed, shorter than anterolateral margins but still quite long; posterior margin weakly concave (modified after Schweitzer and Feldmann, 2010).

Discussion: Goniodromitidae ranges from the Middle

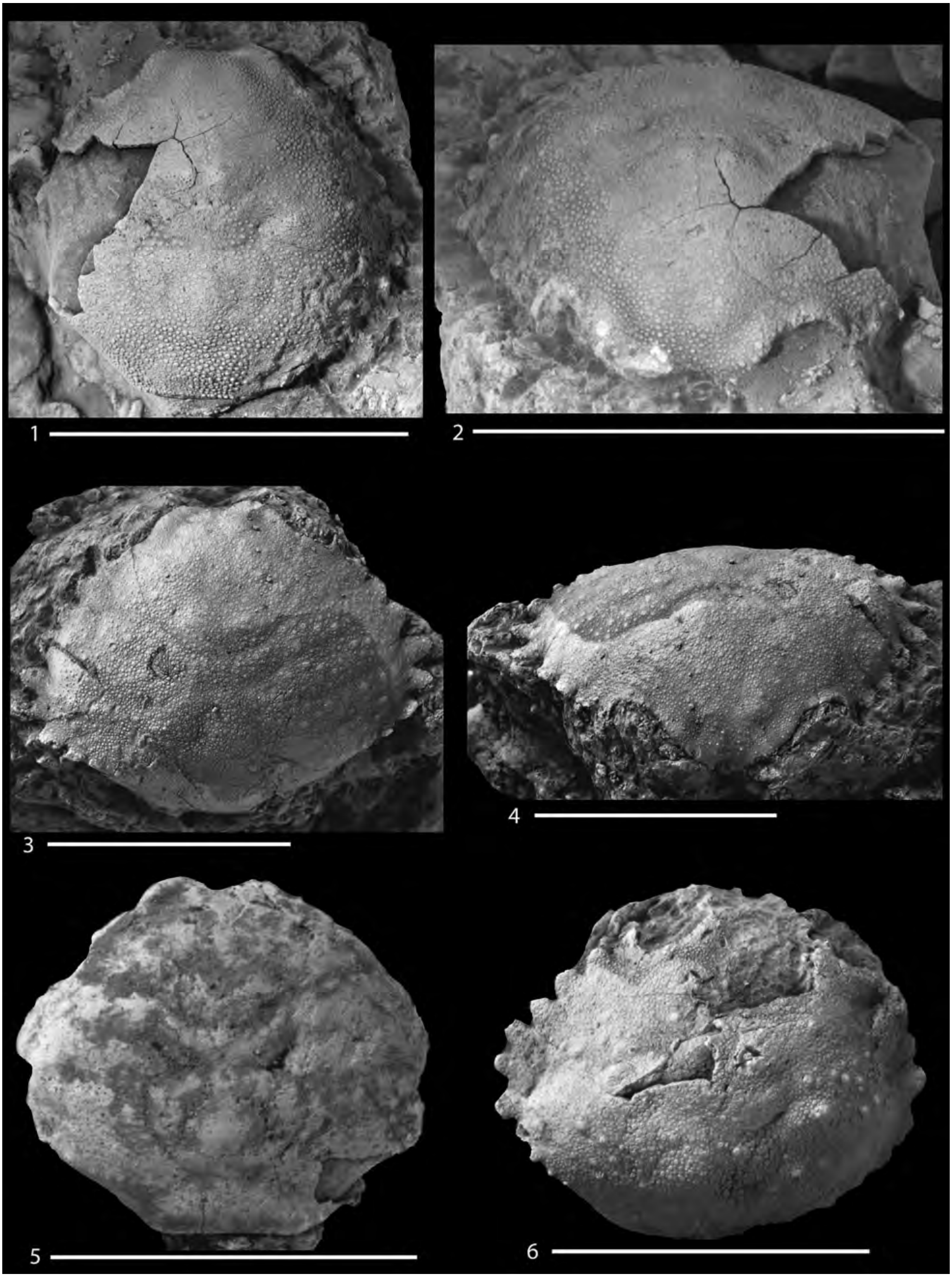


Fig. 4. Goniodromitidae. 1–2, *Palaeodromites xestos* new species, TMM NPL 69651, holotype, dorsal view (1) and oblique anterior view (2). 3–6, *Trachynotocarcinus naglei* (Bishop, 1983); 3–4, TMM NPL 69652 , dorsal view showing well preserved lateral margins, grooves, and carapace ridges (3) and oblique anterior view showing rostrum and orbits (4); 5, TMM NPL 69653, mold of the interior showing carapace grooves but little ornamentation; 6, TMM NPL 69654, showing well-developed anterolateral spines. Scale bars = 1.0 cm.

Jurassic to the Paleocene. Members are abundant and diverse in the Late Jurassic and Early to middle Cretaceous. The genera are united in possessing a slightly longer than wide or about as long as wide carapace, a simple sulcate rostrum; wide, oblique orbits with a distinct augenrest; small, inflated epigastric regions and otherwise poorly defined regions; a well-defined cervical groove and varying definition of the postcervical and branchiocardiac grooves; and well-defined flanks of the carapace. Several genera within it are typified by an equant, smooth carapace with poorly developed grooves; these include *Cycloprosopon, Cyclothyreus, Palaeodromites*, and *Trechmannius*. The new species shares these features with these genera; none has a well-developed branchiocardiac groove and all have a relatively poorly defined postcervical groove. Cervical grooves are variously defined in these genera; a hallmark of the family is that this groove is usually well marked. All other members of the family have very deep branchiocardiac grooves. The new species differs from *Cycloprosopon* spp. in having a much narrower fronto-augenrest width. The overall shape of the carapace is distinctly octagonal in the new species whereas it is circular in *Cyclothyreus* spp. and *Trechmannius* sp. We herein place it within *Palaeodromites*, heretofore monospecific, which is octagonal and has a rimmed and flared orbital margin with an inflection about mid-width as does the new species. The new specimen lacks well defined grooves as does *Palaeodromites*. Unfortunately, the only known illustrations of *Palaeodromites* are not good, so comparisons are difficult. Also regrettable is the poor preservation of the anterolateral margins of the new specimen, making it difficult to determine if they were spinose. Despite these issues, it seems most appropriate to refer the new species to *Palaeodromites* at this time as it shares numerous important similarities with it, including the nature of the orbital margin. This occurrence extends the geographic range of the genus into North America and into the late Early Cretaceous. The type species is known from the Berriasian-Hauterivian of France (A. Milne-Edwards, 1865).

Palaeodromites xestos new species

(Fig. 4.1, 4.2)

Diagnosis: Carapace octagonal, vaulted, finely granular; orbits oblique, with flared rim and inflection; fronto-augenrest width about 63% maximum carapace width; anterolateral margins may have been spinose; cervical and postcervical grooves well defined axially; epigastric regions moderately inflated; mesogastric region with two well-defined swellings posteriorly.

Description: Carapace octagonal, slightly wider than long, length about 90% maximum carapace width, widest a little over half the distance posteriorly on carapace, vaulted transversely and longitudinally; carapace surface finely granular overall.

Rostrum broad, downturned, weakly sulcate, tip unknown. Orbits wide, oblique, directed anterolaterally, with inflection just distal to inner-orbital angle; with weak, flared, granular rim; outer-orbital angle produced into short, triangular, spine; fronto-augenrest width about 63% maximum carapace width. Anterolateral margin appearing to be weakly convex, may bear several blunt spines; posterolateral margin with a few blunt spines anteriorly and concave posteriorly; posterior margin straight, with narrow, granular rim.

Epigastric regions circular, very weakly inflated. Mesogastric region with long anterior process, two marked swellings posteriorly; protogastric and hepatic regions confluent, broadly inflated. Cervical groove absent laterally, weakly developed posterior to protogastric and mesogastric regions, with two gastric pits on posterior margin of mesogastric region. Postcervical groove straight, crossing axial regions, not developed laterally. Branchiocardiac groove obsolete.

Metagastric region short, wide, rectangular; cardiac region broadly triangular, possessing three broad swellings, one axially and longitudinally ovate, reniform swellings on either side of axial swelling; intestinal region poorly defined, somewhat inflated. Epibranchial region flattened anteriorly and inflated posteriorly, especially so axially; remainder of branchial region broadly inflated, with arcuate swelling bounding cardiac region.

Measurements: Measurements (in mm) taken on the holotype and sole specimen of *Palaeodromites xestos* new species: maximum carapace width, 11.8; maximum carapace length, 10.5; length to maximum width, 5.9; fronto-augenrest width, 7.4.

Etymology: The trivial name is derived from the Greek word *xestos*, meaning polished or smooth, with reference to the weak grooves and regional development of the carapace of this species.

Type: The holotype and sole specimen of *Palaeodromites xestos* new species is TMM NPL 69651.

Occurrence: City Park Road locality, Walnut Formation.

Discussion: *Palaeodromites xestos* new species bears superficial resemblance to *Trachynotocarcinus naglei* (Bishop, 1983) represented by numerous specimens from the same formation and belonging to the same family. It differs from that taxon in lacking the transverse swellings on the branchial regions of the carapace, possessing reniform swellings on the cardiac region, possessing a rimmed orbit, and being nearly as wide as long. *Trachynotocarcinus naglei* is generally markedly wider than long. The specimen referred to *Palaeodromites xestos* does not appear to have been crushed or deformed so as to render its shape different, and the carapace ornamentation differences with *Trachynotocarcinus* are both observed on layers of cuticle preserving some ornamentation and on molds of the interior. Thus, the differences are substantial.

Trachynotocarcinus Wright and Collins, 1972

Type species: *Trachynotus sulcatus* Bell, 1863, by monotypy.

Other species: *Trachynotocarcinus naglei* (Bishop, 1983).

Diagnosis: Carapace wider than long, ovoid, widest about 75 % distance posteriorly; weakly vaulted; rostrum downturned, sulcate; anterolateral margin well defined, spinose; orbits oblique, elongate, augenrest small; upper-orbital margin with node marking inner angle of augenrest; cervical groove sinuous, deep; epibranchial region subdivided by cervical and postcervical groove into three transverse swellings; postcervical groove long, extending to lateral margins; branchiocardiac groove well defined laterally; anterior regions coarsely granular, posterior regions with granules arranged into rows; posterior margin narrow, rimmed (modified after Schweitzer *et al*., 2012a).

***Trachynotocarcinus naglei* (Bishop, 1983)**

(Fig. 4.3–4.6)

Palaeodromites naglei Bishop, 1983, p. 44, pl.1, figs. 12–17.

Trachynotocarcinus naglei (Bishop, 1983). Schweitzer *et al*., 2010, p. 60.

Diagnosis: see Bishop (1983).

Material examined and occurrence: Glen Rose Localities: TMM NPL 69652, 69653, 69660, 69665, 69666, 69675 collected from Summit North Subdivision; TMM NPL 69654, 69663 collected from Lakeway; TMM NPL 69655 collected from Highway 281; TMM NPL 69656 collected from Mansfield Dam, TMM NPL 69661, Rocky Creek Ranch Subdivision; TMM NPL 69659, 69662 from the Hollows Subdivision; TMM NPL 69667 (=GAB 25-52), 69668 (=GAB 25-53); 69669 (= GAB 25-54); TMM NPL 69670 (=GAB 25-55); TMM NPL69671 (=GAB 25-56); 69672 (=GAB 25-57); 69673, 69674 from Gale A. Bishop Locality 25 (GAB 25-52, 53, 54, 57 mentioned in table 5, Bishop, 1983). Walnut Formation localities: TMM NPL 69657, 69664 from Great Hills Trail and TMM NPL 69658, 69724 from Pascal Lane. Bishop (1983) mentioned several specimens from locality GAB-25. Those specimens have been discovered in uncatalogued material from the South Dakota School of Mines and are herein assigned specimen numbers for the UT collections and cross-referenced above.

Discussion: Bishop (1983) originally referred this species to *Palaeodromites*, based upon the consensus at that time that *Palaeodromites*, *Cyphonotus* Bell, 1863, and *Distefania* were synonymous. Based upon examination of type material, Schweitzer and Feldmann (2010) removed *Palaeodromites* from that synonymy and denoted *Distefania* as a senior synonym of *Cyphonotus*. That left *Palaeodromites naglei* unplaced; thus, we place it within *Trachynotocarcinus*. *Trachynotocarcinus* is quite similar to *Distefania* in the shape and ornamentation of the carapace and development of grooves. However, the type species of *Trachynotocarcinus* has three well-defined, transverse, parallel ridges on the branchial regions of the carapace that are not present on *Distefania*. In addition, the carapace regions in *Trachynotocarcinus* are more inflated and defined by wider grooves than those seen in *Distefania*. Thus, Schweitzer and Feldmann (2010) and Schweitzer *et al*. (2012) elected to retain it as a distinct genus and included *Palaeodromites naglei* in the range for the genus. Herein, we formally transfer the species to *Trachynotocarcinus*, resulting in *T. naglei* new combination. *Trachynotocarcinus naglei* possesses the diagnostic features of the genus, including the three transverse, parallel ridges on the branchial regions and a carapace that is markedly wider than long. The only other species of the genus, the holotype, is slightly younger, Cenomanian in age, and known from England (Wright and Collins, 1972).

Family Longodromitidae Schweitzer and Feldmann, 2009

Included genera: *Longodromites* Patrulius, 1959; *Abyssophthalmus* Schweitzer and Feldmann, 2009; *Antarctiprosopon* Schweitzer and Feldmann, 2011; *Coelopus* Étallon, 1861; *Dioratiopus* Woods, 1953; *Glaessnerella* Wright and Collins, 1975; *Planoprosopon* Schweitzer, Feldmann, and Lazăr, 2007; *Rosadromites* new genus; *Vespridromites* Schweitzer and Feldmann, 2011.

Diagnosis: see Schweitzer, Feldmann, and Karasawa (2012).

Rosadromites new genus

Type and sole species: *Rosadromites texensis* new species, by monotypy and original designation.

Diagnosis: Outer-augenrest spine directed anterolaterally and upward; protogastric region apparently with some tubercles or swellings and well-differentiated from inflated hepatic region, distinct within family; metagastric region inflated, short, very wide, composed of convex forward arcs; intestinal region broadly triangular, granular, depressed below level of cardiac and branchial regions, well marked for family.

Etymology: The genus name is derived from *Longodromites*, the nominal genus of the family, and the Glen Rose Formation, from which the sole specimen was collected. The gender is feminine.

Discussion: Longodromitidae is already known from the Cretaceous of North America. *Vespridromites* occurs in Campanian rocks of South Dakota and Maastrichtian rocks of Montana, and more importantly, in Albian rocks of Texas. *Rosadromites* new genus possesses the distinctive augenrest with an outer-augenrest spine and a cervical groove placed well-posterior to the outer-augenrest spine, all diagnostic for Longodromitidae. Cervical, discontinuous postcervical, and branchiocardiac grooves are all present, and flanks well developed. The rostrum and ventral portions of the carapace are missing. The axial regions bear superficial resemblance to some members of Homolidae but the carapace clearly lacks *lineae homolicae*.

The new genus described here differs from all other members of the family in having a well-differentiated hepatic region; in other taxa, that region is confluent with the protogastric region. The metagastric region in *Rosadromites* is distinctly arcuate, forming two convex forward arcs, not seen in other genera, and the intestinal region is unusually well-marked for the family. *Vespridromites*, found in the same formation as *Rosadromites*, is nearly as wide as long, rather than much longer than wide, and lacks a defined intestinal region. *Vespridromites* also has a narrower metagastric region. *Rosadromites* is most similar to *Antarctiprosopon* and *Planoprosopon* in terms of morphology; all three are longer than wide and have relatively subdued regional development. However, the latter two genera lack the arcuate metagastric regions and neither has a well-defined hepatic region. Further, *Antarctiprosopon* is known from the Eocene of Antarctica, quite removed in space and time from *Rosadromites*, and *Planoprosopon* spp. are known from the Middle and Late Jurassic of Europe. Thus, *Rosadromites* is quite distinct.

Rosadromites texensis new genus, new species

(Fig. 5)

Diagnosis: as for genus.

Description: Carapace rectangular, longer than wide, width about three quarters length excluding rostrum; moderately vaulted transversely, flattened longitudinally; regions well-defined by grooves and swellings.

Lateral margins approximately parallel; short segment between outer augenrest spine and cervical groove; second segment between cervical groove and branchiocardiac groove slightly longer than first segment; segment bounding branchial regions weakly convex, as long as first two segments together. Posterior margin weakly concave.

Front broken, augenrest weakly concave, outer augenrest spine strong, directed anterolaterally and slightly upward, width between augenrests occupying nearly maximum width of carapace. Mesogastric region with long, weakly keeled, anterior process, widened posteriorly. Protogastric region longer than wide, apparently with some tubercles or swellings. Hepatic region small, with several large tubercles, separated from protogastric region by broad, shallow depression. Cervical groove deep, continuous across midline, more or less directed straight toward axis.

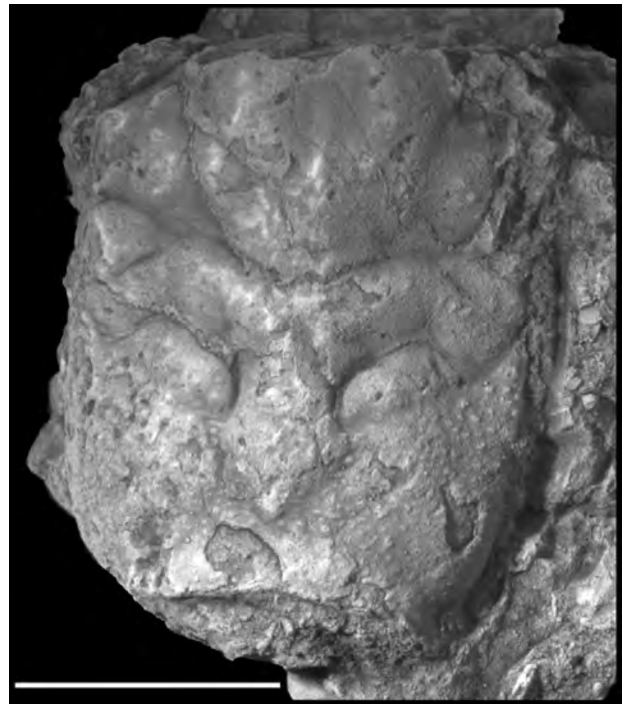


Fig. 5. Longodromitidae, *Rosadromites texensis* new genus, new species, TMM NPL 69676, holotype. Scale bar = 1.0 cm.

Postcervical groove not extending to lateral margin, deep laterally, weak crossing midline, connecting to branchiocardiac groove with arcuate segment bounding lateral margin of urogastric region. Metagastric region inflated, short, very wide, composed of convex forward arcs. Urogastric region long, narrow, depressed below level of other axial regions. Cardiac region pentagonal, with apex directed posteriorly, moderately inflated, appearing to have been granular; intestinal region broadly triangular, granular, depressed below level of cardiac and branchial regions. Branchiocardiac groove extending from lateral margins in weakly concave forward arc to cardiac region. Epibranchial region composed of three obliquely-arranged swellings, inner-most swelling a digitate extension directed at cardiac region. Remainder of branchial region undifferentiated, granular. Flanks short, granular.

Etymology: The trivial name is based upon the state in the USA in which the specimen was collected, Texas.

Measurements: Measurements (in mm) on the sole specimen: carapace length excluding rostrum, 12.8; maximum carapace width, 9.7; width between outer-augenrest spines, 9.2.

Type: The holotype and sole specimen is TMM NPL 69676.

Occurrence: Summit North Subdivision, Glen Rose Formation.

Discussion: The specimen is not particularly well preserved but it retains diagnostic features of the carapace for the family that differentiate it from other genera and species.

Dromiacea incertae sedis

Roemerus Bishop, 1983

Type species: *Roemerus robustus* Bishop, 1983, by original designation.

Diagnosis: Manus about as long as wide, proximal margin strongly rimmed, at about 90° angle to lower margin, inner and outer margins convex, resulting in somewhat bulbous appearance in upper or lower view; fixed finger very short; movable finger about twice as long as fixed finger, strongly arched; possible presence of ovate pits on the fixed finger and the dactyl.

Discussion: *Roemerus* was originally placed within Paguridae; Jagt *et al*. (2010) later suggested that it was more similar in form to claws associated with Dynomenidae and referred to it as a "form genus." We concur that the claws are more closely similar to those associated with dromiaceans for the reasons stated by Jagt *et al*. (2010) and place it within Dromiacea incertae sedis.

Roemerus robustus **Bishop, 1983**

(Fig. 6)

Roemerus robustus Bishop, 1983, p. 42, pl. 3, figs. 20–31. Schweitzer *et al*., 2010, p. 144.

Material examined and occurrence: TMM 69677 (= GAB 25-162 of Bishop, 1983: table 4), TMM NPL 69678 (=GAB 25-163 of Bishop, 1983: table 4), and TMM NPL 69721, all from Gale A. Bishop locality 25. TMM NPL 69726 was collected from the *Orbitolina* marker bed at the Summit North Subdivision locality, all Glen Rose Formation.

Discussion: Bishop (1983) mentioned three specimens from locality GAB-25, including 25-162 and 25-162 (Bishop, 1983: table 4). Those specimens have been discovered in uncatalogued material from the South Dakota School of Mines and are herein assigned specimen numbers for the UT collections.

Section Etyoida Guinot and Tavares, 2001

Superfamily Etyoidea Guinot and Tavares, 2001

Family Etyidae Guinot and Tavares, 2001

Included genera: *Etyus* Leach in Mantell, 1822; *Etyxanthosia* Fraaije *et al*., 2008; *Guinotosia* Beschin *et al*., 2007; *Karyosia* new genus; *Rolerithosia* Collins *et al*., 2013; *Secretanella* Guinot and Tavares, 2001; *Sharnia* Collins and Saward, 2006; *Steorrosia* Schweitzer *et al*., 2012b; *Xanthosia* Bell, 1863.

Diagnosis: See Schweitzer *et al*. (2012b: 129).

Karyosia new genus

Type and sole species: *Karyosia apicava* new species by original designation and monotypy.

Diagnosis: Carapace smooth for family, regions poorly defined, length about two-thirds maximum width; widest two-thirds the distance posteriorly; front with axial pair of rounded lobes, extending laterally into straight segment and blunt inner orbital angle; fronto-orbital width wide for family, about two-thirds maximum carapace width, orbits shallow axially and deeper laterally; anterolateral margin with four lobate or sharp spines; cervical groove weak but well-marked; branchial groove 1 (bg1) of Schweitzer *et al*. (2012b) weakly developed, defining broadly triangular, smooth epibranchial region; branchial groove 2 (bg2) not developed.

Etymology: The genus name is derived from the name *Xanthosia*, a genus and common stem used within the family, and the Greek word *Karya*, meaning walnut tree, after the Walnut Formation from which the holotype was collected. The gender is feminine.

Discussion: The new genus presents the diagnostic features of Etyidae, including the sinuous path of the cervical groove, possession of at least one of bg1 or bg2, a much wider than long carapace, and a spinose anterolateral margin. Unfortunately, the new specimen lacks a sternum and pleon which are quite diagnostic in this family. It differs from other members of the family in having a lobate frontal margin, lobate anterolateral spines one and two, and a relatively smooth carapace with poorly defined regions. *Secretanella* has smooth carapace regions but possesses more anterolateral spines of a different overall shape. Several genera within Etyidae lack bg2 but those genera are much more highly ornamented, such as *Steorrosia*, also known from the Albian of Texas (Schweitzer *et al*., 2012b). *Steorrosia* is very much more highly ornamented than *Karyosia*, and it has very strongly developed anterolateral spines, which *Karyosia* lacks. *Secretanella* and *Karyosia* exhibit by far the smoothest carapaces and have the most subdued regions among etyid genera.

Karyosia apicava **new species**

(Fig. 7)

Diagnosis: as for genus.

Description: Carapace much wider than long, length about two-thirds maximum width; widest at position of third anterolateral spine about two-thirds the distance posteriorly on carapace; broadly vaulted transversely and longitudinally, cuticle present, apparently smooth.

Front slightly produced beyond orbits, with axial pair of rounded lobes, extending laterally into straight segment and blunt inner orbital angle, occupying about 40 % maximum carapace width. Orbits rounded, with granular rim, deeper laterally than axially, giving an oblique appearance, fronto-orbital width about two-thirds maximum carapace width, outer-orbital angle produced by thickened rim, not produced

Fig. 6. Dromiacea *incertae sedis*, *Roemerus robustus* Bishop, 1983. 1-2, TMM NPL 69677 (= GAB 25-162), inner surface of chelae (1) and outer surface (2); 3-4, TMM NPL 69678 (= GAB 25-163), inner surface of chelae (3) and outer surface (4). Note proximal margin of manus at nearly 90° angle to lower margin. Scale bars = 1.0 cm.

into a spine. Anterolateral margin with four spines excluding outer-orbital angle, first two broad, lobate; third broad, triangular; fourth spine smaller, sharp, directed laterally. Posterolateral margin straight; posterior margin broadly concave.

Mesogastric region barely marked, long anterior process widening posteriorly and bounded posteriorly by cervical groove. Protogastric region about as wide as long and weakly inflated. Hepatic region wider than long, flattened. Cervical groove arising on anterior margin between second and third anterolateral spines, arcing weakly concave forward around posterior margin of hepatic region, then weakly convex forward at confluence of hepatic and protogastric regions and bounding posterior margin of mesogastric region. Urogastric region composed of two straight segments directed anterolaterally, forming a V-shaped region; cardiac region broadly triangular, weakly inflated. Branchial groove 1 (bg1) of Schweitzer *et al*. (2012b) weakly developed, defining broadly triangular, smooth epibranchial region; branchial groove 2 (bg2) not developed; remainder of branchial region smooth; branchiocardiac groove arcuate, defining posterior portion of urogastric region and anterior portion of cardiac region.

Etymology: The trivial name is derived from the Latin words *apis*, meaning honeybee, and *cavus*, meaning hollow or hole, denoting the Bee Cave Member of the Walnut Formation from which the holotype and most complete specimen was collected.

Measurements: Measurements (in mm) on the holotype of *Karyosia apicava* new species: maximum carapace width, 17.0; maximum carapace length, 11.3; fronto-orbital width, 11.5; frontal width, 6.4; length to position of maximum width, 7.2.

Type: The holotype is TMM NPL 69679 and the paratype is TMM NPL 69680.

Occurrence: The holotype was collected from the City Park Road locality, Walnut Formation, and the paratype was collected from the Glen Rose Formation at Gale A. Bishop locality GAB 25.

Section Raninoida Ahyong *et al*., 2007

Superfamily Necrocarcinoidea Förster, 1968

Family Cenomanocarcinidae Guinot, Vega, and Van Bakel, 2008

Included genera: *Campylostoma* Bell, 1858; *Cenomanocarcinus* Van Straelen, 1936; *Hasaracancer* Jux, 1971.

Diagnosis: see Karasawa *et al*. (2014, p. 232).

Genus *Cenomanocarcinus* Van Straelen, 1936

Type species: *Cenomanocarcinus inflatus* Van Straelen, 1936, by monotypy.

Other species: see Karasawa *et al*. (2014, p. 232).

Discussion: Karasawa *et al*. (2014) recently diagnosed *Cenomanocarcinus* and the Cenomanocarcinidae. The genus is well-represented in the Cretaceous of North America, where two confirmed species are reported from the Western Interior (Rathbun, 1935; Stenzel, 1945). The Late Cretaceous embraces five species from across the continent (Feldmann *et al*., 2013).

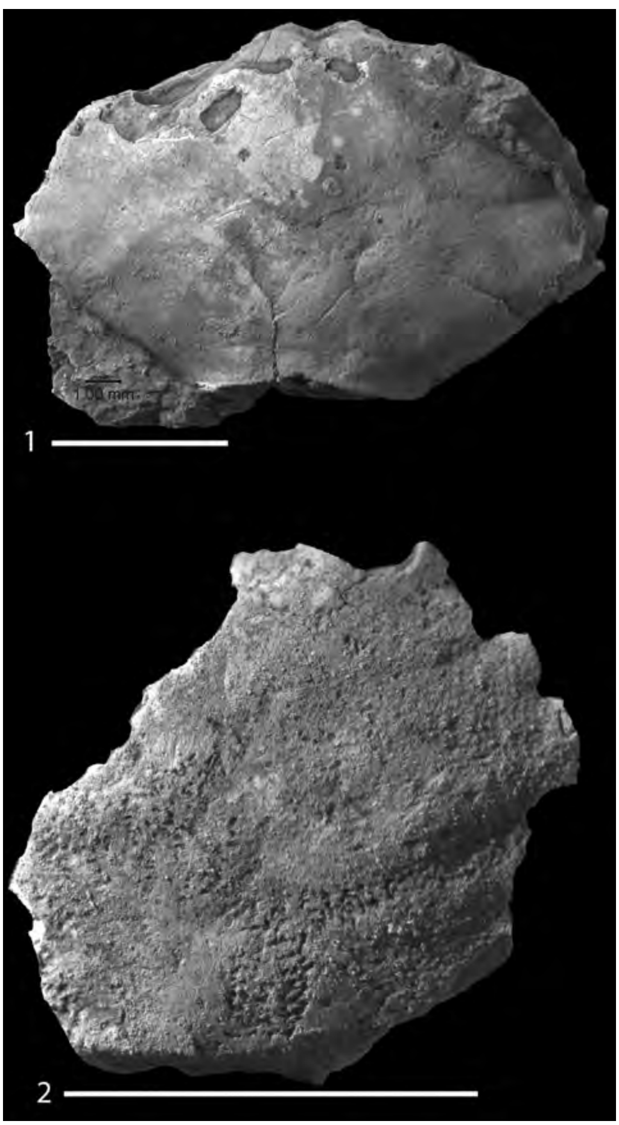


Fig. 7. Etyoidea, *Karyosia apicava* new genus, new species. 1, TMM NPL 69679, holotype, dorsal carapace; 2, TMM NPL 69680, right anterolateral margin and orbit, paratype. Scale bars = 5.0 mm.

***Cenomanocarcinus renfroae* (Stenzel, 1945)**

(Fig. 8.3, 8.4)

Necrocarcinus renfroae Stenzel, 1945, p. 443, pl. 41, fig. 13, text fig. 15.

Cenomanocarcinus renfroae (Stenzel, 1945). Schweitzer *et al*., 2010, p. 70; Vega *et al*., 2010, p. 272; Karasawa *et al*., 2014, p. 17.

Hasaracancer renfroae (Stenzel, 1945). Van Bakel *et al*., 2012, p. 58.

Diagnosis: Carapace not much wider than long, flattened longitudinally and transversely; orbits directed forward, small, with two fissures; keels on axis and branchial regions narrow but distinct; arcuate epibranchial keel and hepatic transverse ridge diagnostic for genus.

Material examined and occurrence: TMM NPL 69681 was collected from the Highway 281 locality, and TMM NPL 69682 was collected from the Summit North Subdivision locality, Glen Rose Formation; cast of holotype of *Hasaracancer cristatus* Jux, 1971, numbered KSU D 560 taken from BSP 1988 III 147.

Discussion: Karasawa *et al*. (2014) questionably referred *Necrocarcinus renfroae* to *Cenomanocarcinus* following Schweitzer *et al*. (2010) and Vega *et al*. (2010) who had also placed it within that genus. That seems to be the best placement for it at this time. The species possesses longitudinal keels on the axis and branchial regions, and the dorsal carapace is flattened, typical of *Cenomanocarcinus*. In addition, the orbits bear two fissures. However, the orbits are more broadly spaced than other members of *Cenomanocarcinus*, and *N. renfroae* lacks the strong transverse ridges on the hepatic and epibranchial regions typical of *Cenomanocarcinus*. Van Bakel *et al*. (2012) placed *N. renfroae* within *Hasaracancer* Jux, 1971. That genus, however, is characterized by species with closely spaced, square orbits that appear to lack fissures and with a second longitudinal ridge on the branchial regions. The anterolateral margins may be very strongly spined in *Hasaracancer*, and the posterolateral margin may also be spinose, not seen in *Necrocarcinus renfroae*. In addition, *Necrocarcinus renfroae* lacks the strongly vaulted carapace of Necrocarcinidae Förster, 1968, and it lacks the strong carapace ornamentation typical of Paranecrocarcininae Fraaije *et al*., 2008, within Necrocarcinidae. Unpublished specimens of *N. renfroae* from the Pawpaw Formation currently known to us exhibit sterna characteristic of Cenomanocarcinidae. That species may represent a new genus within Cenomanocarcinidae. For now, we place it within *Cenomanocarcinus*.

Family Orithopsidae

Schweizer, Feldmann, Fam, Hessin, Hetrick, Nyborg, and Ross, 2003

Included genera: *Aetocarcinus* new genus; *Bellcarcinus* Luque, 2014; *Cherpiocarcinus* Marangon and De Angeli, 1997; *Marycarcinus* Schweitzer *et al*., 2003; *Orithopsis* Carter, 1872; *Paradoxilissopsa* Schweitzer, Dworschak, and Martin, 2011 (= *Lissopsis* Frič and Kafka, 1887); *Paradoxicarcinus* Schweitzer *et al*., 2003; *Silvacarcinus* Collins and Smith, 1993.

Diagnosis: Carapace hexagonal, angular, wider than long or about as wide as long excluding orbital and rostral spines, length averaging about 90% carapace width, widest at position of last anterolateral spine, about one-third to one-half the distance posteriorly on carapace; flattened; rostrum projected well beyond orbits, with two to four spines; orbits broad; inter-, intra-, and outer orbital spines well developed, outer orbital spine sometimes bifid; fronto-orbital width 50–70% maximum carapace width; anterolateral margin short, about half maximum carapace length, with several spines; protogastric regions narrow, sometimes with small nodes or elongate, reniform swellings; hepatic regions wide, sometimes with small nodes or elongate, reniform swellings; cervical and branchiocardiac grooves shallow, not well defined; branchial regions sometimes with longitudinal ridges and small nodes anteriorly; axial regions may have longitudinal ridge; sternite 2 small, pentagonal; sternite 3 triangle, separate from sternite 4 by axial grooves; sternite 4 flattened axially and raised laterally, sternal suture 4/5 incomplete, deep, straight, then turning at nearly right angle and oriented parallel to axis of animal axially; sternite 5 wider than long, articulating with pereiopod 2, directed laterally, sternal suture 5/6 incomplete, deep, straight,

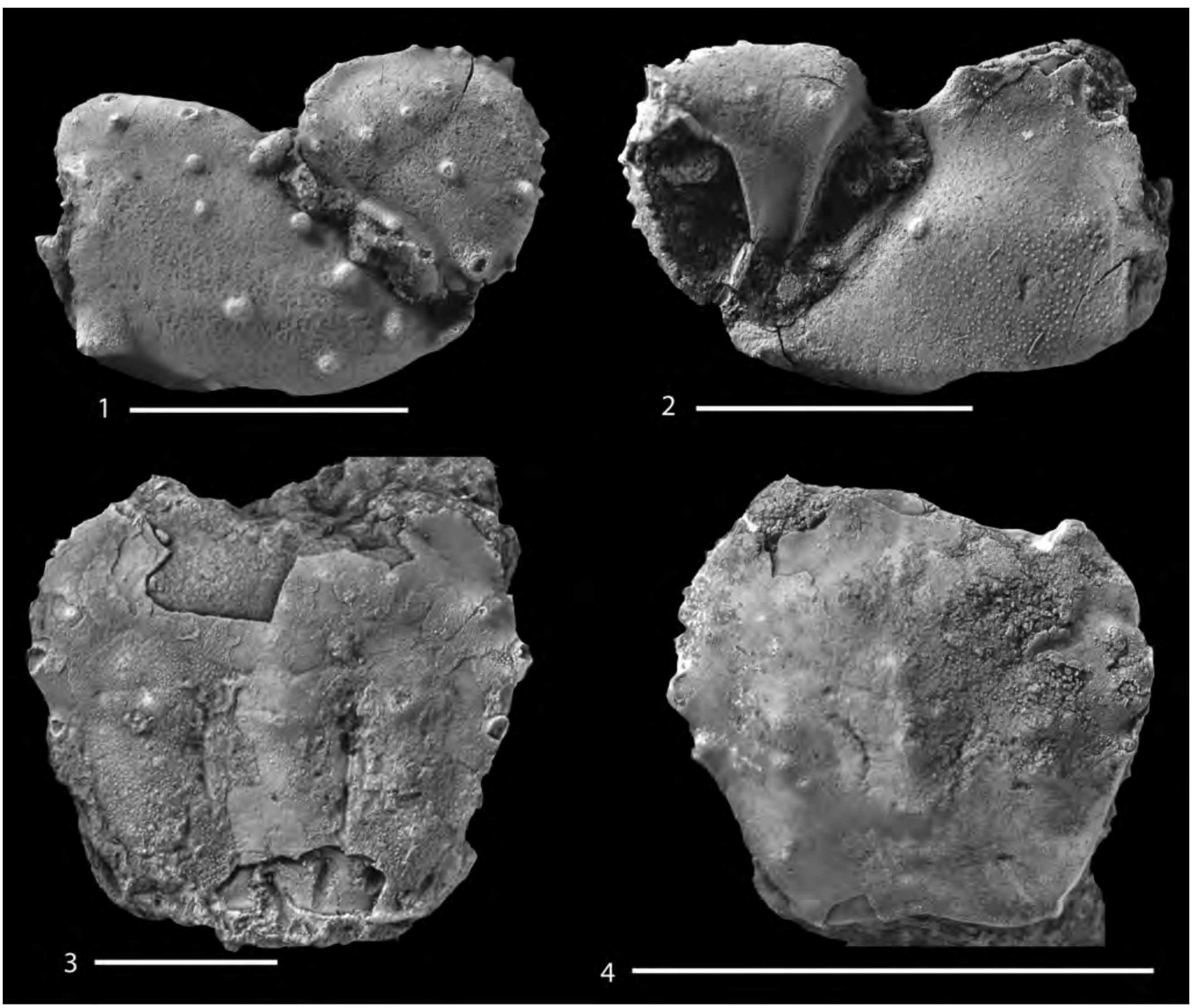
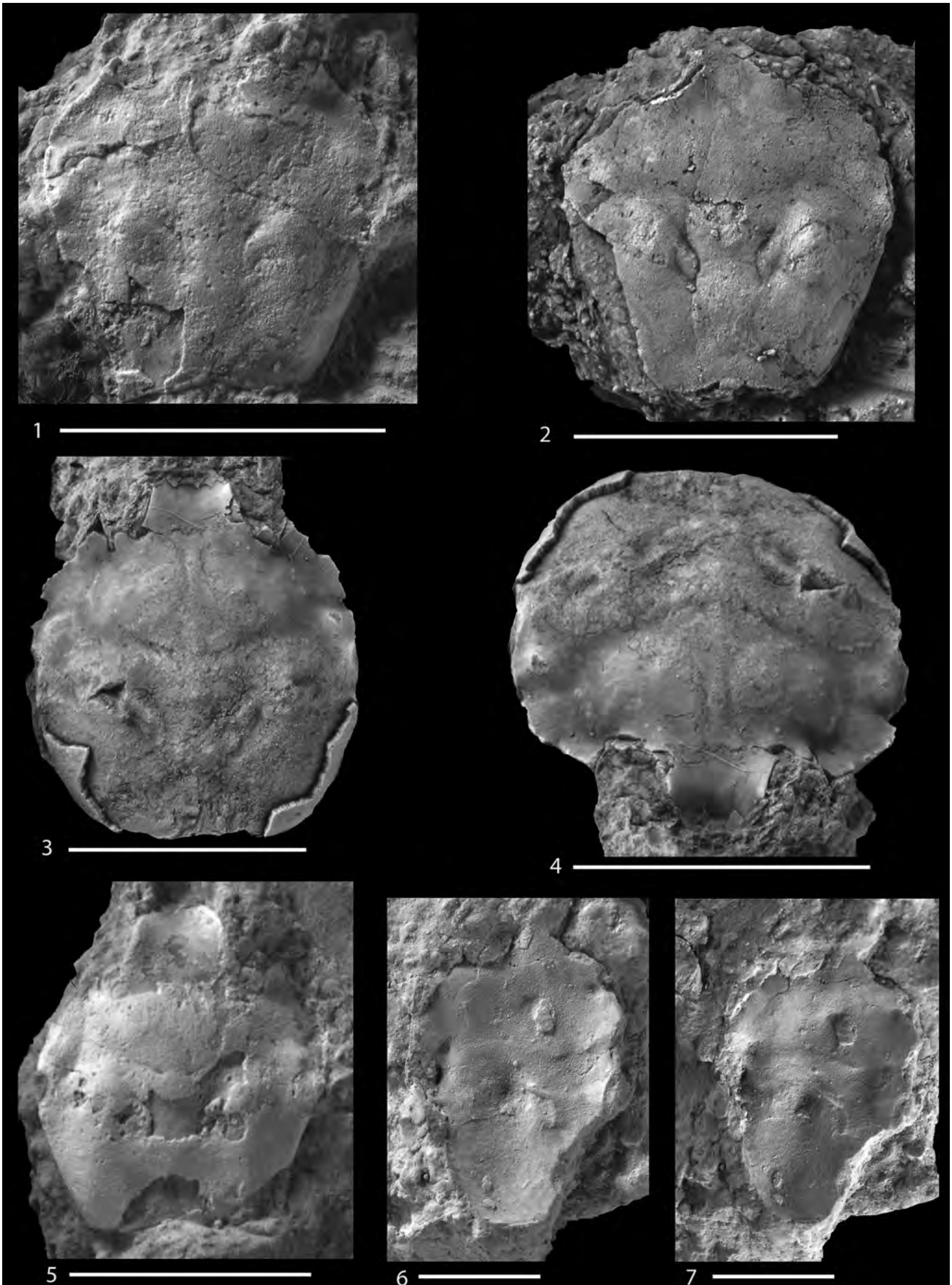


Fig. 8. Necrocarcinoidea. 1–2, Necrocarcinidae, *Necrocarcinus hodgesi* (Bishop, 1983), TMM NPL 69716 (= GAB 25-49), outer surface (1) and inner surface (2) of left manus and carpus, showing articulation of proximal margin of manus at low angle. 3–4, Cenomanocarcinidae, *Cenomanocarcinus renfroae* (Stenzel, 1945), TMM NPL 69681 (3), and TMM NPL 69682 (4). Scale bars = 1.0 cm.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then turning at nearly right angle and oriented parallel to axis of animal axially; sternite 6 directed posterolaterally, sternal suture 6/7 incomplete, deep, arcuate and oriented parallel to axis of animal axially; sternite 7 reduced with bulge anteriorly and axially, suture 7/8 appearing to be complete; sternite 8 reduced, vertical, visible only in posterior view; all pleonites free in females, with blunt axial ridge on each somite, somite 6 much longer than wide, telson extending to level of middle of somite 4 in female (after Karasawa *et al*., 2011; Karasawa *et al*., 2014).

Discussion: Orithopsidae was recovered as a distinct family within Necrocarcinoidea, although most members lack sternal elements (Karasawa *et al*., 2014). Thus, most genera referred to the family have been done so based upon dorsal carapace characters. The genus referred herein is no exception. The new genus *Aetocarcinus* is referred to Orithopsidae based upon its similarity to *Bellcarcinus*, originally placed within the Orithopsidae (Luque, 2014). *Aetocarcinus* new genus is also superficially similar to *Diaulax rosablanca* Gómez-Cruz *et al*., 2015, of Diaulacidae and some members of Necrocarcinidae, including those placed within Paranecrocarcininae. *Aetocarcinus* lacks sternal and pleonal elements, but it possesses the wide fronto-orbital width and well-developed rostrum typical of orithopsids and generally lacking in necrocarcinids. The affinities among the Necrocarcinoidea and the Diaulacidae are currently under study by two of us (CES and RMF) and colleagues; thus, the family placement of *Aetocarcinus* will be clarified.

Aetocarcinus new genus

Type species: *Diaulax roddai* Bishop, 1983, by original designation (=*Pseudonecrocarcinus stenzeli* Bishop, 1983).

Other species: *Aetocarcinus muricatus* new species.

Diagnosis: Carapace about as wide as long; rostrum extending well beyond orbits, axially broadly sulcate; distal half triangular, apparently blunt tipped, strongly downturned to be at high angle to carapace; proximal half with flared rim, rectangular; orbits with two orbital fissures; outer orbital spine broad, triangular, fronto-orbital width about 60% maximum carapace width; anterolateral margins short, with about 7 spines excluding outer-orbital spines; cervical groove better developed than postcervical and branchiocardiac grooves; carapace smooth or with tubercles, always with broadly inflated branchial ridge subparallel to axis.

Etymology: The genus name is derived from the Greek word *aetes* for wind, gale, honoring Gale A. Bishop, who originally described the type species of the genus. *Carcinus*, after the Greek *karkinos*, meaning crab, is a common stem in the family.

Discussion: Bishop (1983) originally described two new species in two different genera from the Glen Rose Formation, *Diaulax roddai* and *Pseudonecrocarcinus stenzeli*. Examination of the holotypes of these two species suggests that they are conspecific. *Diaulax roddai* is by far the better preserved and more complete of the two and was based upon not only the holotype, but also two other specimens which were not deposited in a museum. Those two specimens are now at hand (TMM NPL 69686, 69687). Comparison of the holotype of *D. roddai*, the two other originally referred specimens of *D. roddai*, and the holotype of *P. stenzeli* show that all are characterized by an equant carapace, a branchiocardiac groove that forms a loop-like curve lateral to the urogastric region, anterolateral margins shorter than the posterolateral margins, and depressed hepatic regions. Unfortunately, the holotype of *P. stenzeli* shows little more in the way of morphology. Thus, we synonymize these two species, and choose *Diaulax roddai* as the senior name.

Neither *Diaulax* nor *Pseudonecrocarcinus* can accommodate this species. Species of *Diaulax* do not have elongate, spatulate rostra as seen on *D. roddai* nor do they possess the broadly inflated ridge on the branchial region parallel to the axis as is present on *D. roddai*. Thus, we refer the species to a new genus within Orithopsidae, *Aetocarcinus*. *Pseudonecrocarcinus* is overall granular, with granular anterolateral margins and broad swellings on the carapace. The cuticle is very poorly preserved on all but one specimen, masking possible ornamentation. The specimens referred to the two species within this genus consist only of dorsal carapace material. Some are only molds of the interior, and when cuticle is preserved, only the inner layers are preserved.

Aetocarcinus roddai **(Bishop, 1983) new combination**
(Fig. 9)

Diaulax roddai Bishop, 1983, p. 45, pl. 1, figs. 1–2. Schweitzer *et al*., 2010, p. 66.

Pseudonecrocarcinus stenzeli Bishop, 1983, p. 48, pl. 1, figs. 3–5. Schweitzer *et al*., 2010, p. 81; Karasawa *et al*., 2014, p. 20.

Fig. 9. Orithopsidae, *Aetocarcinus roddai* new genus new combination. 1, holotype, SDSNH 23640; 2, TMM NPL 69683, partially exfoliated dorsal carapace; 3–4, TMM NPL 69684, mold of the interior with well-preserved rostrum and orbits showing orbital fissure, outer orbital spine, and strongly down-turned tip of rostrum; 5, TMM NPL 69688, partially preserved cuticle and well-preserved rostrum; 6–7, holotype of *Pseudonecrocarcinus stenzeli* Bishop, 1983, herein synonymized with *Aetocarcinus roddai*, image of moldic specimen (6) and image of specimen with reversed lighting (7) so that it appears convex. Scale bars = 1.0 cm except 6 and 7 which = 5.0 mm.

Diagnosis: Carapace about as wide as long; rostrum extending well beyond orbits, axially broadly sulcate; distal half triangular, apparently blunt tipped, strongly downturned to be at high angle to carapace; proximal half with flared rim, rectangular; orbits with two orbital fissures; outer orbital spine broad, triangular, fronto-orbital width about 62% maximum carapace width; anterolateral margins short, crispate, with about 7-9 projections excluding outer-orbital spines; cervical groove better developed than postcervical and branchiocardiac grooves; carapace smooth, always with broadly inflated branchial ridge subparallel to axis.

Description: Carapace about as wide as long, length excluding rostrum about 95% maximum carapace width, very weakly vaulted transversely and longitudinally; anterolateral margins shorter than posterolateral margins.

Rostrum extending well beyond orbits, axially broadly sulcate; distal half triangular, apparently blunt tipped, strongly downturned to be at high angle to carapace; proximal half with flared rim, rectangular. Orbits moderately deep, directed forward, with two orbital fissures, inner one half as deep as outer one; outer orbital spine broad, triangular, directed forward, fronto-orbital width about 62 % maximum carapace width, frontal width about 27 % maximum carapace width.

Anterolateral margins short, with about 7-9 small, blunt projections excluding outer-orbital spines, crispate in mold of interior. Posterolateral margin straight, longer than anterolateral margin, with one small spine posterior to last anterolateral spine. Posterior margin overall concave; composed of two convex arcs, overall concave, rimmed.

Mesogastric region short, anterior process narrow, posteriorly widened. Protogastric region wider than long, with larger swelling axially and smaller swelling laterally; hepatic region poorly defined, flattened.

Cervical groove deeply incised on lateral margin, undeveloped posterior to hepatic region, moderately developed posterior to protogastric region, discontinuous axially; better developed on mold of interior. Metagastric region wide; urogastric region poorly marked, depressed slightly below level of metagastric and cardiac regions; cardiac region triangular, moderately inflated. Urogastric region laterally bounded with loop-like remnant of branchiocardiac groove. Intestinal region broadly triangular, flattened. Epibranchial region defined as large swelling along urogastric region, extends into branchial ridge on some specimens; remainder of branchial region undifferentiated.

Material examined and occurrence: *Diaulax roddai* Bishop 1983, holotype, SDSNH 23640 and *Pseudonecrocarcinus stenzeli* Bishop, 1983, holotype, SDSNH 23641, both herein referred to *Aetocarcinus roddai* new combination, and collected from Gale Bishop locality 25. TMM NPL 69683-69685 were collected from Primrose Path, *Orbitolina* marker bed, Summit North Subdivision locality, Glen Rose Formation. TMM NPL 69686 (= GAB-25-58 of Bishop, 1983: table 6); 69687 (= GAB-25-161 of Bishop, 1983: table 6); and 69688-69692 are from Gale A. Bishop locality 25. TMM NPL 69725 was collected from the Summit North Subdivision locality, Glen Rose Formation.

Measurements: Measurements (in mm) taken on specimens of *Aetocarcinus roddai* are presented in Table 1.

Discussion: Some range of variation is apparent in the anterolateral margins and dorsal carapace ornamentation of *Aetocarcinus roddai*. Much of this seems to be due to cuticle preservation. Molds of the interior present a crispate anterolateral margin, and those with some layers of cuticle range from possessing blunt nodes to barely discernable nodes on a rimmed margin. Carapace swellings range from

Table 1. Measurements (in mm) taken on specimens of *Aetocarcinus* spp. indicated by TMM NPL number.

Specimen number	Carapace width	Carapace length excluding rostrum	Fronto-orbital width	Rostral width	Length to position of maximum width from base of rostrum
Aetocarcinus roddai 69684	13.7	13.1	7.8	3.2	4.2
Aetocarcinus roddai 69683	12.4	12.5			4.5
Aetocarcinus roddai 69685	15.0	12.2	10.0		
Aetocarcinus roddai 69688	6.1	5.4	4.4	2.2	2.0
Aetocarcinus roddai 69686	5.7		4.0		
Aetocarcinus muricatus 69693	14.1	13.3	9.0	4.4	3.5

discrete circular swellings as on the protogastric region of the holotype of *Diaulax roddai* to broadly inflated regions.

Aetocarcinus muricatus new species
(Fig. 10)

Diagnosis: Carapace about as wide as long; orbits with two orbital fissures; outer orbital spine broad, triangular, fronto-orbital width about 62% maximum carapace width; anterolateral margins with 7 spines excluding outer-orbital spines varying in size; cervical groove better developed than postcervical and branchiocardiac grooves; carapace regions with large tubercles; branchial region with oblique, longitudinal ridge with three large tubercles.

Description: Carapace about as wide as long, length excluding rostrum about 95 % maximum carapace width, very weakly vaulted transversely and longitudinally; anterolateral margins shorter than posterolateral margins.

Rostrum extending well beyond orbits, axially broadly sulcate, remainder unknown. Orbits deep, directed forward, with two orbital fissures, inner one half as deep as outer one; outer orbital spine broad, triangular, directed forward, fronto-orbital width about 62% maximum carapace width, frontal width about 27% maximum carapace width.

Anterolateral margins short, with about 7 spines excluding outer-orbital spines, varying in size and shape; first two small, blunt; third and fourth paired, followed by marked notch in margin where cervical groove intersects it; fifth spine broadly triangular, sixth spine small; seventh largest, long, directed laterally and somewhat upturned. Posterolateral margin straight, longer than anterolateral margin, with one spine posterior to last anterolateral spine followed by several granules. Posterior margin composed of two convex arcs, overall concave, rimmed.

Mesogastric region short, anterior process narrow, posteriorly widened into short, very wide region. Protogastric region wider than long, with granular swelling axially and smaller tubercle laterally; hepatic region poorly defined, depressed.

Cervical groove deeply incised on lateral margin, undeveloped posterior to hepatic region, moderately developed posterior to protogastric region, discontinuous axially. Metagastric region wide, with very large granular tubercle axially; urogastric region poorly marked, depressed slightly below level of metagastric and cardiac regions; cardiac region triangular, with two longitudinally arrayed tubercles, anterior one largest. Urogastric region laterally bounded with loop-like remnant of branchiocardiac groove.

Epibranchial region smooth, poorly defined, with large tubercle along lateral margin; remainder of branchial region with oblique, longitudinal ridge with three large tubercles.

Small, possible juvenile specimen with preserved cuticle with smaller, sharper spines and tubercles than larger specimen with preserved cuticle.

Etymology: The trivial name is the Latin word *muricatus* meaning pointed or spiny, like a muricid mollusk, in reference to the anterolateral spines and carapace tubercles diagnostic for this species.

Measurements: Measurements (in mm) taken on the types of *Aetocarcinus muricatus* new species are presented in Table 1.

Type: Holotype TMM NPL 69693.

Occurrence: Unit 6, Upper Member, Glen Rose Formation.

Discussion: Although range of variation is present in *Aetocarcinus roddai*, the range does not seem broad enough to accommodate the distinct, sharp spines on the anterolateral margins and discrete spines on the dorsal carapace seen in *Aetocarcinus muricatus*.Thus, the new species and *A. roddai* differ from one another in the observation that *A. muricatus* exhibits much more strongly developed dorsal ornamentation than does *A. roddai*.

Necrocarcinoidea incertae sedis
Necrocarcinus Bell, 1863 sensu lato

Necrocarcinus hodgesi (Bishop, 1983) new combination
(Fig. 8.1, 8.2)

Prehepatus hodgesi Bishop, 1983, p. 50, pl. 3, figs. 1–19. Schweitzer *et al*., 2010, p. 86.

Diagnosis: Carpus short, about as long as high, becoming shorter proximally, ornamented with short spines; manus slightly longer than high, proximal margin at low angle to lower margin, articulation with carpus rotated somewhat toward inner surface of manus; outer surface ornamented with short, sharp spines.

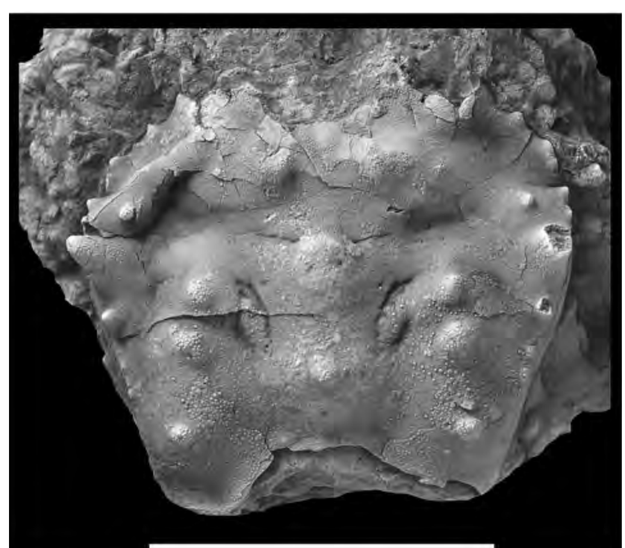

Fig. 10. Orithopsidae, *Aetocarcinus muricatus* new genus, new species. TMM 69683, holotype. Scale bar = 1.0 cm.

Material examined and occurrence: TMM NPL 69694-69719. Several of these specimens correspond to GAB 25 numbers (Bishop, 1983: table 7) (Table 2). All were collected at Gale A. Bishop locality 25, Glen Rose Formation.

Discussion: Jagt *et al*. (2010) noted that some species previously assigned to *Necrocarcinus* based upon claws could not be accommodated in that genus due to their straight proximal margin articulating at a more or less 90° angle with the carpus. They assigned several species with such a manus and with weak overall ornamentation and pits on the fingers, some of which had been originally assigned to *Prehepatus*, to *Roemerus* Bishop, 1983. Examination of the illustrations of the type species of *Prehepatus* Rathbun, 1935, *P. cretaceus*, indicates that it also possesses a manus with a proximal margin oriented at a 90° angle to the lower margin and robust ornamentation. Another species referred by Rathbun (1935) to *Prehepatus* in the same paper, *P. pawpawensis*, has a proximal margin oriented at a low angle to the lower margin and that wraps around toward the inner margin to articulate with the carpus along the inner margin. This is morphology typical of Raninoida and of that seen in *Necrocarcinus* and other Necrocarcinoidea. Thus, we assign *P. pawpawensis* to *Necrocarcinus* sensu lato until specimens can be recovered articulated with a dorsal carapace that could confirm another generic placement. The same manus morphology is observed in *Prehepatus hodges*i; thus, we refer it to *Necrocarcinus* sensu lato until it can be found articulated with a carapace.

Table 2. Texas Memorial Museum specimen numbers for *Necrocarcinus hodgesi* (Bishop, 1983) listed in Bishop (1983: table 7) under GAB 25 numbers.

TMM NPL number	GAB 25 number
69695	25-13
69696	25-17
69697	25-20
69698	25-21
69699	25-32
69700	25-33
69701	25-34
69702	25-35
69703	25-36
69704	25-37
69705	25-38
69706	25-39
69707	25-40
69708	25-41
69709	25-42
69710	25-43
69711	25-44
69712	25-45
69713	25-46
69714	25-47
69715	25-48
69716	25-49
69717	25-50
69718	25-51

Discussion

The carbonate Glen Rose and Walnut formations are Albian in age as is the Pawpaw Formation, although the Pawpaw is slightly younger. However, lithologically, the formations are quite different. The Pawpaw Formation is dominantly siliciclastic, and has been described and interpreted as clays and calcareous shales deposited in a nearshore, possibly lagoonal, environment. This setting is confirmed by the microfossil assemblage as well (Franţescu, 2014a, b). The lithologic differences between the Glen Rose and Walnut carbonates and the Pawpaw siliciclastics result in both composition and preservational style of the decapod faunas recovered from each.

Fossils collected from the Glen Rose and Walnut formations are uniformly preserved as molds, casts, and cuticle composed of calcium carbonate. The cuticle material is replaced by calcite, and the replacement is coarse enough that little remains of the original cuticular structure. The cuticle may be well preserved, as in the numerous fragments of pagurid claws, or it may be strongly etched. Specimens are disarticulated and only dorsal carapace material is preserved in all but one brachyuran species. No carapace specimens are accompanied by sterna, pleons, or appendages. By contrast, the specimens collected from the Pawpaw Shale display a wide range of preservational styles. Some have been preserved in limonitic concretions and some in marcasite concretions. Pyritization of specimens is common. Specimens may be preserved with original cuticle or as molds and casts. In addition to dissociated fragments, many specimens are preserved in 3-D with articulated appendages and pleons; others have been completely compressed during burial. Bioturbation in the surrounding sediment is not typically observed, but the interior of specimens is typically composed mostly of fecal pellets. Fecal pellets are not observed in the Glen Rose and Walnut specimens.

The difference in diversity of decapods between the Pawpaw Formation and the Glen Rose and Walnut formations is noteworthy (Fig. 11; Table 3). The carbonate environments have yielded 10 families thus far, whereas the Pawpaw has yielded 18, nearly twice as many (Rathbun, 1935; Schweitzer *et al*., 2012b; Franţescu, 2013, 2014a, b). The same pattern is true for genera, wherein the Pawpaw Formation has yielded just over twice as many, 27, as the carbonates, 13. Six families are represented in both faunas, but only three genera and possibly one species are shared.

Table 3. All known decapods from the Glen Rose and Walnut formations.

Infraorder Astacidea Latreille, 1802
Superfamily Nephropoidea Dana, 1852
Family Nephropidae Dana, 1852
Homarus Weber, 1795
Homarus travisensis Stenzel, 1945
Infraorder Anomura MacLeay, 1838
Superfamily Paguroidea Latreille, 1802
Family Paguridae Latreille, 1802
Pagurus Fabricius, 1775
Pagurus banderensis Rathbun, 1935
Infraorder Axiidea de Saint Laurent, 1979
Superfamily Callianassoidea Dana, 1852
Family Callianassidae Dana, 1852
Callianassa sensu lato Leach 1814
Callianassa klofi (Bishop, 1983)
Infraorder Brachyura Linnaeus, 1758
Section Dromiacea De Haan, 1833
Superfamily Homolodromioidea Alcock, 1900
Family Goniodromitidae Beurlen, 1932
Trachynotocarcinus Wright and Collins, 1972
Trachynotocarcinus naglei (Bishop, 1983)
Palaeodromites A. Milne-Edwards, 1865
Palaeodromites xestos new species
Family Longodromitidae Schweitzer and Feldmann, 2009
Rosadromites new genus
Rosadromites texensis new species
Vespridromites Schweitzer and Feldmann, 2011
Vespridromites? *scotti* (Bishop, 1983)
Dromiacea Incertae sedis
Roemerus Bishop, 1983
Roemerus robustus Bishop, 1983
Section Raninoida Ahyong et al., 2007
Superfamily Necrocarcinoidea Förster, 1968
Family Cenomanocarcinidae Guinot, Vega, and Van Bakel, 2008
Cenomanocarcinus Van Straelen, 1936
Cenomanocarcinus renfroae (Stenzel, 1945)
Family Orithopsidae Schweitzer et al., 2003
Aetocarcinus new genus
Aetocarcinus roddai (Bishop, 1983)
(=*Pseudonecrocarcinus stenzeli* Bishop, 1983)
Aetocarcinus muricatus new species
Family Necrocarcinidae Förster, 1968 sensu lato
Necrocarcinus hodgesi (Bishop, 1983)
Section Etyoida Guinot and Tavares, 2001
Superfamily Etyoidea Guinot and Tavares, 2001
Family Etyidae Guinot and Tavares, 2001
Karyosia new genus
Karyosia apicava new species
Section Cyclodorippoida Ortmann, 1892
Superfamily Cyclodorippoidea Ortmann, 1892
Family Cyclodorippidae Ortmann, 1892
Hillius Bishop, 1983
Hillius youngi Bishop, 1983
Chelae Incertae sedis
Torynomma? *densus* Bishop, 1983

The lithologies of the two formations are very different, suggesting that they reflect substantially different ecological settings. Further, the faunal differences reflect adaptation of the organisms to different substrates and possibly different water conditions, including salinity, temperature, and clarity.

The new taxa document some geographic and temporal range extensions. The range extensions for Goniodromitidae are notable. This is the first notice of *Palaeodromites* and *Trachynotocarcinus* in North America. Previously, the genera were known only from Northern Europe. *Palaeodromites* is extended from the early Early to late Early Cretaceous, and the range of *Trachynotocarcinus* is extended from Cenomanian to Albian. The late Early Cretaceous is further supported as a time of diversity and abundance in the decapod fauna of North America and the North Atlantic and Gulf Coastal Plain.

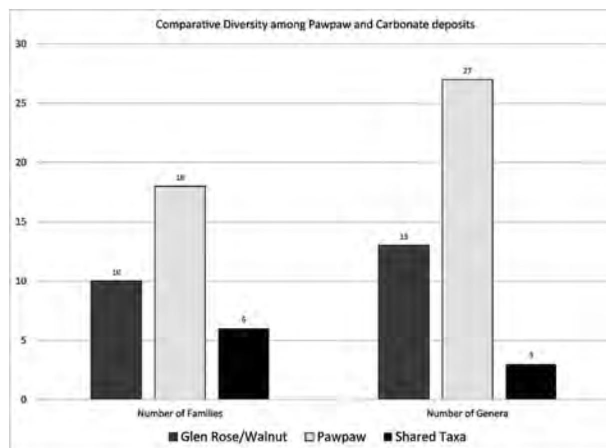

Fig. 11. Comparative diversity between Pawpaw Formation and Glen Rose and Walnut formations, all Albian age from Texas.

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