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A NEW FAMILY, GENUS, AND SPECIES OF LOBSTER (DECAPODA: ACHELATA) FROM THE GADVAN FORMATION (EARLY CRETACEOUS) OF IRAN

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INTRODUCTION

RECORDS OF fossil decapod crustaceans from Iran are scarce. Förster and Seyed-Emami (1982) reported *Eryma bedelta* (Quenstedt, 1857) from the Aalenian (Middle Jurassic) in northern Iran. Garassino and Krobicki (2002, p. 56) noted the presence of the lobster *Eryma* von Meyer, 1840, from Iran. Garassino (personal commun., 2005) confirmed that this referred to the work of Förster and Seyed-Emami and noted that this was the only decapod occurrence in the country known to him. Toraby and Yazdi (2002) reported a portunid from the Miocene of the country in an abstract but we are unaware of a subsequent publication. Microcoprolites with an internal structure characteristic of decapods are known from the Jurassic of Iran (Brönnimann, 1977). Thus, the discovery of the remains of a remarkable macrurous decapod, recovered from a well core sampling the Gadvan Formation, is noteworthy. This unique specimen is the basis for description of a new family, genus, and species of palinuroid lobster.

The Gadvan Formation, named by James and Wynd (1965), has its type locality in the Fars Province at Kuh-e-Gadvan, east-northeast from Shiraz, Iran. It is a part of the progradational Megasequence VI (Alavi, 2004) of deep-marine to shallow-shelf sediments. At the type locality, the formation consists of about 107 m of dark gray, argillaceous, bioclastic limestone interbedded with gray, green, and brownish yellow marl. Laterally, the formation grades into dark shale and argillaceous limestone in the Khuzestan Province, the area from which the decapod was collected. Specifically, the specimen was extracted from a well at latitude 31°18′ 13.3″N and longitude 47°47′28.6″E (Fig. 1), at a depth of 3,852 m in the lower calcareous shale of the lower part of the siliciclastic member of the Gadvan Formation. The unit is the lateral equivalent of the Zubair Formation in Iraq (James and Wynd, 1965). As echinoderm and pelecypod shell fragments are abundant, some of the shales have been interpreted to have been deposited in a shallow, open-marine environment although, as discussed below, the shale enclosing the decapod described herein was likely deposited in deeper water. The age of the formation has been determined to be Barremian to Aptian, based upon foraminiferans (see James and Wynd, 1965, fig. 5). The age is well constrained because the Gadvan Formation is part of the primary oil- and gas-producing sequence in the area surrounding the Persian Gulf.

Order DECAPODA Latreille, 1802
Infraorder ACHELATA Scholz and Richter, 1995
Superfamily PALINUROIDEA Latreille, 1802
Family TRICARINIDAE new family

Diagnosis.—Dorsoventrally flattened carapace lacking cervical or other transverse grooves but bearing distinctive narrow axial and branchial carinae; remainder of carapace depressed; antennae arise near anterolateral corners; eyes and orbits not developed; front broad and projected well in advance of antennal bases; anterolateral and posterolateral corners with prominent spines. Sole preserved pereiopod achelate.

Discussion.—Most families of macrurous crustaceans embrace genera in which the cephalothorax is generally cylindrical. Notable exceptions to this are the Coleiidae Van Straelen, 1924, Eryonidae de Haan, 1841, Polychelidae Wood-Mason, 1874, and Tetrachelidae Beurlen, 1930, within the Eryonoidea de Haan, 1841; and the Scyllaridae Latreille, 1825, within the Palinuroidea Latreille, 1802. However, none of these families can accommodate the new genus described below for several reasons. The Coleiidae, Polychelidae, and Tetrachelidae have well-developed transverse grooves, well-developed regions, prominent orbits, and a narrow front, none of which is present in the new specimen. The Eryonidae have a narrow front and well-defined orbits, and if longitudinal carinae are present, they seem to be confined to the posterior part of the carapace.

The Scyllaridae is the most speciose of these families, and has been subdivided into four subfamilies (Holthuis, 1985), none of which exhibit the characters present on the sole species within the new genus. Members of the Scyllaridae have well-developed orbits on the anterior margin, many proximal to the anterolateral corner. The new species lacks orbits entirely. Transverse grooves tend to be prominent, and in some genera the cervical groove is developed into a distinctive cervical incision (Holthuis, 1985, 1991) in the Scyllaridae; none is characterized by a prominent posterolateral spine as is present in the new specimen. The antennal bases arise near the axis and the distal antennal elements are extremely broad, flattened, and never annulated in the Scyllaridae, whereas in the new specimen the antennal bases arise near the anterolateral corner. Thus, although definition of a new family must be done with considerable caution, placement of the specimen referred to the new genus and species in a currently recognized family would necessitate expanding the concept of any of the macruran families to the point that they would become meaningless. It is unfortunate that the taxon must be erected on the basis of a single, incomplete specimen; however, the specimen was retrieved from a well core and the probability of collecting a second specimen is remote. It is fortunate that one specimen was collected and identified at all.

Genus TRICARINA new genus

Type species.—*Tricarina gadvanensis* n. sp., by original designation.

Diagnosis.—As for family.

Description.—As for species.

Etymology.—The generic name is a combination of the Latin words, *tri-*, a prefix denoting three, and *carina* = keel, in reference to the most distinctive feature of the carapace.

Occurrence.—The genus is presently known only from the Barremian–Aptian (Early Cretaceous) Gadvan Formation in Iran.

FIGURE *1*—Map of southwestern Iran and adjacent countries, showing the well site (arrow) from which *Tricarina gadvanensis* n. gen. and sp. was collected.

TRICARINA GADVANENSIS new species
Figure 2

Diagnosis.—As for family.

Description.—Carapace more or less equidimensional, width = 43.8 mm, greater than preserved length, >33.3 mm, truncated by saw cut; dorsoventrally flattened. Front unknown, but narrows anteriorly from basal elements of antennae and projects well beyond basal antennal articles. Carapace widest at anterolateral corners, projected into short, distinct, anteriorly directed spines. Lateral margins nearly straight, with narrow rim and furrow, converging posteriorly to long, slender posterolateral spines directed anterolaterally and curving more anteriorly at tips. Posterior margin broad, 33.4 mm measured between bases of posterolateral spines, sinuous. Carapace surface without transverse grooves. Axis elevated as prominent, narrow ridge, extending to near posterior margin where it bifurcates, resulting in flattened, triangular, elevated region broadening posteriorly. Broader, prominent ridges [posterior branchial carina of Holthuis (1991)] extend from midpoints of antennal bases nearly parallel to lateral margins, curve axially and broaden posteriorly to become swollen areas merging into axial ridge along posterior margin. Surface ornamentation on cephalothorax subtly scabrous.

First abdominal somite slightly shorter, 6.1 mm, than second, 6.5 mm, measured along axis. First somite approximately as wide as posterior margin of carapace, narrowing laterally and apparently lacking pleura. Second and third somites remain broad laterally with tergal surfaces merging into long, sinuous pleural spines which curve posteriorly initially and then curve anterolaterally near distal ends. Fourth somite truncated at margin of core. Surface of abdomen, where observable, weakly pustulose.

Antennal bases broader, 6.5 mm, than long, 4.6 mm, swollen; arise near anterolateral corners. Distal elements of antennae with pustulose surface, outline not observable.

One fragment of a left thoracic appendage preserved as long, slender, tapering element. Termination not chelate.

Etymology.—The trivial name alludes to the Gadvan Formation, from which the sole specimen was collected.

Type.—The holotype and sole specimen, CM 54197, deposited in the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, consists of part and counterpart of the carapace, with the frontal margin sawn off, and the first four abdominal somites.

Occurrence.—The specimen was collected from a well core taken from the Barremian–Aptian Gadvan Formation from the Khuzestan Plain, west of the Zagros Mountains, in southwest Iran.

Discussion.—Recognition of the uniqueness of the species has been discussed above. There are relatively few macrurans that do not exhibit some trace of transverse grooves and none with the basal elements of the antennae so close to the anterolateral corner without an intervening orbit. Further, no other fossil or extant taxon within the families discussed above in which placement was considered exhibits strong anterolateral and posterolateral spines separated by a straight, smooth lateral margin. In fact, the distinctive, curving spine on the posterolateral corner renders the species unique. Finally, the abdomen, which lacks an axial keel and which possesses very long, curving pleura, is unlike that of other decapod taxa.

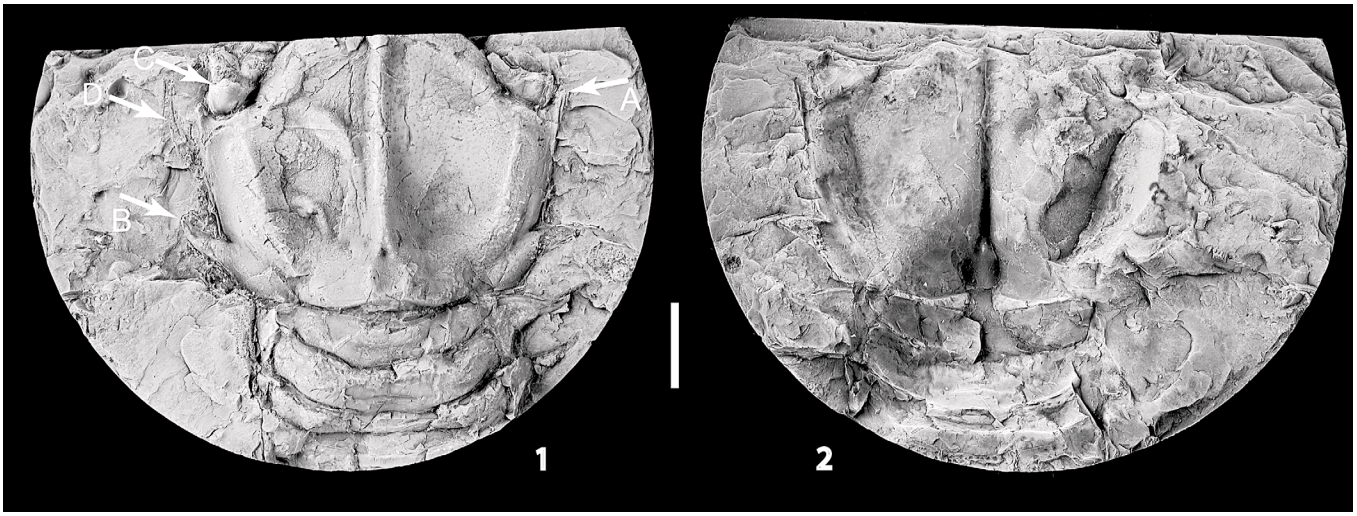

FIGURE *2*—*Tricarina gadvanensis* n. gen. and sp. *1,* part, and *2,* counterpart of holotype, CM 54197. The core was cut before it was split to reveal the specimen. Arrow A denotes the anterolateral spine, Arrow B denotes the posterolateral spine, and Arrow C denotes the basal elements of the antenna. Arrow D denotes the sole achelate thoracic appendage. Scale bar equals 1 cm.

Placement of the new family within the Palinuroidea is made with somewhat less confidence. The possession of transverse carapace grooves and general outline of palinuroids and eryonoids can be similar. However, a useful distinguishing preservable feature is the nature of the terminations on the first four pereiopods. Those appendages are chelate on representatives of the Eryonoidea and are not chelate on members of the Palinuroidea. The sole pereiopod preserved on *Tricarina gadvanensis* lacks evidence of a chela and, therefore, the genus is placed within the latter superfamily. Certainly, additional confirming evidence would provide reassurance; however, none will be forthcoming until more, and more complete, material is collected.

When rotated 180°, the specimen bears a superficial resemblance to the abdomen and telson of a stomatopod. However, several features confirm that the resemblance is superficial. The sixth abdominal somite in stomatopods is well developed and bears the articulation for the uropod. No such feature is evident on the Iranian specimen and, in fact, the first abdominal somite, as interpreted herein, is reduced and bears reduced pleura, as is typical in macrurans. Additionally, the basal elements of the antennae, as interpreted herein, cannnot be ascribed to any structure on the telson of stomatopods. Finally, the general outline of the carapace, as interpreted herein, bears no resemblance to the tapering telson of stomatopods. Therefore, the systematic position of the specimen as a decapod crustacean is assured.

The sole specimen was preserved in a fissile, black shale interpreted to have been deposited in an offshore, deepwater setting (Alavi, 2004). Because the specimen represents the sole member of the family, close analogs upon which ecological interpretations can be made are not available. However, from the standpoint of functional morphology, *Tricarina gadvanensis* bears some resemblance to several genera within the Scyllaridae. Both this tricarinid and the scyllarids have dorsoventrally compressed carapaces, broad abdomens, and achelate pereiopods. Extant scyllarids are known to inhabit both reefal and soft-bottom environments (Davie, 2002; Poore, 2004) and are found at depths up to approximately 500 m (Davie, 2002, p. 439). They hide in caves and crevices in reefs and burrow in sand and mud in open-bottom settings. Based upon the similarity in form of *Tricarina gadvanensis* to the scyllarids and considering the nature of the sediment in which the specimen is preserved, it seems likely that this organism burrowed into the soft substrate for concealment. The large marginal spines and the scabrous ornamentation of the cephalothorax are similar to those of *Eryon arctiformis* (Schlotheim, 1820) from the Late Jurassic of the Solnhofen Lithographic Limestone, although that species exhibits more lateral spines. *Eryon arctiformis* also inhabited a soft substrate. The lack of eyes in *Tricarina gadvanensis* suggests that the organism may have been adapted to an aphotic environment. Eyes are absent in other deepwater decapods such as, for example, the Thaumastochelidae Bate, 1888.

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