

# A new shallow-marine munidopsid (Anomura, Galattheoidea) from the Upper Miocene in the Maroni-Psematismenos Basin of Cyprus

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Several well-preserved remains of a new munidopsid anomuran, *Palmunidopsis muelleri* n. gen., n. sp., are described from a Late Miocene (Tortonian-Messinian) reef-associated decapod crustacean faunule of southern Cyprus. This is the first record of a Late Miocene representative of the family. The occurrence in very shallow-water, reefal limestones of the Koronia Member (Pakhna Formation) in southern Cyprus is atypical in comparison to the ecology of extant munidopsids.

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## Introduction

Until now, there were no records of Miocene decapod crustaceans from Cyprus. During fieldwork in western and southern Cyprus in 1999 several localities with decapod-rich Miocene reefal limestones were discovered by the author. A few hundred metres northwest of the small village of Maroni some outcrops along an unpaved country road yielded a diverse decapod crustacean fauna, inclusive of a few specimens of the new munidopsid described herein. At this locality, described by Greensmith (1994), reefal limestones of the Koronia Member (Pakhna Formation) are exposed. These deposits are covered with evaporites of the Kalavastos Formation; this dates these limestones as latest Tortonian to earliest Messinian (Robertson *et al.*, 1991). Faunal elements represented within the reefal limestones of the Koronia Member comprise calcareous red algae, bivalves, bryozoans, gastropods and serpulids.

Neogene basins in southern Cyprus came into existence during an Early to Middle Miocene period of palaeogeographical reorganisation that was probably related to the onset of the final phase of subduction in the easternmost Mediterranean (Follows *et al.*, 1996). Three depositional centres developed to the south of the Troodos Massif, namely the Polemi, Pissouri and Maroni-Psematismenos basins. The last-named basin encompasses an area that measures *c.* 14 km from east to west, and *c.* 10 km from north to

south. Reefs of Early and Late Miocene age are exposed in these basins. Reef growth followed Early Cenozoic deep-water sedimentation and localised tectonic uplift (Kinnaird, 2008). The Late Miocene reefs were dominated by the coral genus *Porites*, first largely domal in structure, later occurring mainly as sheet-like encrustations. Reef growth was finally halted by the Messinian desiccation of the Mediterranean (*e.g.*, Robertson *et al.*, 1995; Follows *et al.*, 1996).

In modern oceans, the family Munidopsidae includes the deepest-dwelling galatheoids, usually occurring at slope to abyssal depths and near hydrothermal vents. The majority of munidopsids have reduced or degenerated eyes, reflecting their depth preference (Baba *et al.*, 2008; Ah Yong *et al.*, 2010). Only a single extant species, *Munidopsis polymorpha* Koelbel, 1892, occurs at depths as shallow as 2 metres, and is endemic to caves in the northern half of the island of Lanzarote. These caves include a saltwater basin the water in which is tide influenced (Wilkins *et al.*, 1986). Despite their ecological importance and high diversity, many aspects of galatheoid systematics and distribution are still poorly known (Baba, 2005).

Ahyong *et al.* (2010) have recently elevated the Munidopsinae to family level to reflect the huge diversity found within the Galatheoidea. It is the oldest family within that superfamily; their range extends from the Middle Jurassic to the Recent. The Munidopsidae currently embraces fifteen exclusively fossil genera, while *Munidopsis* and *Shinkaia* both have a fossil and extant record, and two genera, *Galacantha* and *Leiogalatheia*, comprise only extant species (Robins *et al.*, 2013). The taxonomic key to families, on the basis of carapace morphology, within Galatheoidea of Robins *et al.* (2013) is used herein.

### Systematic palaeontology

**Order Decapoda Latreille, 1802**  
**Infraorder Anomura H. Milne Edwards, 1832**  
**Superfamily Galatheoidea Samouelle, 1819**  
**Family Munidopsidae Ortmann, 1898**  
**Genus *Palmunidopsis* nov.**

*Diagnosis* – Carapace pentagonal, longer than wide, moderately convex transversely, weakly convex longitudinally, widest at epibranchial regions, tapering towards narrow posterior rim. Rostrum short, unidentate and strongly keeled. Circumgastric cervical and branchiocardiac grooves well defined, as are all regions. Pronounced transverse suborbital rims. Rostral keel extending as longitudinal rim onto epigastric. Subtriangular cardiac as broad as epigastric, anteriorly bordered by extremely large urogastric. All regions ornamented with widely spaced tubercles, largest on branchial regions. Pro-



Fig. 1. Map of Cyprus, indicating the village of Maroni in the south of the island.

nounced posterior rim covered with crenulate row of tubercles. Elongated chela with cutting edge of dactylus straight. Proximal part of cutting edge of fixed finger arched, leaving considerable crescent-shaped gap when fingers are closed.

*Type species* – *Palmunidopsis muelleri* n. sp., the sole species known to date.

*Etymology* – A member of the Munidopsidae named after my Hungarian colleague and friend, Pál Müller.

*Palmunidopsis muelleri* n. sp.

Pl. 1.

*Diagnosis* – As for the genus.

*Etymology* – To honour Pál Müller, a fine colleague from Budapest, Hungary.

*Types* – Holotype, MAB k. 3284, is a near-complete carapace (maximum length 5 mm) with some pereopod fragments; paratypes are MAB k. 3285a-c, two incomplete carapaces and some fragments of pereopods (counterpart slab of holotype).

*Locality and stratigraphy* – The specimens were found in an outcrop along an unsealed country road a few hundred metres northwest of the village of Maroni, southern Cyprus. Around some local Messinian celestite mounds of bioclastic limestones rich in molluscs and serpulids a diverse fauna of decapod crustaceans was collected during a field trip in 1999. These limestones belong to the Koronia Member (Pakhna Formation) and are reported to be of Late Miocene (Tortonian) age (Kinnaird, 2008).

*Description* – Carapace pentagonal, longer than wide, L/W ratio 1.1 (length measured from orbit to posterior edge), moderately convex transversely, weakly convex longitudinally, widest at epibranchial regions, tapering towards narrow posterior rim. Rostrum short, unidentate and markedly keeled. Circumgastric cervical and branchio-cardiac grooves well defined, as are all regions. Pronounced transverse suborbital rims. Rostral keel extending as longitudinal rim onto epigastric. Elevated epigastric and protogastric delineated by shallow grooves. Inflated hepatic, epibranchial and mesobranchial. Mesobranchial divided by longitudinal groove. Deep, broad and smooth urogastric region. Subtriangular cardiac as broad as metagastric, anteriorly covered by crescent shaped, crenulate transverse ridge. Carapace ornamented with widely spaced, forwardly directed tubercles, largest on branchial regions. Pronounced concave posterior rim covered with a crenulate row of tubercles.

Chelae elongated and smooth, except for a fine row of paired tubercles along the ventral and dorsal edges. Dactylus about one-third of total propodus length. Cutting edge of slender dactylus straight. Proximal part of cutting edge of fixed finger arched leaving a considerable crescent-shaped gap when fingers are closed.

*Remarks* – Robins *et al.* (2013) introduced a very useful key to families within the Galatheaidea using exclusively dorsal carapace characteristics. The presence of a

circumgastric cervical groove is unique to the Munidopsidae. *Palmunidopsis* n. gen. could not be placed properly in the key to genera within the Munidopsidae presented by Robins *et al.* (2013), using dorsal carapace characteristics. *Palmunidopsis* n. gen. is easily differentiated from all other known munidopsid genera in having a pentagonal outline with strongly tapering posterolateral sides, an extremely large urogastric and a strongly concave and ornamented posterior rim.

The morphologically closest form is an unidentified posterior part of a ?munidopsid carapace from the Upper Albian of northern Spain (Klompmaeker *et al.*, 2012, p. 142, fig. 12). As preserved, this shows a comparable morphology with, in particular, a markedly concave ornamented posterior rim, tapering posterolateral margins, mesogastric, urogastric, grooved mesobranchial and inflated epibranchial regions. Given the close morphological resemblance, the Albian ?munidopsid is best accommodated in *Palmunidopsis* n. gen. as well.

The anterior part of the carapace of *Munidopsis scabrosa* Feldmann & Wilson, 1988 from the Eocene of Seymour Island, Antarctica, also is reminiscent in displaying a similarly shaped keeled rostrum, postorbital rim, gastric regions and cervical groove. However, the posterior part is utterly different and shows no strong taper of the sides, nor a concave ornamented posterior rim. *Palmunidopsis* n. gen. occurs in shallow-marine patch reefal environments and *Munidopsis scabrosa* originates from nearshore, shallow-water, wave- and tide-dominated habitats that have been interpreted to represent a deltaic complex.

All Jurassic and Cretaceous munidopsids known to date have been found in similar shallow-marine environments (Robins *et al.*, 2013). The first fossil munidopsid known to have preferred deep settings, similar to extant munidopsids, is *Shinkaia katapsyxis* Schweitzer & Feldmann, 2008, from the Eocene of Washington State, USA. This species was found in an area interpreted to have been a deep-marine, hydrocarbon seep environment. *Munidopsis lieskovensis* Hyžný & Schlögl, 2011, from the Miocene of Cerová-Lieskové (Vienna Basin, Slovakia) and *Munidopsis* sp. from the Miocene Morozaki Group of central Japan (Takeda *et al.*, 1986) are the first fossil representatives to have been recorded from siliciclastic bathyal environments. Apparently, the adaptation and migration of munidopsids to bathyal and abyssal regions occurred some time between the Late Jurassic and Eocene.

Palaeobathymetric analyses show that depositional environments in Cyprus during the Late Miocene were characterised by a progressive shallowing from approximately 500 m to very shallow-water conditions (Krijgsman *et al.*, 2002). Their high-resolution correlations demonstrated that the Messinian Salinity Crisis, dated at 5.96 Ma, was a remarkably synchronous event across the Mediterranean. Conditions favouring the establishment of reef-building in the Late Miocene prevailed between the Late Tortonian and Messinian, as demonstrated in all the Mediterranean regions with reefal buildups, such as Spain, the Balearic Isles, Italy, Sicily, Malta, Tunisia, Crete, Cyprus, Turkey and Israel. From several of these Late Miocene reef deposits decapod crustaceans have been reported (*e.g.*, Müller, 1984; Georgiades-Dikeoulia & Müller, 1984; Garcia Socias, 1990; Gatt & De Angeli, 2010; De Angeli *et al.*, 2011).

The occurrence of a shallow-marine munidopsid in the Upper Miocene of Cyprus just prior to the desiccation of the Mediterranean suggests that this species was probably able to adapt and migrate from deep to very shallow-marine environments within

a geologically short time span. The ecological flexibility of munidopsids is also seen in the extant endemic species, *Munidopsis polymorpha*, which occurs in caves in the northern half of the island of Lanzarote.

Claverie & Smith (2007) reported large-sized individuals, particularly males, of the northeast Atlantic squat lobster *Munida rugosa* (Fabricius, 1775) that also have identical 'arched' chelae, i.e., the proximal sections of the dactylus and pollex are curved, leaving a gap when the chela is closed (Ingrand, 1937). They concluded that the arched morphology of the chela in *M. rugosa* appeared to be a trait that evolved in males by means of sexual selection, owing to its enhanced functionality to inflict injuries to an opponent (i.e., weapon) during agonistic interactions.

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**Plate 1**

*Palmunidopsis muelleri* n. gen., n. sp., from Late Miocene (Tortonian) limestones of the Koronia Member (Pakhna Formation), northwest of the village of Maroni, southern Cyprus (see Fig. 1).

Fig. 1. Holotype (MAB k. 3284), carapace.

Fig. 2. Paratypes (MAB k. 3285a-c), carapaces and appendages.

Scale bars equal 5 mm.