Bulletin of the Mizunami Fossil Museum, no. 45 (March 15, 2019), p. 1–6, 2 figs.

Earliest known sponge crab (Brachyura, Dromiidae) from the Upper Cretaceous Wenonah Formation, New Jersey, USA

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Abstract

A single specimen collected from the Campanian Wenonah Formation in New Jersey forms the basis for definition of a new genus and species of dromiid crab, *Costadromia hajzeri*. This occurrence represents the oldest known occurrence of Dromiidae. The discovery represents only the second decapod crustacean found in the formation and brings the total number of Cretaceous decapods in New Jersey to 23.

Key words: Decapoda, Dromiacea, Campanian, systematics, paleoecology, New Jersey

Introduction

Fossil decapod crustaceans, shrimp, lobsters, and crabs, have been known from New Jersey since the early 19th Century (Van Rensselaer, 1825; Morton, 1830, 1834) and were first monographed by Pilsbry (1901). More recently, Roberts (1962) provided descriptions and illustrations of 18 species of New Jersey Cretaceous decapods. Feldmann *et al.* (2013) updated the systematic placement and nomenclature where appropriate as well as adding one new genus and four new species to the Cretaceous New Jersey assemblage. The purpose of this work is to describe a fossil crab representing a new genus and species from the Wenonah Formation. The discovery represents only the second decapod known from that formation. Roberts (1962) recorded *Protocallianassa mortoni* (Pilsbry, 1901), now *Mesostylus mortoni* (Pilsbry, 1901) (fide Feldmann *et al.* 2013), from the unit.

Materials and Methods

The specimen was illustrated using a Nikon D3100 camera with an AF-5 Micro Nikkor 60mm lens. Tonal balance was achieved in Adobe Photoshop. Diversity data for fossil Dromiidae was taken from Schweitzer *et al*. (2010) and updated with more recently added taxa. Determination of rock type from which specimens were collected was taken from personal observation of sediment associated with specimens examined by the authors and from literature describing occurrences not seen by them.

Institutional Abbreviation

NJSM, New Jersey State Museum, Trenton, New Jersey, USA

Systematic Paleontology

Infraorder Brachyura Linnaeus, 1758
Section Dromiacea De Haan, 1833
Superfamily Dromioidea De Haan, 1833

Family Dromiidae De Haan, 1833

Included fossil genera: *Basadromia* Artal, Van Bakel, Domínguez, and Gómez, 2016; *Costadromia* n. gen. herein; *Cryptodromia* Stimpson, 1858; *Dromia* Weber, 1795; *Dromidia* Stimpson, 1858; *Dromiopsis* Reuss, 1858[1857]; *Epigodromia* McLay, 1993; *Kerepesia* Müller, 1976; *Pseudodromilites* Beurlen, 1928; *Quinquerugatus* Franțescu, Feldmann, and Schweitzer, 2010.

Diagnosis: See Schweitzer *et al*. (2012, p. 28). Salient features include, "Carapace longer than wide or as long as wide; rostrum typically bilobed; orbits without augenrest, deep, circular; orbital margin often with protuberance or rim, subouter-orbital spine visible in dorsal view; cervical groove weak; postcervical groove sometimes present; branchiocardiac groove present."

Discussion: The new taxon conforms to the diagnostic characters above in most essential characters. Placement of the new genus within Dromiidae is based largely upon details of the frontal margin which is triangular, downturned, and bears a rim which is continuous with the orbital rim, and a subouterorbital spine visible in dorsal view. The front of the new species is reminiscent of that of *Dromiopsis rugosus* (Schlotheim, 1820) from the Paleocene of Denmark, the type species of *Dromiopsis* and a typical fossil representative of the family. The orbits of the new species are ovoid and deep, lack an augenrest, and exhibit a suborbital spine that can be viewed dorsally. Jagt *et al*. (2015, p. 867) referred *D. rugosa* to Dynomenidae. However, *D. rugosa* exhibits a suborbital margin bearing a suborbital spine visible in dorsal view which is consistent with the definition of Dromiidae. The suborbital margin in Dynomenidae is complete and entirely visible in dorsal view.

The new species bears superficial resemblance to species within Goniodromitidae Beurlen, 1932; however, the possession of orbits arising beneath the rostrum and an augenrest directed anterolaterally in Goniodromitidae are significantly different from Dromiidae. The orbital architecture of species within Dromiidae lacks an augenrest and has forward-directed orbits placed lateral to the rostrum. The new genus and species possesses the orbital characters of Dromiidae.

Placement of the new genus within Dromiidae extends the range of the family into the Campanian. Previously, the earliest occurrences were recorded from the Maastrichtian (Schweitzer *et al*., 2010).

Costadromia, new genus

Type species: *Costadromia hajzeri* n. sp.

Etymology: The generic name is derived from the Latin costa = ridge and *Dromia*, the type genus of Dromiidae. The gender is female.

Diagnosis: As for species.

Discussion: The dense development of granules and nodes on the carapace, as well as possession of three granular ridges on the branchial regions, distinguishes *Costadromia* from all other genera within the family. The frontal architecture of *Costadromia* n. sp. is similar to that of *Dromiopsis rugosus*; however, the two genera differ in other essential characters. The cervical groove is about equally developed in *Dromiopsis rugosus* and the new species; however, the postcervical and branchiocardiac grooves are not obvious in the new species but are deep in *D. rugosus*. *Dromiopsis rugosus* is also slightly wider than long. The new species in *Costadromia* n. gen. differs from *D. rugosus* in that the former lacks postcervical and branchiocardiac grooves and possesses granular nodes and transverse branchial ridges unlike the uniformly granular surface of *D. rugosus*. *Epigodromia areolata* (Ihle, 1913) bears granular nodes, but it possesses a bifid front and lacks transverse branchial ridges. The cervical groove is less developed or not expressed in other dromiid genera, which serves to distinguish them from *Costadromia* n. gen.

Costadromia hajzeri, new species

(Fig. 1)

Diagnosis: Dromiid slightly wider than long, with granular frontal and orbital ridge, blunt suborbital spine, granular and nodose carapace ornamentation, and three transverse, arcuate granular ridges on meso- and metabranchial regions.

Etymology: The trivial name recognizes Mr. Frank Hajzer, Lawrence Township, New Jersey, who collected the specimen, made it available to us for study, and donated it to the New Jersey State Museum, Trenton, New Jersey.

Description: Strongly ornamented carapace; wider, 37.6 mm measured at midlength, than long, 30.5 mm; L/W = 0.81; moderately vaulted transversely; strongly arched anteriorly in longitudinal view and less so posteriorly; highest position on carapace at mesogastric region.

Front triangular, downturned, axially sulcate; marginal rim finely granular extending in continuous arc to form granular orbital rim. Orbits ovate, ca. 3.7 mm in diameter, outer orbital corner projected, blunt suborbital spine visible when viewed dorsally. Fronto-orbital width 17.6 mm; FOW/W = 0.47. Anterolateral and posterolateral margins form convex arc. Posterior margin broken.

Sulcate rostral surface bounded by divergent epigastric regions bearing longitudinal granular ridges terminating posteriorly in large granular tubercle bounding anterior projection of mesogastric region bearing single row of four granules. Posterior part of mesogastric region strongly inflated, wider than long, surface with granular tubercles. Protogastric region depressed below axial region, granular with one larger granular tubercle at posterior corner. Hepatic region a single, granular tubercle. Metagastric region a concave-forward granular arc as wide as mesogastric region, narrowing posteriorly. Urogastric region depressed,

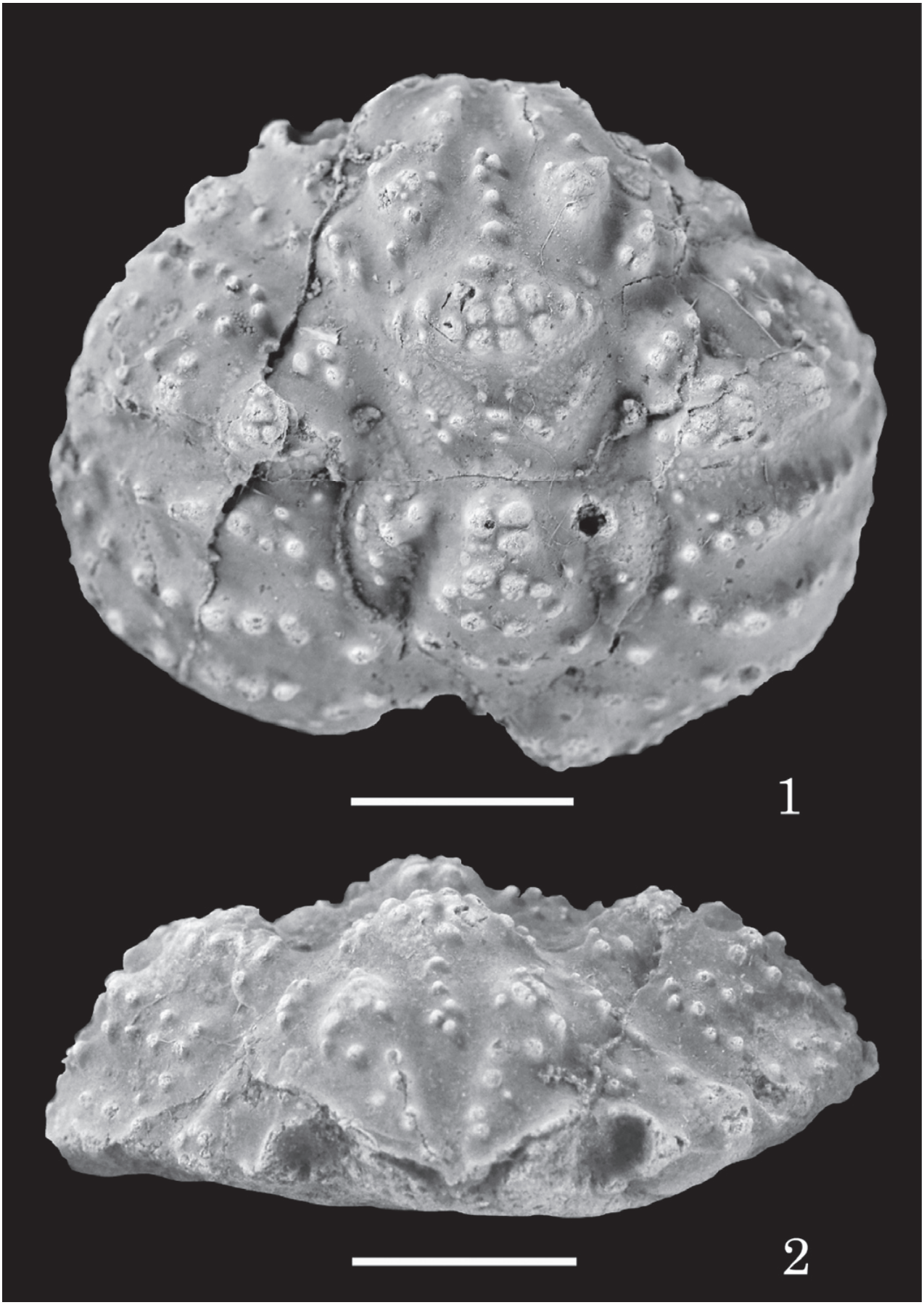

Fig. 1. ***Costadromia hajzeri,*** **new genus and species.** *1*, dorsal view of holotype, NJSM 24329; *2*, frontal view of the same specimen. Scale bars = 1 cm.

smooth. Cardiac region an isosceles triangle bounded by smooth depressions, longer than wide, widest posteriorly, with granular tubercles in concave-forward arcs. Intestinal region depressed, smooth.

Cervical groove weakly convex-forward, extending from base of hepatic region to mesogastric region as depressed, oblique, smooth surface, turning strongly posteriorly to cross midline in poorly defined V-shaped surface. Epibranchial region large with granular surface laterally, becoming tubercular axially. Small, longitudinally arcuate, tubercular branchial swellings situated parallel to cardiac region. Mesobranchial and metabranchial regions undifferentiated, with three prominent concave-forward ridges with granular tubercles on crests.

Sternum, pleon, and appendages not preserved.

Locality and stratigraphic position: The sole specimen was collected from the Big Brook Locality on "Coelurus Run" in Marlboro Township, Monmouth County, New Jersey. At this locality fossil specimens may be derived from the Wenonah and Navesink formations, both of Cretaceous age (Garb *et al.* 2007; Callahan *et al.* 2014). The Wenonah/Navesink transition is non-conformable, marked by the presence of a transgressive lag at the base of the Navesink Formation, interpreted to be the Campanian/Maastrichtian boundary. The matrix adhering to the specimen is typical of the Wenonah Formation. It is primarily terrigenous material, lacking the substantial amounts of the authigenic mineral glauconite that would be expected in the Navesink Formation. The age is late Campanian.

Holotype: The holotype and sole specimen, NJSM 24329, is deposited in the New Jersey State Museum, Trenton, New Jersey, USA.

Discussion: Although the ornamentation of the carapace of *Costadromia hajzeri* n. gen., n. sp., differs markedly from all other known species of dromiid, the architecture of the frontal and orbital regions, as discussed above, as well as the general form of the axial regions is consistent with placement within Dromiidae and rules out placement of the new species in other genera. The metagastric region is as broad as the mesogastric region and curves around the mesogastric, the urogastric region is depressed and

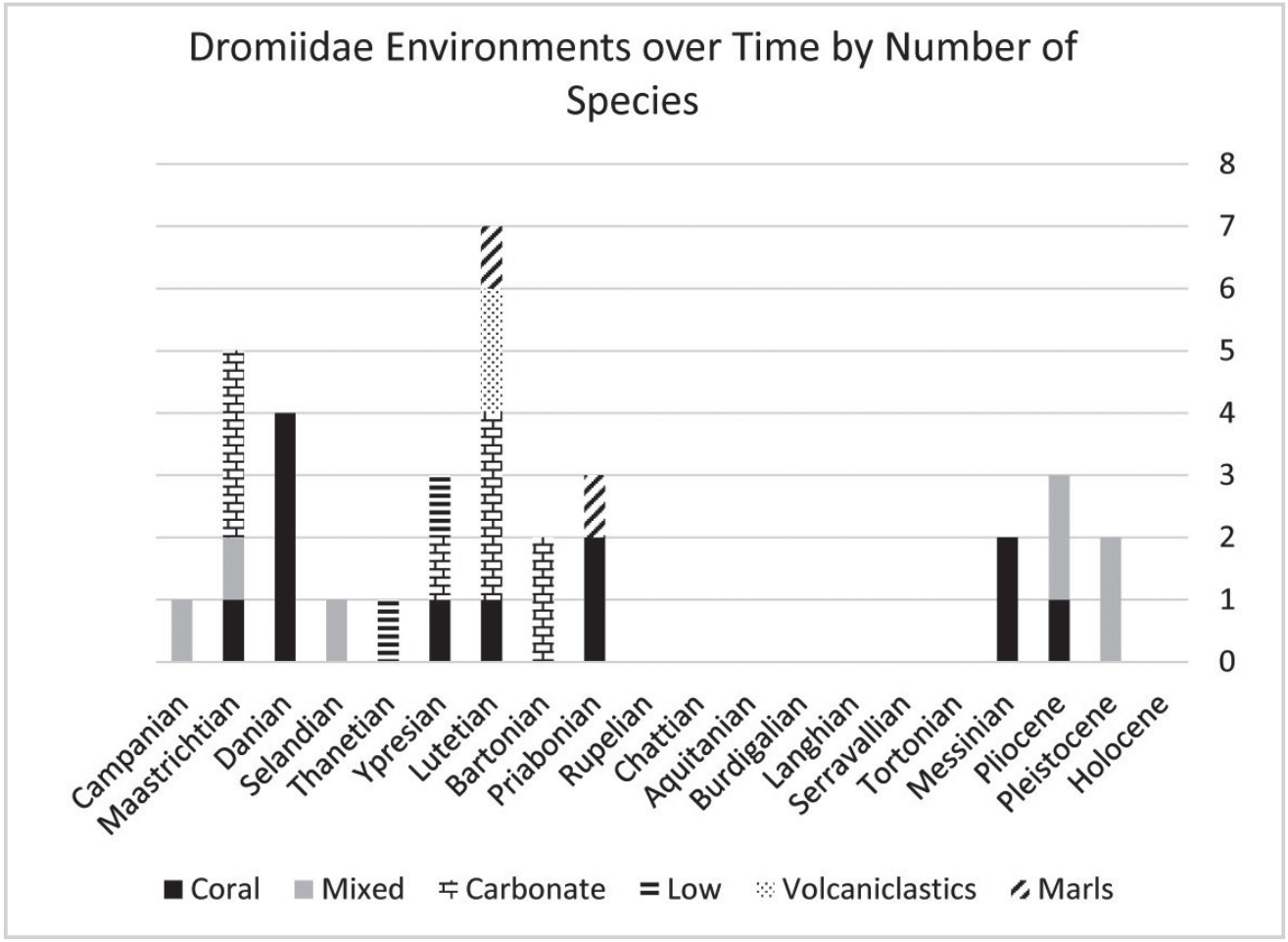

Fig. 2. Distribution of habitat preferences for Dromiidae through their known geological occurrences. One hundred twenty-eight species of Dromiidae were reported by Ng *et al.* (2008), but habitat preferences were not compiled.

smooth, and the cardiac region is a prominent, triangular structure. The most distinctive feature of the sole specimen is the development of the strong tuberculate ridges on the branchial regions.

The Dromiidae is often given the colloquial name of sponge crab in reference to the common habit in extant forms of selecting a piece of sponge or tunicates to carry on the carapace as camouflage (Guinot and Wicksten, 2015). McLay (1993) provided the most recent monograph of the Dromiidae wherein he concentrated on species from New Caledonia and the Philippines; however, he did consider members of the family from other regions as well. Although little or no reference was made to substrate preference, McLay (1993) recorded species ranging from intertidal to 440 m depths. Most species were collected from depths less than 100 m. Sakai (1976) reported species of Dromiidae on muddy, sandy, shelly, and rocky substrates, typically at depths less than 100 m. Ng (1998) reported species from the western central Pacific in shallow regions on substrates ranging from muddy to rocky-muddy on substrates often near reefs. Compilation of the substrate preferences of fossil Dromiidae (Fig. 2) documents a broad range of preferred habitats throughout the history of the family. The lithology of the Wenonah Formation consists of fine-grained micaceous sandstone with occasional grains of glauconite (Spangler and Peterson 1950), which is confirmed by examination of the reverse side of the holotype. This is a siliciclastic environment not unlike that characterized by Ng, but at a paleolatitude well above that in which corals would flourish. The association of the new species with the callianassid ghost shrimp, *Mesostylus mortoni*, documents a shallow marine, intertidal to subtidal, siliciclastic habitat consistent with that of some extant dromiids, but absent nearby reefs. This occurrence is consistent with the range of habitats occupied by extant species.

Acknowledgments

Mr. Frank Hajzer collected the specimen described herein and made it available for study. In addition, he provided information regarding the collecting locality and suggested key literature to the stratigraphic occurrence. Dr. David C. Parris and Wayne Callahan, New Jersey State Museum, Trenton, read the manuscript and provided additional information regarding the stratigraphic setting. Careful reviews by Dr. Francisco Vega, Instituto de Geología, UNAM, México, D. F., Mexico, and the editor, Dr. Hiroaki Karasawa, strengthened the manuscript. Diversity and environmental analyses were supported by NSF grant EAR-1223206 to Schweitzer and Feldmann.

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Manuscript accepted on September 2, 2018