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The oldest Munididae (Decapoda: Anomura: Galatheoidea) from Ernstbrunn, Austria (Tithonian)

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(With 2 figures)

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Abstract

Two new species of Munididae from the Jurassic, *Juracrista perculta* and *Juracrista costaspinosa*, are the oldest known members of the Munididae. This new discovery parallels the other galatheoid lineages, with the Galatheidae, Munidopsidae, and Porcellanidae all having roots in the Middle-Late Jurassic.

Keywords: Munididae, Galatheoidea, Ernstbrunn Limestone, Tithonian, new taxa, phylogeny

Zusammenfassung

Zwei neuen Arten jurassischer Munididae, *Juracrista perculta* und *Juracrista costaspinosa*, sind die ältesten bekannten Vertreter dieser Familie. Diese Neuentdeckung zeigt Parallelen zu den Galatheidae, Munidopsidae, und Porcellanidae, die ebenfalls alle Wurzeln im mittleren bis oberen Jura haben.

Schlüsselworte: Munididae, Galatheoidea, Ernstbrunner Kalk, Tithonium, Neue Taxa, Phylogenie

Introduction

The paleontological research staff of the Natural History Museum of Wien, Austria, made available for study many specimens from Friedrich Bachmayer's Jurassic decapod collection. Thousands of decapod specimens were collected by Bachmayer and his associates during his long paleontological career. The specimens come from the Ernstbrunn Limestone of Lower Austria (Fig. 1). Among the hundreds of galatheoids

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Fig. 1. A schematic view of the study area.

made available are the oldest known members of the Munididae. Both the excellent preservation of these specimens and their unique characteristics present an opportunity to improve our understanding of the early history of the munidid lineage.

Extensive publications by Schweitzer & Feldmann detail numerous other elements of the decapod fauna identified from the Ernstbrunn Limestone, indicating that a large brachyuran radiation occurred during the Late Jurassic (Feldmann & Schweitzer 2009; Schweitzer & Feldmann 2009a, 2009b). The large variety of galatheoids found within Bachmayer's collection indicate that the galatheoids also underwent a radiation similar to the brachyurans during this time period. Study of the remaining galatheoids in the collection is ongoing.

Study Area

The Ernstbrunn Limestone crops out in several locations in Lower Austria and, based on ammonites (Zeiss 2001), was most likely deposited during the Tithonian (latest Late Jurassic; Adámek 2005). Hofmann (1993), citing Zeiss & Bachmayer (1989) and Řehánek (1987), further narrowed the time period of deposition to middle middle Tithonian continuing to the end of the early late Tithonian.

The Bachmayer Collection is a combination of material sourced from five Ernstbrunn Limestone quarries in the Ernstbrunn area. The exact stratigraphic locations and associations of the material are unknown.

Abbreviations and Notes

The specimens studied for this work are housed in the Naturhistorisches Museum in Wien, Austria (NHMW). Unless otherwise noted, all illustrated specimens were dyed with removable blue dye and subsequently coated with ammonium chloride sublimate

prior to photography. When possible, measurements were taken of total length, excluding rostrum (L), maximum width (MW), width of frontal margin (FW), orbital width (O), and rostral length (RL). Exclusively fossil genera are denoted with §§. Genera with both an extant and fossil record are denoted with §. All other genera listed are exclusively extant.

Systematic Paleontology

Order Decapoda Latreille, 1802

Infraorder Anomura H. Milne-Edwards, 1832

Superfamily Galatheoidea Samouelle, 1819

Family Munididae Ahyong et al., 2010

Type genus: *Munida* Leach, 1820, by original designation.

Included genera: *Agononida*§ Baba & de Saint Laurent, 1996; *Anomoeomunida* Baba, 1993; *Anoplonida* Baba & de Saint Laurent, 1996; *Austromunida*§§ Schweitzer & Feldmann, 2000; *Babamunida* Cabezas, Macpherson & Machordom, 2008; *Bathymunida* Balss, 1914; *Cervimunida* Benedict, 1902; *Cretagalathea*§§ Garassino, De Angeli, & Pasini, 2008; *Crosnierita* Macpherson, 1998; *Enriquea* Baba, 2005; *Heteronida* Baba & de Saint Laurent, 1996; *Juracrista*§§ nov. gen.; *Munida*§ Leach, 1820; *Neonida* Baba & de Saint Laurent, 1996; *Onconida* Baba & de Saint Laurent, 1996; *Paramunida* Baba, 1988; *Plesionida* Baba & de Saint Laurent, 1996; *Pleuroncodes* Stimpson, 1860; *Protomunida*§§ Beurlen, 1930; *Raymunida* Macpherson & Machordom, 2000; *Sadayoshia*§ Baba, 1969; *Setanida* Macpherson, 2006; *Tasmanida* Ahyong, 2007; *Torbenella* Baba, 2008.

Diagnosis: Dorsal carapace ornamented with strong transverse ridges. Frontal margin almost always trifid; composed of central rostral component and one or two pairs of supraorbital spines. Supraorbital spines typically very narrow, needle-like.

Discussion: The diagnosis above is based exclusively on characteristics that have been found in both the fossil and extant record. There are numerous other characteristics shared between exclusively extant members of the Munididae, detailed in Ahyong et al. (2010); however, most of those features are rarely fossilized. The main unifying characteristic of the dorsal carapace of the munidids is the presence of the trifid frontal margin composed of supraorbital spines and rostrum, albeit in some genera the supraorbital spines and rostrum, while still present, are very reduced. Figure 2.5 and 2.6 illustrate the frontal margin. When the frontal margin is not preserved, it is often difficult to separate the fossil Munididae from the Galatheidae Samouelle, 1819, as both families are composed of genera bearing ornamentation of transverse ridges.

Cretagalathea, an Upper Cretaceous munidid that does not have a preserved rostrum, was reclassified from the Galatheidae to the Munididae by Ahyong et al. (2010) based

upon the possession of long pereiopods, a characteristic included in the original diagnosis of Munididae by Ahyong et al. (2010). It should be noted that long pereiopods are traits commonly identified with, but not unique to, the Munididae. Members of Munididae do not always exhibit long pereiopods, and several species of both Munidopsidae Ortmann, 1892, and Galatheidae possess long pereiopods. The possible presence of diminutive supraorbital spines on *Cretagalathea* may strengthen its placement within Munididae, but small supraorbital spines are also found within members of the Galatheidae. Given the overlapping morphological characteristics of Galatheidae and Munididae, ornamentation and long pereiopods are not enough to distinguish fossil munidids from fossil galatheids. When only a dorsal carapace is preserved, the only way to distinguish between fossil munidids and galatheids is the rostrum. Galatheids have a broad, typically subtriangular rostrum, whereas munidids usually have a trifid rostrum that is typically very narrow.

Genus *Juracrista* nov. gen.

Type species: *Juracrista perculta* nov. spec.

Other included species: *Juracrista costaspinosa* nov. spec.

Diagnosis: Carapace sub-square excluding rostrum. Frontal margin has three distinct components; two large supraorbital spines and a central rostrum. Rostrum broad, unkeeled, deflected, slightly axially sulcate, may have three spines. Supraorbital spines narrowly triangular. Cervical groove strong; weakens slightly anteriorly. Epigastric, protogastric, mesogastric, metagastric, hepatic, and epibranchial regions well defined. Cardiac region weakly defined. Carapace ornamented with strong transverse ridges and small spines; spines adorn anterior of ridges in epigastric area; epibranchial and hepatic regions adorned with spines. No dorsal spines visible posterior to cervical groove. Lateral margin spined.

Etymology: The name is a combination of *Jura*, denoting the Jurassic, and the Latin *crista*, meaning crested. The combination refers to the age of the genus and the ornate rostrum. Feminine gender.

Discussion: *Juracrista* is referable to the Munididae based upon the extremely pronounced supraorbital spines, broad rostral shape, and transverse ornamentation, which are diagnostic for the munidids. Members of the Galatheidae, whereas they have transverse ornamentation, also have a triangular rostrum, typically without supraorbital spines. Members of the Munidopsidae have a circumgastric groove, lack transverse ornamentation, and often have a keeled, narrow rostrum. The Porcellanidae Haworth, 1825, often have weak ornamentation and a flattened carapace with either a diminished or extremely broad, spatulate rostrum.

Although the supraorbital spines and rostrum exhibited by members of *Juracrista* are larger and wider than those of typical, modern munidids, Munididae still provides the

best overall fit for this new genus. Many modern munidids have a narrow, needle-like rostrum as well as two needle-like supraorbital spines diverging from the main body of the rostrum closer to the frontal margin than those of *Juracrista*. Despite this difference, *Juracrista* still fits well within Munididae. The modern genus *Bathymunida*, as well as the fossil and extant *Sadayoshia*, have frontal margin morphologies that differ significantly from the typical members of Munididae (see Ahyong et al. 2010, p. 61, Figs 2E – 2H, for *Munida* and *Bathymunida*; see Macpherson & Baba 2010, p. 419, Fig. 1A, for *Sadayoshia*). Several members of *Bathymunida* have a reduced rostrum and supraorbital spines, where the three distinct components of the frontal margin are not always readily apparent, specifically in *Bathymunida frontis* Baba & de Saint Laurent, 1996 (illustrated in Baba & de Saint Laurent 1996; Fig. 1, p. 435). *Sadayoshia* has what are interpreted as two pairs of supraorbital spines, separating it from all other munidids. Though *Juracrista* differs from all other genera by its broad rostrum, and one pair of narrowly triangular supraorbital spines, the trifid frontal margin is still readily apparent, and thus the genus should be placed within the Munididae.

The majority of genera within the Munididae are extant, without a fossil record. It is the most speciose of the families within the Galatheoidea, with over 350 species documented (Ahyong et al. 2010).

The paucity of fossil munidids may be due to their morphological similarity to galatheids. The Galatheidae possess transverse ornamentation much like the Munididae. The only way to differentiate them in the fossil record is by the frontal margin. On munidids, the frontal margin is trifid; on galatheids, the rostrum is generally much broader. The rostrum is often not preserved, so differentiation between the Munididae and Galatheidae is difficult.

An exclusively fossil Cretaceous genus, *Cretagalathea,* was placed within the Munididae by Ahyong et al. (2010), based on its transverse ornamentation and its long, slender pereiopods. Unfortunately, the majority of the rostrum of the only known specimen of *Cretagalathea* is missing, but it appears to have two short supraorbital spines, which are much less developed than those found on *Juracrista*.

The only other exclusively fossil genus, *Protomunida*, containing the sole species *Protomunida munidoides* (Segerberg, 1900), was originally described by Segerberg (1900) as being halfway between *Galathea* and *Munida*, with a triangular rostrum and small supraorbital spines. The photo of the lectotype, published by Jakobsen & Collins (1997) without a description, shows an incomplete galatheoid, but the dorsal carapace has much more continuous transverse ridges and more narrowly spaced ridges than those of *Juracrista*.

The new genus does bear some resemblance to *Sadayoshia*. *Sadayoshia* is extant, but is also known from one fossil occurrence from the Eocene, *Sadayoshia pentacantha* (Müller & Collins, 1991). On the frontal margin, the outermost pair of supraorbital spines of *Sadayoshia* is much smaller than those of *Juracrista*, with three needle-like spines in the central portion of the frontal margin. The rostrum of *Juracrista* is not needle-like.

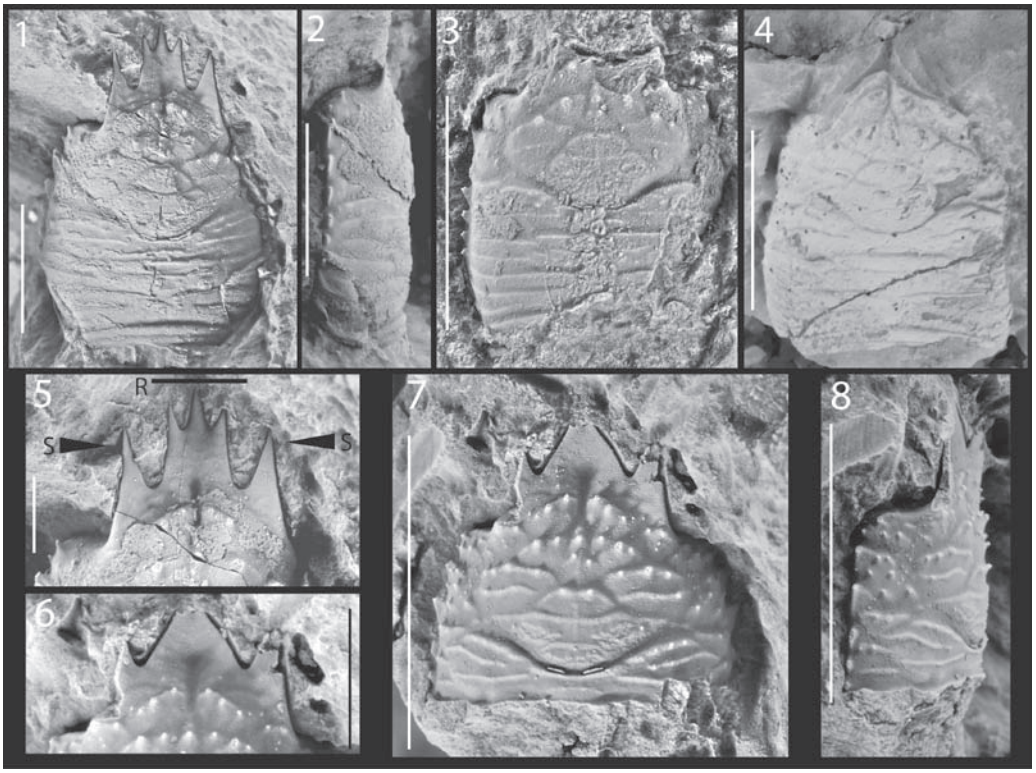

Fig 2.**1**: *Juracrista perculta*, holotype, scale equals 5 mm. NHMW 2007z0149/0369. **2**: *J. perculta*, holotype, side view, scale equals 5 mm. NHMW 2007z0149/0369. **3**: *J. perculta*, paratype, scale equals 5 mm. NHMW 2007z0149/0370. **4**: *J. perculta*, paratype, scale equals 5 mm. NHMW 2007z0149/0371 (This specimen was not dyed due to the poor condition of its cuticle, but was whitened with ammonium chloride powder.) **5**: *J. perculta*, holotype, close up of rostrum and supraorbital spines, scale equals 2 mm. NHMW 2007z0149/0369. S denotes supraorbital spines; R denotes rostrum. **6**: *Juracrista costaspinosa*, holotype, close up of rostrum, scale equals 2 mm. NHMW 2007z0149/0372. **7**: *J. costaspinosa*, holotype, scale equals 5 mm. NHMW 2007z0149/0372. **8**: *J. costaspinosa*, holotype, side view, scale equals 5 mm. NHMW 2007z0149/0372.

***Juracrista perculta* nov. spec.**

(Figs 2.1–2.5)

Diagnosis: Carapace weakly convex transversely; sub-square excluding rostrum. Frontal margin has three distinct components; two large supraorbital spines and a central rostrum with tridentate termination. Rostrum broad, unkeeled, deflected, slightly axially sulcate. Supraorbital spines narrowly triangular; tips sharp, directed outward; spines extend to tridentate separation of rostrum. Cervical groove strong; weakens slightly anteriorly. Epigastric, protogastric, mesogastric, metagastric, hepatic, and epibranchial regions well defined. Cardiac region weakly defined.

Carapace ornamented with strong transverse ridges and small spines. Mesogastric process terminates at cervical groove, outlining mesogastric and metagastric region. Four spines adorn anteriormost ridge in epigastric area; ridge immediately posterior adorned with seven spines; epibranchial region bears four spines, one at the anterior of epibranchial region and three on anterior of ridge crossing middle of epibranchial region. No dorsal spines visible posterior to cervical groove. Lateral margin spined. Posterior margin very strongly rimmed.

Etymology: From the Latin *percultus*, meaning highly adorned. The name is in reference to the incredibly ornate frontal margin.

Measurements (in mm): NHMW 2007z0149/0369, holotype: L, 9.6; MW, 9.5; FW, 7.6; O, 5.0; RL, 3.1; NHMW 2007z0149/0370, paratype: MW, 5.4; FW, 4.9; O, 3.3; NHMW 2007z0149/0371, paratype: L, 7.7; MW, 7.3; FW, 5.4.

Holotype: NHMW 2007z0149/0369.

Paratypes: NHMW 2007z0149/0370, NHMW 2007z0149/0371.

Type locality: Ernstbrunn Quarries.

Type stratum: Ernstbrunn Limestones, Tithonian, Upper Jurassic.

Description: Carapace, exclusive of rostrum, weakly convex transversely, flat longitudinally. Carapace widens slightly posteriorly; sub-square excluding rostrum. Frontal margin has three distinct components; two supraorbital spines and a central rostrum with tridentate termination. Rostrum broad, deflected, unkeeled. Supraorbital spines narrowly triangular; tips sharp, directed outward; extend to tridentate separation of rostrum. Supraorbital spine slanted downward toward rostrum. Rostrum has slight sulcus at base; sulcus weakens anteriorly. Rostrum depressed below supraorbital spines. Rostrum has outer spines slightly smaller than center spine; outer spines of tridentate tip angle slightly outward.

Orbits appear shallow, horizontal; appear to extend under rostrum along angle of anterior border of epigastric region.

Cervical groove strong; weakens slightly anteriorly. Cervical groove branches anterior and posterior to epibranchial region. Epigastric, protogastric, mesogastric, metagastric, hepatic, and epibranchial regions well defined. Cardiac region weakly defined; mesobranchial and metabranchial regions undifferentiated.

Carapace ornamented with strong transverse ridges and small spines. Ornamentation strong across all areas of carapace. Spines adorn anterior of ridges in gastric and epibranchial areas; spines ornament hepatic area only. Anterior of ridges across gastric area arched concave posterior; interrupted by mesogastric process. Mesogastric process terminates at cervical groove, outlining mesogastric and metagastric region. Ridges most arched in epigastric region; arching progressively less approaching cervical groove at posterior of gastric region. Four spines adorn anteriormost ridge in epigastric area; ridge immediately posterior adorned with seven. No other spines visible on gastric region; epibranchial region bears four spines, one at the anterior of epibranchial region and three

on anterior of ridge crossing middle of epibranchial region. No spines visible posterior to cervical groove. Lateral margin spined; many spines broken. Posterior to cervical groove, transverse ornamentation continues. Ridges long, extending across one third to entirety of carapace. Ridges narrow immediately anterior to cardiac region. Cardiac region defined by strong, pronounced ridge at anterior and slight interruption of grooves bordering lateral regions of cardiac region. Posterior margin very strongly rimmed; rim bisected horizontally by groove. Ventral surface and appendages not preserved.

Discussion: Three individuals of this species were found; unfortunately, only one still retained its rostrum. The other two possess the same traits on the dorsal carapace, duplicating the transverse ridge and spine pattern. All three specimens have poorly preserved, disintegrating cuticle, which in some areas obscures detail. This is especially apparent on Fig. 2.4. The rostrum of this species may be ornamented with transversely ovate, squamous tubercles; however, this was not included in the description due to the possibility that the rostral ornamentation appearance is due to cuticle degradation.

The other species within this genus, *Juracrista costaspinosa*, seems to have a narrower rostrum than that of *J. perculta*. While the rostral tip of *J. costaspinosa* is incompletely preserved, it does not seem to be tridentate like that of *J. perculta*. The two also can be easily differentiated through dorsal carapace morphology. *Juracrista perculta* has a mesogastric and metagastric region outlined by a weak groove that extends from the middle anterior of the carapace to the cervical groove. *Juracrista costaspinosa* has the same groove in the mesogastric area, but the groove appears to be truncated by a transverse ridge prior to the cervical groove. *Juracrista costaspinosa* also possesses smaller, more numerous spines in the anterior gastric, hepatic, and epibranchial areas, especially visible from a lateral view.

Juracrista costaspinosa **nov. spec.**
(Figs 2.6–2.8)

Diagnosis: Carapace appears to widen posteriorly. Frontal margin has three distinct components; two supraorbital spines and a sub-triangular rostrum. Rostrum broad, unkeeled, has slight sulcus at base; flattens anteriorly. Rostral termination unknown. Cervical groove strong; weakens slightly anteriorly. Cervical groove clearly branches anterior to epibranchial region; weakly branches posterior to epibranchial region. Epigastric, protogastric, mesogastric, metagastric, hepatic, and epibranchial regions well defined. Carapace ornamented with strong transverse ridges and small spines. Mesogastric process terminates at metagastric region; does not reach cervical groove. Spines adorn anterior of ridges in gastric area; spines solely ornament hepatic and epibranchial areas. Ten spines adorn anteriormost ridge in epigastric area; ridges immediately posterior adorned with six, two, eight, and two spines, respectively. No dorsal spines visible posterior to cervical groove. Lateral margins spined.

Etymology: From the Latin *costa*, meaning rib, and *spinosa*, meaning spine. The name refers to the multiple spines found on the strong transverse ridges of this species.

Measurements (in mm): NHMW 2007z0149/0372, holotype: FW, 3.7; O, 3.2.

Holotype: NHMW 2007z0149/0372.

Type locality: Ernstbrunn Quarries.

Type stratum: Ernstbrunn Limestones, Tithonian, Upper Jurassic.

Description: Carapace incomplete; metabranchial and cardiac regions absent; frontal margin and mesobranchial regions partially preserved. Carapace appears to widen posteriorly; shape unknown. Frontal margin has three distinct components; two supraorbital spines and a sub-triangular rostrum. Rostrum incomplete; broad, unkeeled, has slight sulcus at base; flattens anteriorly. Central portion of rostrum slightly depressed below supraorbital spines. Rostral termination unknown.

Cervical groove strong; weakens slightly anteriorly. Cervical groove clearly branches anterior to epibranchial region; weakly branches posterior to epibranchial region. Epigastric, protogastric, mesogastric, metagastric, hepatic, and epibranchial regions well defined. Carapace broken immediately anterior to area most likely inhabited by cardiac region.

Carapace ornamented with strong transverse ridges and small spines. Ornamentation strong across all preserved areas of carapace. Spines adorn anterior of ridges in gastric area; spines solely ornament hepatic and epibranchial areas. Ridges across gastric area inflected concave posteriorly; interrupted by mesogastric process. Mesogastric process terminates at metagastric region; does not reach cervical groove. Ridges most arched in epigastric region; arching progressively less approaching cervical groove posteriorly. Ten spines adorn anteriormost ridge in epigastric area; ridges immediately posterior adorned with six, two, eight, and two spines, respectively. No pattern was discernable in spines in hepatic and epibranchial areas. No dorsal spines visible posterior to cervical groove. Lateral margins spined; many spines broken. Posterior to cervical groove, transverse ornamentation continues. Ridges long, extending across one third of carapace. Posterior margin, ventral surface, and appendages not preserved.

Discussion: Only one incomplete specimen of this species has been found. It differs from *Juracrista perculta* nov. spec. by possessing smaller, more numerous spines in the gastric, hepatic, and epibranchial regions. The rostrum also is narrower and more triangular in shape than that of *J. perculta*. It appears to be more convex than *J. perculta*; however, this may be due to preservational issues. Although it appears in Fig. 2.8 that the mesobranchial regions may be elevated above the remainder of the branchial areas, this is due to the lack of preservation of the cuticle along the lateral margin, not actual carapace disfigurement.

Discussion

The Munididae is the most diverse family within the Galatheoidea; however, the vast majority of those species are extant (De Grave et al. 2009; Ahyong et al. 2010). Only nine of the over 350 species within the family Munididae have been found exclusively

in the fossil record; all others are extant without a known fossil record. Previously, the fossil record for the munidids extended into the Late Cretaceous with one species; all others are Cenozoic in age. This new discovery expands the Munididae into the Late Jurassic. The oldest Porcellanidae has previously been reported from the same locality (Schweitzer & Feldmann 2010). This extends the idea that the warm, shallow Tethys seas of the Late Jurassic were host not only to the massive diversification of brachyurans (Feldmann & Schweitzer 2009; Schweitzer & Feldmann 2009a, 2009b, 2010), but to galatheoids as well. All but one family within the Galatheoidea, the Retrorsichelidae, from the Cretaceous of Antarctica (Feldmann et al. 1993), now have roots in the Mid-Late Jurassic. The Munididae developed at approximately the same time as the galatheoid families Munidopsidae (Middle Jurassic), the Galatheidae (Late Jurassic), and the Porcellanidae (Late Jurassic). Extensive revisions of the fossil Galatheoidea are ongoing.

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