Dynomenid crabs (Decapoda, Brachyura) and stalked barnacles (Cirripedia, Scalpelliformes) from upper Cenomanian-lower Turonian nearshore, shallow-water strata in the Bohemian Cretaceous Basin, Czech Republic

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Key words – Dromioidea, Graptocarcininae, Thoracica, Upper Cretaceous, palaeoecology.
Crustacea (dynomenid crabs and cirripedes) from the upper Cenomanian-lower Turonian nearshore, shallow-water bioclastic limestones to marly siltstones found along the southern and eastern margins of the Bohemian Cretaceous Basin (BCB) are described. Crabs are rather rare in this area, and mostly restricted to fragmentary pereiopods, i.e., isolated claws or dactyli. In view of the confused taxonomy of isolated claws, their proper identity could not be determined; they were mostly referred to the necrocarcinid genus *Necrocarcinus* Bell, 1863. A recent re-examination of material deposited in the collections of the National Museum (Národní Muzeum, Prague), and of new finds, has revealed that all allegedly necrocarcinid pereiopods and nearly all carapaces from these shallow-water strata actually belong to the dynomenid *Graptocarcinus* Roemer, 1887 (carapaces) and the 'form genus' *Roemerus* Bishop, 1983 (isolated claws). Here we present a summary report of occurrence of these dynomenid genera in the BCB. Cirripedes are more abundant, yet all available material is in the form of disarticulated, isolated capitular plates, which is typical for almost all Mesozoic thoracicans. More than 400 capitular plates of stalked barnacles have been discovered in sieve residues during the last decade. A study of newly recovered specimens, together with a revision of material contained in museum collections, has resulted in the description of a new species of the genus *Zeugmatolepas* Withers, 1913 and confirmation of the occurrence of '*Scillaelepas*' *conica* (Reuss, 1844), *Titanolepas tuberculata* (Darwin, 1851), *Smilium*? *parvulum* (Withers, 1914), *Cretiscalpellum glabrum* (Roemer, 1841), *C. striatum* (Darwin, 1851) and *Arcoscalpellum angustatum* (Geinitz, 1843).

Contents

Introduction

Despite almost two centuries of palaeontological research in the Bohemian Cretaceous Basin (BCB), our knowledge of crabs from the nearshore/shallow-water deposits remains poor. The material studied herein was extensively recorded by Fritsch & Kafka (1887) and Frič (1911). Since then the systematics and taxonomy have changed significantly and much of the material from museum collections is in need of a modern revision (Veselská, 2009, 2011). Moreover, numerous new isolated crab claws and dactyli have been recovered during the last decade from nearshore, shallow-water facies of the BCB. Well-preserved carapaces and first pereiopods, often with major and minor chelae, of decapod crustaceans have been considered relatively well represented in the pelagic facies of the BCB; nearly one hundred specimens are known to date, including historical and newly collected ones. The fossil record of decapods from the nearshore deposits is rather scanty, and so far limited to fragments of brachyuran crabs. Unfortunately, crab carapaces are very rare and mostly poorly preserved, lacking associated chelipeds.

Brachyuran crabs. It is clear that conditions conducive to preservation of small crabs in nearshore, shallow-water deposits of the BCB were poor, which explains the paucity of carapaces in the area. Fritsch *in* Fritsch & Kafka (1887, p. 47, pl. 10, figs. 2, 10, 11, 13; p. 48, pl. 10, fig. 12, respectively) erected *Necrocarcinus avicularis* to accommodate isolated brachyuran chelipeds and (*Cancer*?) *modestus* [*sic*] for caparaces from nearshore deposits in the BCB. That author noted (Fritsch *in* Fritsch & Kafka, 1887, p. 49) that carapaces of the second taxon came from the same horizon and from the same locality as chelipeds of *N. avicularis*. Glaessner (1929) considered that remains of (*C*?). *modestus* were indeterminate. Later, Förster (1968) synonymised, albeit with a query, (*C*?). *modestus* with *Graptocarcinus integrimarginatus* Wright & Wright, 1950 (a junior synonym of *G. texanus* Roemer, 1887), a decision subscribed to by Wright & Collins (1972, p. 54), who provisionally synonymised (*C*?). *modestus* with *G. texanus*. Fraaye (1996) subsequently noted that morphologically (*C*?). *modestus* was very close to *G. muiri* (another junior synonym of *G. texanus*, see below). Schweitzer *et al*. (2010) assigned *N. avicularis* to *Necrocarcinus*, while (*C*?). *modestus* was erroneously listed under *Cancer*. Jagt *et al*. (2010) preferred to use parataxonomy for such cases and noted that isolated claws of *N. avicularis* would also be best assigned to the 'form genus' *Roemerus* Bishop, 1983, which was considered to be a dynomenid, since it co-occurred with carapaces. Subsequently, Veselská (2011) and Van Bakel *et al*. (2012) proposed that both the claws (Fritsch & Kafka, 1887, pl. 10, figs. 2, 10, 11) and the carapace fragment (Fritsch & Kafka, 1887, pl. 10, fig. 12) could belong to *Graptocarcinus*, but that the material was too fragmentary and dissociated to be certain.

In addition, a note on the inconsistency in Fritsch's usage of the name (*Cancer*?) *modestus* is called for. In the paper in which (*C*?). *modestus* is erected (Fritsch & Kafka, 1887, p. 49), the captions of the figures read *Necrocarcinus avicularis*. The same name is used also in a later paper (Frič, 1911), despite the fact that he had previously (1887, p. 49) considered the carapaces of (*C*?). *modestus* and chelipeds of *N. avicularis* not to represent the same taxon.

Cirripedes. The first studies dealing with cirripedes from the BCB are those by Reuss (1844, 1845-1846, 1864), followed by Kafka (1885), Fritsch & Kafka (1887), Frič (1911)

and Withers (1935). The last-named listed eleven species, mentioning also the collections of A. Frič and J. Šulc. Moreover, numerous new finds of cirripede capitular plates (some 400 specimens) have been made during the last decade. During 2001-2013, the authors conducted several field campaigns at Velim, Kamajka and Chrtníky (situated along the southeast margin of the BCB), where more than 200 kg of residue were amassed and sieved (1 mm mesh width). Our analyses of newly recovered specimens, together with a re-examination of material from museum collections, have resulted in the description of a new species of *Zeugmatolepas* (Kočová Veselská *et al*., in press) and confirmation of the occurrence of the scalpelliform cirripedes *Cretiscalpellum glabrum*, *C. striatum*, *Arcoscalpellum angustatum*, *Zeugmatolepas cretae* (Steenstrup, 1837) and *Smilium*? *parvulum* in the nearshore, shallow-water deposits of the BCB (Kočí & Kočová Veselská, 2012a, b, 2013a, b). All material studied is preserved as disarticulated, isolated capitular plates, which is typical of almost all Mesozoic thoracicans. A preliminary

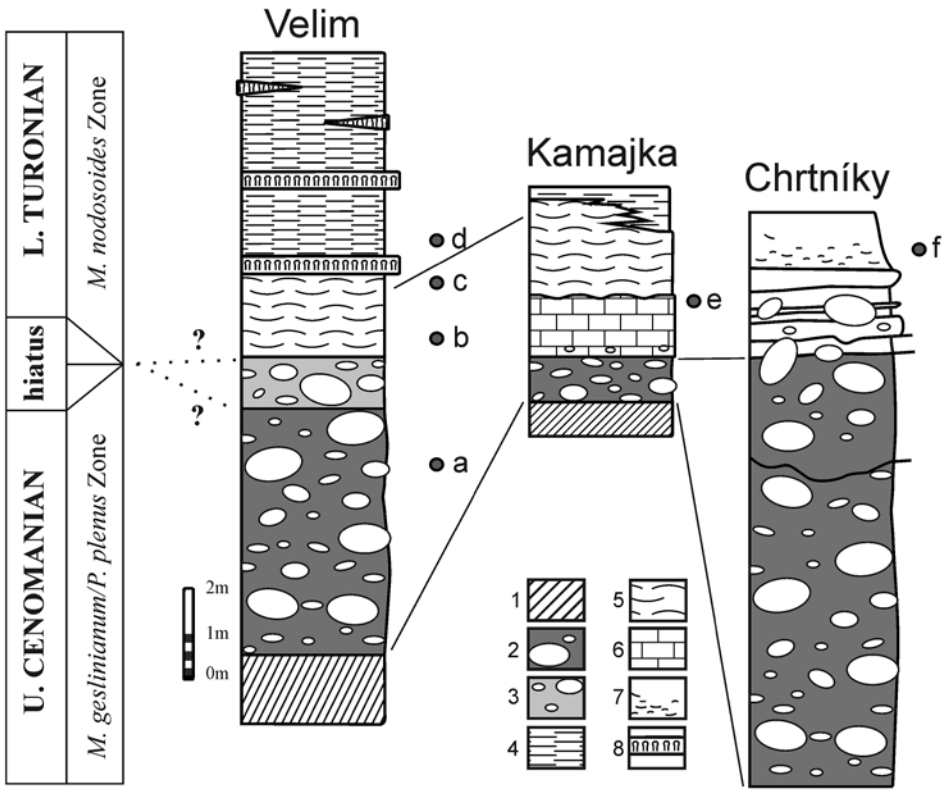

Fig. 1. Stratigraphic provenance of crabs and cirripedes. A. Velim, B. Kamajka, C. Chrtníky. Legend: 1 – crystalline basement; 2 – basal Cenomanian conglomerate; 3 – redeposited Turonian conglomerate; 4 – marly siltstone with intercalations of phosphatised horizon; 5 – organodetritic clayey limestone; 6 – organodetritic limestone with calcitiic-clayey matrix; 7 – clayey siltstone with abundant fauna; 8 – sponge 'meadows' (modified from Žítt *et al*., 2006; Košťák *et al*., 2010). Lower-case letters indicate the presence of crustacean taxa: a-d – isolated dactyli and cirripede plates; e – crab claws and carapaces; f – one crab claw and isolated dactyli.

study has revealed approximately 180 plates (mainly terga, scuta and carinae) of *C. glabrum* and *A. angustatum*. In contrast, merely a single carina of *S.*? *parvulum* and one scutum of *C. striatum* are known from the area (Kočí & Kočová Veselská, 2012a, b).

Geography and stratigraphy

The present material comes from nearshore, shallow-water deposits situated along the southern and eastern margin of the BCB, which are interpreted to have been laid down under high-energy conditions (Žítt *et al*., 1997a, b). Currently, these outcrops are overgrown and, in part, covered in scree (Žítt & Nekvasilová, 1994; Žítt *et al*., 1999). Newly recovered specimens come from Velim (GPS co-ordinates: 50°3'38.14"N, 15°7'46.34"E), Kamajka (GPS co-ordinates: 49°57'45.790"N, 15°22'19.163"E) and Chrtníky (GPS co-ordinates: 49°58'36.875"N, 15°36'25.421"E), which are situated approximately 60-100 km east of Prague in the vicinity of Kolín (Figs. 2, 3), where nearshore, shallow-water sediments are exposed in depressions of metamorphic rocks. Whereas strata containing cirripedes and brachyuran crabs at Kamajka and Chrtníky are exclusively of early Turonian age, crustaceans from Velim are from both upper Cenomanian and lower Turonian nearshore sediments. Unfortunately, the exact correlation between the localities is complicated by frequent non-sequences and redeposition of older faunas. The sedimentation was also influenced by palaeohydrodynamics, palaeogeography, clast distribution and character and abundance of detrital material (Žítt & Nekvasilová, 1989, 1994, 1996; Žítt, 1992; Hradecká *et al*., 1994; Žítt *et al*., 1999, 2006). Generally, the horizont yielding crabs and cirripedes is developed in characteristic facies. Lithologically, these consist of bioclastic limestones to marlstones and siltstones with sponges at Chrtníky, of organodetritic clay limestones at Kamajka and /or calcareous siltstones with abundant organodetritus at Velim and Kamajka. The rich fauna from Velim was studied and described in detail by Žítt *et al*. (1997a, b) and rich fossil communites from Chrtníky were examined by Žítt *et al*. (2006). The stratigraphic position of crabs and cirripedes is shown in Fig. 1.

Material and methods

All specimens (Fritsch's original material together with newly collected isolated chelipeds or dactyli and cirripede capitular plates) are deposited in the palaeontological collections at the National Museum (Prague) and at the Natural History Museum (London).

Between 2001 and 2013, the authors conducted field work at Velim, Chrtníky and Kamajka, during which an additional 200 kg of rubble were amassed and sieved (Fig. 1). These sessions have confirmed the occurrence of isolated dactyli and cirripede plates. Material is rich in sabellid and serpulid worms, bryozoans, bivalves and echinoderms (especially crinoids), but unfortunately none of these are key index taxa. Macrofaunal elements associated are listed in Table 1. An additional crustacean collection was deposited in the basement of the National Museum (NM); this was put at our disposal. During 2005 and 2010, a total weight of *c*. 40 kg of this residue was washed and screened through a 1 mm-sieve. This yielded 95 cirripede plates belonging to *Zeugmatolepas* n. sp. (Kočová Veselská *et al*., in press). Unfortunately, the original labels

Table 1. Macrofaunal composition of the original sieve residues stored at the National Museum (Prague); see text for explanations.

	rare	common
Octocorallia		
Moltkia foveolata (Reuss, 1846)	•	
Sabellid worms		
Glomerula serpentina (Goldfuss, 1831)		•
Serpulid worms		
Dorsoserpula gamigensis (Geinitz, 1875)	•	
Dorsoserpula wegneri (Jäger, 1983)	•	
Propomatoceros sp.		•
Neovermilia ex gr. *ampullacea* (J. de C. Sowerby, 1829)		•
Cementula? cf. *sphaerica* (Brünnich Nielsen, 1931)		•
?*Conorca* sp.	•	
Filogranula cincta (Goldfuss, 1831)	•	
Placostegus zbyslavus (Ziegler, 1984)	•	
Placostegus sp.	•	
Pyrgopolon cf. *tricostata* (Goldfuss, 1831)	•	
Pyrgopolon sp.	•	
Neomicrorbis crenatostriatus subrugosus (Münster *in* Goldfuss, 1831)	•	
Bryozoa		
Stomatopora sp.		•
Cyclostomata indet.		•
Cheilostomata indet.		•
Brachiopoda		
Terebratulina striatula (Mantell, 1822)	•	
Phaseolina phaseolina (Valenciennes *in* Lamarck, 1819)	•	
Gisilina? *rudolphi* (Geinitz, 1875)		•
Ancistrocrania sp.	•	
Bivalvia		
Amphidonte (A.) *reticulatum* (Reuss, 1846)	•	
Gryphaeostrea canaliculata (J. Sowerby, 1813)		•
Rastellum carinatum (Lamarck, 1819)		•
Rastellum diluvianum (Linnaeus, 1767)		•
Ostreidae gen. et sp. indet.		•
Spondylus sp.	•	
Neithea (*Neithella*) *notabilis* (Münster *in* Goldfuss, 1833)	•	
Neithea (*Neithea*) *aequicostata* (Lamarck, 1819)	•	
Isognomon lanceolatum (Geinitz, 1845)	•	
Gastropoda		
Neritopsis nodosa (Geinitz, 1840)	•	
Echinodermata - Crinoidea		
Isocrinus? cf. *cenomanensis* (d'Orbigny, 1850)		•
Echinodermata - Echinoidea		
Temnocidaris (*Stereocidaris*) *vesiculosa* (Goldfuss, 1829)	•	
Tylocidaris sorigneti (Desor, 1858)	•	
Salenia sp.	•	
Echinodermata - Asteroidea		
Metopaster sp.	•	
Vertebrata - Selachii		
Paranomotodon angustidens (Reuss, 1846)	•	
Scaphanorhynchus rhaphiodon (Agassiz, 1843)	•	

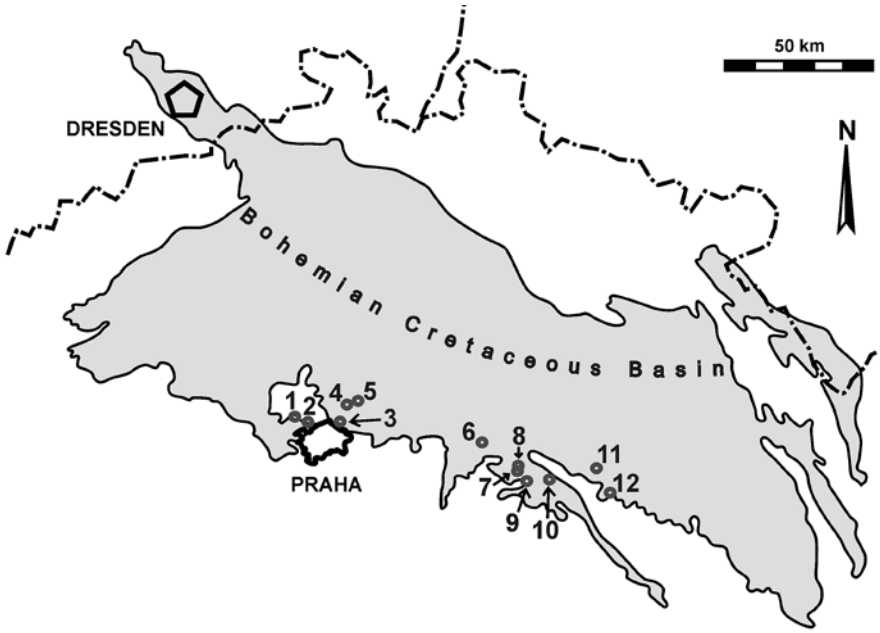

Fig. 2. Simplified map of the Bohemian Cretaceous Basin (BCB, Czech Republic), showing the occurrence (circles) of cirripedes in nearshore, shallow-water deposits, from west to east: 1 - Černovičky (upper Cenomanian), 2 - Kněžívka (lower Turonian), 3 - Odolena Voda (lower Turonian), 4 - Předboj (upper Cenomanian), 5 - Kojetice (upper Cenomanian), 6 - Velim (upper Cenomanian, lower Turonian), 7 - Kaňk (upper Cenomanian), 8 - Turkaňk (lower Turonian) 9 - Karlov (lower Turonian), 10 - Kamajka (lower Turonian), 11 - Chrtníky(lower Turonian) and 12 - Běstvina (lower Turonian).

were lost and the precise stratigraphical position of the material is uncertain. What we do know is that all material comes from an outcrop exposing upper Cenomanian and lower Turonian strata (Žítt *et al*., 1997a, b). All material is preserved as disarticulated, isolated capitular plates. Some cirripede material and dactyli from now overgrown localities (i. e. Karlov, Běstvina, Černovičky, Předboj, Kněžívka; see Figs. 2, 3) are known only from Žítt & Nekvasilová (1989) and Hradecká *et al.* (1994). The presence of *Cretiscalpellum glabrum* and *Arcoscalpellum angustatum* was also mentioned by Košťák *et al*. (2010) in faunal lists for the localities of Kamajka, Turkaňk and Velim.

To achieve better contrast when photographing the specimens, standard procedure using ammonium chloride sublimate was initially adopted (excluding Frič's original NM O4014, which is very fragile). The results were, however, unsatisfactory, which is why different photographic documentation was used. Frič occasionally painted or varnished the specimens to enhance contrast of the fossil – as a result, many details are obscured by painting and proper re-examination is hampered. This is also true for grooves on the dorsal surface of (*Cancer*?) *modestus* (as here interpreted). Photographs of Frič's original crab material were taken under low-angle light, using a Canon EOS 550D digital camera. Photographs of other cirripede capitular plates were taken using scanning electron microscope (SEM) Hitachi S-3700N in low vacuum at the NM (Prague) and JEOL JSM-6380LV in low vacuum at the Institute of Geology and Palaeontology

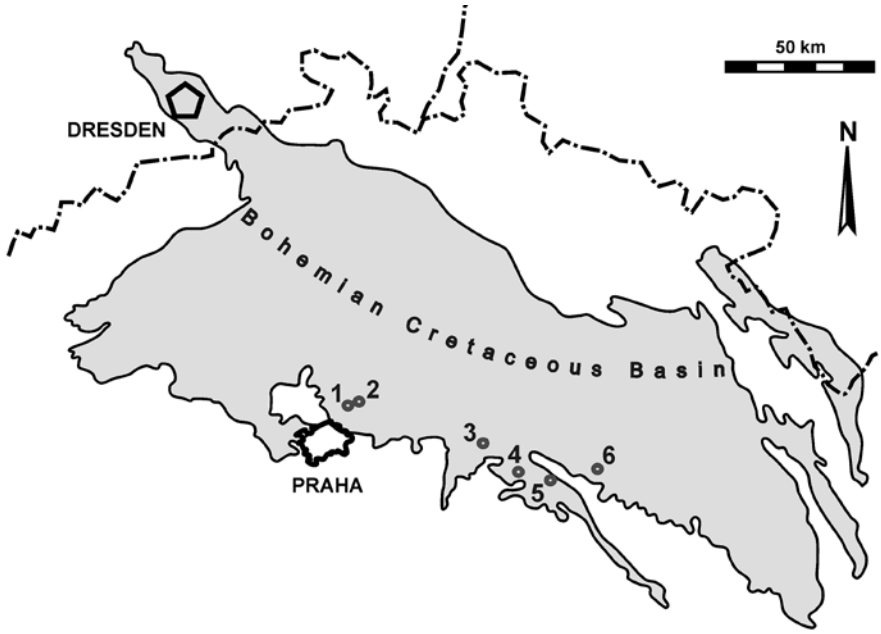

Fig. 3. Simplified map of the Bohemian Cretaceous Basin (BCB, Czech Republic), showing the occurrence (circles) of *Graptocarcinus texanus* Roemer, 1887 and *Roemerus avicularis* (Fritsch *in* Fritsch & Kafka, 1887) in nearshore, shallow-water deposits, from west to east: 1 - Odolena Voda (lower Turonian), 2 - Předboj (upper Cenomanian), 3 - Kojetice (upper Cenomanian), 4 - Velim (upper Cenomanian, lower Turonian), 5 - Kaňk (upper Cenomanian), 6 - Chrtníky (upper Cenomanian, lower Turonian).

(Charles University, Prague). When using SEM, the specimens were left uncoated, hence the use of low vacuum. Series of photographs taken with SEM were assembled into final images using the computer freeware Microsoft Image Composite Editor 1.4.4. Plates were made using Corel Graphic Suite X4.

Systematic palaeontology

Order Decapoda Latreille, 1802
Infraorder Brachyura Latreille, 1802
Section Podotremata Guinot, 1977
Subsection Dynomeniformia Guinot, Tavares & Castro, 2013
Superfamily Dromioidea De Haan, 1833
Family Dynomenidae Ortmann, 1892
Subfamily Graptocarcininae Van Bakel, Guinot, Corral & Artal, 2012
Genus *Graptocarcinus* Roemer, 1887

Type species – *Graptocarcinus texanus* Roemer, 1887, by monotypy.

Species included – See Klompmaker (2013, p. 152).

Graptocarcinus texanus Roemer, 1887
Pl. 1, figs. 1-4.

1887 *Graptocarcinus texanus* Roemer, p. 173, text-fig.
1887 (*Cancer*?) *modestus* Fritsch *in* Fritsch & Kafka, p. 49, pl. 10, fig. 12.
1911 *Necrocarcinus avicularis* Fritsch; Frič, p. 71, fig. 300c.
?1972 *Graptocarcinus texanus* Roemer; Wright & Collins, p. 55 (with synonymy).
?1996 *Graptocarcinus muiri* Stenzel; Fraaye, p. 463.

Material – Three poorly preserved, partially crushed carapaces, lacking chelipeds or other appendages (NM O4015, NM O4016 and NM O7147) from the lower Turonian calcareous siltstones at Kamajka. NM O4015 and NM O4016 are the originals of Fritsch *in* Fritsch & Kafka (1887), and both are syntypes of (*Cancer*?) *modestus*. NM O4015 is designated lectotype herein.

Diagnosis – See Wright & Collins (1972, p. 54).

Description – Carapace transversely oval in outline, wider than long. Dorsal surface convex longitudinally and transversely, nearly flat in central part. Orbitofrontal margin narrow, broken, only right orbit preserved (NM O7147; Pl. 1, figs. 3, 4), small, rather shallow, with slightly upturned rim bordered by row of granules; left orbit and rostrum absent; anterolateral margins slightly convex, right one with preserved granulated flanged rim; posterolateral margins poorly preserved, straight, about the same length as anterolateral; posterior margin not preserved. Cervical groove distinct, well developed, broadly V-shaped, as wide as fronto-orbital margin, interrupted in median part; branchial grooves indistinct, shorter and weaker (preserved only in NM O4015), defined only in their anterior parts as converging grooves, parallel to cervical groove. Carapace surface damaged (mainly in NM O4016), uniformly ornamented with large, blunt granules, mostly with hollow tops and surrounded by numerous minute setal pits.

Remarks – (*Cancer*?) *modestus*, as originally described by Fritsch *in* Fritsch & Kafka (1887), is based only on three rather poorly preserved, fragmentary carapaces the morphology of which is typical of graptocarcinines. Unfortunately, Fritsch *in* Fritsch & Kafka (1887) did not state which one of the two originally described carapaces of (*C*?). *modestus* was the holotype, which means that both need to be considered syntypes. In view of the fact that in the original paper only specimen NM O4015 was illustrated (as pl. 10, fig. 12, under the name of *N. avicularis*), we designate this herein as lectotype of (*C*?). *modestus*.

There are few records of (*Cancer*?) *modestus* in the literature. Wright & Collins (1972, p. 55), who concluded that *G. muiri* was a junior synonym of *G. texanus*, already suspected (*C*?). *modestus* to be synonymous with *G. texanus*. However, subsequently Bishop (1986), Fraaye (1996) and Van Bakel *et al*. (2012) treated *G. muiri* and *G. texanus* as separate species on the basis of differences in carapace shape, tuberculation and variously developed raised margins covered with granules and tubercles. Fraaye (1996, p. 463) also noted that the incomplete carapace illustrated by Fritsch & Kafka (1887) as *Necrocarcinus avicularis* was probably close to *G. muiri*. Specimens of (*C*?). *modestus* are slightly broader and oval in outline rather than pentagonal and show coarser tuberculation.

These features indeed correspond to *G. muiri*. By contrast, (*C*?). *modestus* is very close to *G. texanus* in having developed raised rims covered with granules along the right anterolateral margins (left ones are not preserved) and a groove pattern with a broadly V-shaped cervical groove and a branchial groove in NM O4015. Its absence in other Czech specimens is most likely a function of the poor state of preservation. Finally, Klompmaker (2013, p. 154) considered *G. muiri* to be a junior synonym of *G. texanus*, and discussed all potential differences between these two species (i.e., carapace shape and size, length/width ratio, presence of a rostral protrusion and raised margins covered with granules and tubercles). A variety of features often overlap between these forms and none of the minor differences justifies specific separation.

Nomenclature – Wright & Collins (1972, p. 55) also noted a potential nomenclatorial problem regarding the priority of Fritsch's and Roemer's papers, both published in 1887. We have been unable to ascertain the exact dates. Thus, in the interests of stability and preservation of the long-established name *G. texanus* in its accustomed meaning (ICZN Article 23. 9), we opt for the specific name *texanus* to take precedence over *modestus*.

'Form genus' *Roemerus* Bishop, 1983

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

Diagnosis – For a detailed diagnosis, reference is made to Jagt *et al*. (2010, p. 179).

Roemerus avicularis (Fritsch *in* Fritsch & Kafka, 1887)

Pl. 1, fig. 5 [in part], 7; Pl. 2, figs. 1-10.

*1887 *Necrocarcinus avicularis* Fritsch *in* Fritsch & Kafka, p. 47, pl. 10, figs. 2, 10, 11, 13 (manus only).
1911 *Necrocarcinus avicularis* Fritsch; Frič, p. 71, fig. 300a, b, d.

Types – Five claws (NM O4004, NM O4005, NM O4013, NM O4014 and NM O4018 [part]), the originals of Fritsch (*in* Fritsch & Kafka, 1887), all syntypes. NM O4004 is here designated lectotype. All material comes from the lower Turonian calcareous siltstones at Kamajka.

Material – In addition to the types (see above), numerous isolated dactyli (collective number P/5137c) from the upper Cenomanian at Předboj, Kojetice, Kaňk, Velim and from the lower Turonian at Velim and Chrtníky, plus one claw (NM O7148) from the lower Turonian at Kamajka are available.

Description – Manus subrectangular in outline; upper margin slightly rounded, depressed proximally; lower margin nearly straight, more or less in line with fixed finger; outer and inner surfaces convex longitudinally and transversely, passing rather sharply into broad upper surface; outer surface with short vertical groove close to dactyl articulation, subparallel to distal margin; broad furrow separating finely granular carpal artuculation from remainder of manus; propodus/carpus articulation with distinctive bulge. Surface uniformly covered by rows of large, blunt tubercles mostly with hollow

tops, forming slightly curving horizontal lines; and by several smaller tubercles scattered among these lines; tubercles becoming progressively smaller towards fixed finger. Fingers short, stout; moderately curved, strongly downturned dactylus with shallow furrow parallel to arched upper margin and terminating halfway of dactylus length; fixed finger about one quarter of manus length, with one proximal large cusp on occlusal surface near base, deep depression occuring below cusp. Both fixed finger and dactylus covered with several rows of fine granular humps decreasing in size distally and continuing almost to tips.

Remarks – Fritsch *in* Fritsch & Kafka (1887) erected *Necrocarcinus avicularis* to accommodate isolated claws (NM O4004, O4005, O4013 and O4014) and a single carapace fragment, with an unassociated manus preserved on the same matrix slab, NM O4018 (Fritsch & Kafka, 1887, pl. 10, fig. 13) from Kamajka. Nevertheless, he did not state which specimen of *N. avicularis* was the holotype; thus, all are syntypes. In view of the fact that in the original paper specimen NM O4004 is illustrated first and also represents the best-preserved crab cheliped in the original collection, we here designate this lectotype.

Conditions conducive to the preservation of small crabs in nearshore deposits in the BCB were poor, which explains why carapaces in the area are very rare. Excluding three specimens of *Graptocarcinus texanus* (see above) and a carapace fragment (part of NM O4018), no other carapaces are known from the nearshore deposits in this area. In contrast, crab claws and dactyli are common in the nearshore, shallow-water strata in the BCB. However, such isolated decapod appendages are notoriously difficult to identify (Jagt *et al*., 2010). Isolated crab chelipeds and dactyli originally described as *N. avicularis* are covered with small tubercles and are rectangular in outline with a distinctive bulge on the propodus/carpus articulation which is typical of graptocarcinines (Jagt *et al*., 2010; Van Bakel *et al*., 2012). Although these chelipeds (NM O4004, O4005, O4013 and O4014, plus a fragment of O4018) come from the same horizon and the same locality, Kamajka, as specimens of *G. texanus*, they have not yet been found articulated with carapaces. Jagt *et al*. (2010) preferred to use parataxonomy for such cases and suggested using the 'form genus' *Roemerus* for isolated dynomenid chelae. In fact, records of carapaces preserving appendages are extremely sparse amongst graptocarcinines, and so far, such preservation is known only in specimens of *Graptocarcinus urbasaensis* Van Bakel, Guinot, Corral & Artal, 2012 from the Upper Cretaceous of northern Spain (Álava and Navarra). Other species of *Graptocarcinus* are only known from carapace material.

A recent re-examination of cheliped remains deposited in the National Museum at Prague has revealed that all alleged necrocarcinid claws or dactyli from nearshore strata in the BCB indeed correspond to the diagnosis of the dynomenid 'form genus' *Roemerus*, in size, ornament, development of fixed and moveable fingers and presence of ovate depressions in dactylus and fixed finger. Although still not found articulated with carapaces, these claws may be conspecific with the co-occurring, carapace-based species, *G. texanus*, at Kamajka.

A re-examination of specimens of *N. avicularis* has also shown that the carapace fragment and manus on the same matrix slab, NM O4018, represent two entirely different taxa. Whereas the manus represents the 'form genus' *Roemerus*, the carapace does not seem to have affinities with dynomenids, but rather is of a necrocarcinid nature. The carapace itself is very poorly preserved, representing merely a small fragment with

oblique margin without raised rim; its surface is covered with sparse, large granules (no other structure is present) and no grooves are seen. Thus, the true identity of this carapace (Fritsch & Kafka, 1887, pl. 10, fig. 13) remains unresolved, at least for the time being.

Subclass Cirripedia Burmeister, 1834
Superorder Thoracica Darwin, 1854
Order Scalpelliformes Buckeridge & Newman, 2006
Family Zeugmatolepadidae Newman, 2004
Genus *Zeugmatolepas* Withers, 1913

Type species – *Zeugmatolepas mockleri* Withers, 1913, by original designation.

***Zeugmatolepas* n. sp. Kočová Veselská, Kočí & Collins, in press**
Pl. 5, figs. 1-13.

Material – Two carinae (NM O7031 and NM O7032), 18 right scuta (NM O7033, NM O7034, NM O7045-7060) and 19 left scuta (NM O7035-O7037, NM O7044, NM O7062-O7077), five right terga (NM O7038, NM O7078-O7081) and nine left terga (NM O7039 [holotype], NM O7082-O7089), plus 27 rostra (NM O7040-O7043, NM O7090-O7112).

Description – Reference is made to Kočová Veselská *et al*. (in press).

Remarks – *Zeugmatolepas cretae* is distinguished by having an elongated apex and subcentral umbo in the scutum, a rhomboidal tergum; in addition, plates are generally smooth. For more details, reference is made to Kočová Veselská *et al*. (in press).

Occurrence (BCB) – ?Upper Cenomanian-lower Turonian (Velim, eastern part).

Stratigraphic range – ?Upper Cenomanian-lower Turonian.

Family Calanticidae Zevina, 1978
Genus *Cretiscalpellum* Withers, 1922

Type species – *Pollicipes unguis* J. de C. Sowerby, 1836, by original designation.

***Cretiscalpellum glabrum* (Roemer, 1841)**
Pl. 6, figs. 1-7.

1935 *Cretiscalpellum glabrum* (Roemer); Withers, p. 161, pl. 15, figs. 8-17; pl. 16, figs. 1-20; pl. 17, figs. 1-21; pl. 18, figs. 1-5 (with additional synonymy).
1999 *Cretiscalpellum glabrum* (Roemer); Jagt & Collins, p. 102, figs. 2A, 6A-I.
2013a *Cretiscalpellum glabrum* (Roemer); Kočí & Kočová Veselská, p. 109, figs. 24, 25.
2013 *Cretiscalpellum glabrum* (Roemer); Jagt, p. 251, figs. 11, 12.

Material – 75 carinae, 45 scuta, four carinal latera, one rostral latus, 42 right terga, 47 left terga, 70 fragmentary terga (left and right), plus a single rostrum. All these specimens are deposited in the collections of the National Museum (Prague).

Description – Carina with obtuse apex, lacking parietes and intraparietes. Median ridge of carina distinct. Lateral margins of carina slightly rounded inwards. Carinal surface at first glance appearing smooth, but under microscope distinct sharp lines parallel to basal margin visible. Tergum of subrhomboidal shape. In first third, apicoscutal groove in form of narrow channel, parallel to occludent margin. Distinct median furrow from apex. Basal angle between scutal and carinal margins sharp. Surface with distinct grooves parallel to scutal margin, leading to grooves parallel to basal margin. Occludent margin of scutum straight and basal margin at right angles, tergal margin gradually turning into lateral margin. Surface with fine sharp grooves parallel to basal margin.Tergal lines and lateral surfaces at right angles. From apex two prominent folds, forming flat surface and dividing scutum into four parts. All lines sharp, straight, distinct and typically forming dense network of parallel grooves. Carinal latus square, diagonally divided into two parts, surface with very fine grooves. Rostrum very small, triangular, dorsally convex, one and half times wider than tall, with wide apicobasal ridge. Lateral margin almost straight, basal margin concave in median part under apicobasal ridge and laterobasal margin convex in places.

Remarks – The present species most closely resembles *C. striatum* (see below) which has a wider tergum with a more clearly protruding apicobasal ridge that extends to the laterobasal margin. The carina of *C. striatum* has an apicobasal ridge that is stronger than other longitudinal lines, and also has markedly developed transverse lines. In addition, it has a wider scutum with more distinct longitudinal lines. *Cretiscalpellum bronni* (Roemer, 1841) has a carina which lacks transverse lines and has a less prominent apicobasal ridge. The tergum has a more prominent apicobasal ridge and its shape is elongated rhomboidal. *Cretiscalpellum unguis* (J. de C. Sowerby, 1829) differs in having a wider carina with slightly rounded parietes and strongly developed transverse lines. The tergum of *C. unguis* is more elongated with a rounded carinal margin, while the scutum is wider in the basal part, the lateral part being narrow and curved inwards. The early Campanian *C. obtusum* Jagt & Collins, 1989 has a more convex, trapezoidal scutum in which the apicobasal ridge is broad, with distinct longitudinal and transverse lines.

Occurrence (BCB) – Upper Cenomanian at Velim and ?Černovičky; lower Turonian at Velim, Kamajka, Turkaňk, Karlov, Odolena Voda, Běstvina and Chrtníky.

Stratigraphic range – Upper Albian-upper Maastrichtian.

***Cretiscalpellum striatum* (Darwin, 1851)**

Pl. 6, fig. 8.

1935 *Cretiscalpellum striatum* (Darwin); Withers, p. 183, pl. 20, figs. 1-5, 15-21; pls. 21, 22 (with additional synonymy).
1989 *Cretiscalpellum striatum* (Darwin); Jagt & Collins, p. 189, fig. 4l, m.
1999 *Cretiscalpellum striatum* (Darwin); Collins & Jagt, p. 159, figs. 2C-E, 3A-G.
2000 *Cretiscalpellum striatum* (Darwin); Carriol & Collins, p. 142, pl. 1, fig. 5.
2002 *Cretiscalpellum striatum* (Darwin); Carriol & Collins, p. 5, pl. 1, fig. 5.
2013a *Cretiscalpellum striatum* (Darwin); Kočí & Kočová Veselská, p. 113, figs. 26, 27.
2013 *Cretiscalpellum striatum* (Darwin); Jagt, p. 250, figs. 8-10.

Material – A single left tergum (NM O7461) from the lower Turonian at Velim, in the collections of the National Museum (Prague).

Description – Tergum elongated and irregularly rhomboidal. Apical umbo sharp and slightly curved. Apicobasal ridge distinct and sharp. Occludent margin straight; scutal margin forming angle of 50° with occludent margin. Longitudinal lines on carinal part of tergum clear and distinct. Apicobasal groove near scutal margin, ending at scutal margin 2 mm from occludent margin. Distinct transverse lines parallel to scutal margin. Inner part smooth and with distinct growth lines of carinal fold near carinal margin.

Remarks – *Cretiscalpellum striatum* has a more elongated tergum than *C. glabrum*. The main distinguishing features are the sharp longitudinal and transverse lines in the former. The congener *C. paucistriatum* (Woodward, 1906) (see Jagt & Van Bakel, 2007) has an elongated tergum, which is much less clearly longitudinally striated to near-smooth and shows a peculiar transverse convexity. *Cretiscalpellum naidini* Alekseev, 2009, from eastern Mangyshlak (lower Campanian), has a markedly convex tergum with very thick axial part and a wide occludent rib. The carina of *C. sharapovi* Alekseev, 2009, also from eastern Mangyshlak (lower Campanian), has a thick apical part, covered by narrow ribs.

Occurrence (BCB) – Lower Turonian at Velim. *Cretiscalpellum striatum* was also mentioned from the lower Turonian at Velim and Karlov by Žítt & Nekvasilová (1989, p. 86, as *Pollicipes costatus* Kafka) and from coeval levels at Běstvina by Žítt & Nekvasilová (1994, p. 26 as *P. costatus* Kafka).

Stratigraphic range – Lower Cenomanian-upper Maastrichtian.

Genus *Scillaelepas* Seguenza, 1876

Type species – Pollicipes carinatus Philippi, 1836, by original designation.

‘*Scillaelepas*’ *conica* (Reuss, 1844)
Pl. 3, figs. 1-16.

Synonymy – See Withers (1935, p. 120).

Material – All material from Kaňk is deposited in the collections of the Natural History Museum (Department of Palaeontology, London); this comprises five scuta (NHM In. 16739-40, In. 16742-45), one carina (NHM In. 16746), one rostrum (NHM In. 16747) and four terga (NHM In. 16753-56).

Description – For a detailed account, reference is made to Withers (1935, pp. 120-122), who described material collected by A. Frič in 1897 and subsequently sold to the NHM London.

Remarks – Frič (1889a, b) referred to the type specimen of Reuss (1844, p. 216) from Kyselka near Bílina (Reuss’s Sauerbrunnberges) in his account of the ‘Teplitzer Schichten’, while earlier Fritsch (*in* Fritsch & Kafka, 1887) had recorded this species

from the Priesener Schichten (now Březno Formation) at Luschitz. Frič (1911), in his account of the upper Cenomanian (now Korycany Member), mentioned but a single occurrence, from Kyselka (Sauerbrunnberges), but did not present any illustration. More detailed remarks were made by Withers (1935, p. 121).

Occurrence (BCB) – Upper Cenomanian at Kaňk; and ?upper Turonian at Kyselka, ?lower Coniacian at Luschitz.

Stratigraphic range – Upper Cenomanian (-?lower Coniacian).

Genus *Titanolepas* Withers, 1913

Type species – *Scalpellum tuberculatum* Darwin, 1851, by original designation.

Titanolepas tuberculata (Darwin, 1851)

Pl. 4, fig. 1.

1935 *Calantica* (*Titanolepas*) *tuberculata* Darwin; Withers, p. 130, pl. 11, figs. 1-10; pl. 12, figs. 1-3 (with additional synonymy).
1983 *Calantica* (*Titanolepas*) *tuberculata* Darwin; Collins *in* Viaud *et al*., p. 330, pl. 3, figs. 3-5.

Material – A single poorly preserved tergum from Kamajka (NM O3407), plus a similarly preserved tergum (NM O7462) from Velim, both deposited in the collections of the National Museum (Prague).

Description – Tergum diamond shaped, elongated. Apicobasal ridge almost straight and very prominent. Apicobasal ridge thickening towards very acute basal angle. Surface more highly ornamented, longitudinal ribs crossing transverse ribs and creating short blunt spines.

Remarks – *Titanolepas tuberculata* is distinguished from *T. subtuberculata* Withers, 1935 in that the latter has a sigmoidally curved apicobasal ridge and the prominent, coarse, close-set lines on the tergum are finer and less numerous. Another species, *T. martini* (Withers, 1913), from the upper Senonian (Niobrara Group) of Kansas, is differentiated by a subcentral scutum.

Occurrence – Lower Turonian at Kamajka and at Velim. Withers (1935) also mentioned some capitular plates of *T. tuberculata* from the ?upper Turonian (*Holaster* [*Sternotaxis*] *planus* Zone) at Na Vinici near Kolín in the southern part of the BCB. Unfortunately, this locality is now completely overgrown; it cannot be determined if a nearshore or a pelagic facies was formerly exposed there. Collections of fossils from this locality made by the palaeontologist Dr J. Šulc included 30 carinae, 29 scuta, 34 terga and five lower latera of *T. tuberculata*, but unfortunately this material was lost during the Second World War, with the exception of six carinae, five scuta, six terga and two lower latera which he had donated to the British Museum (Natural History; now the Natural History Museum, London).

Stratigraphic range – Lower Turonian (?upper Turonian).

Genus *Smilium* Leach, 1825

Type species – *Scalpellum* sp. (*sensu* Darwin 1851).

***Smilium*? *parvulum* (Withers, 1914)**
Pl. 4, figs. 2, 3.

1935 *Smilium* (?) *parvulum* (Withers); Withers, p. 141, pl. 12, figs. 9-15 (with additional synonymy).
2012b *Smilium* (?) *parvulum* (Withers); Kočí & Kočová Veselská, p. 39, fig. 1.
2013a *Smilium* (?) *parvulum* (Withers); Kočí & Kočová Veselská, p. 107, fig. 23.
2013b *Smilium* (?) *parvulum* (Withers); Kočí & Kočová Veselská, p. 149, text-fig. 3.

Material – A single minute carina (NM O7133), 4 mm in length and 1.4 mm in basal width, in the collections of the National Museum (Prague).

Description – Umbo below rounded apex, about one third from apex. Carina rounded in upper third of umbo, not developing longitudinal ridge on tectum. At two-thirds from basal edge, parietes developed; lateral sides with distinct transverse lines. Intraparietes form carinal elongation, rendering beak-like, tapered shape. Growth lines fine, yet distinct. Inner surface smooth, lacking growth lines.

Remarks – Reference is made to Withers (1935), Collins (1974) and Kočí & Kočová Veselská (2013a, b).

Occurrence (BCB) – Lower Turonian (possibly *Mytiloides labiatus* Zone) at Velim.

Stratigraphic range – Upper Albian-upper Turonian.

Family Scalpellidae Pilsbry, 1916
Subfamily Arcoscalpellinae Zevina, 1978
Genus *Arcoscalpellum* Hoek, 1907

Type species – *Arcoscalpellum velutinum* Hoek, 1907, by original designation.

***Arcoscalpellum angustatum* (Geinitz, 1843)**
Pl. 4, figs. 4-9.

1935 *Arcoscalpellum angustatum* (Geinitz); Withers, p. 215, pl. 25, figs. 2-20; pl. 26, fig. 1 (with additional synonymy).
1983 *Arcoscalpellum angustatum* (Geinitz); Collins *in* Viaud *et al*., p. 330, pl. 3, figs. 6, 7; pl. 4, figs. 1-3, 5.
2013a *Arcoscalpellum angustatum* (Geinitz); Kočí & Kočová Veselská, p. 116, figs. 28-36.

Material – Two carinal latera from Velim (eastern part); 27 carinae, one scutum, ten terga (one of them complete), 16 carinal latera, and three upper latera from Velim (western part). All material is deposited in the collections of the National Museum (Prague).

Description – Carina narrowly expanding to basal margin with sharp apex. Tectum almost flat. On both sides of tectum prominent straight edges. On tectal transverse lines, V-shaped. Fine longitudinal lines may occur, inclusive of distinct median line. Parietes narrow, concave and forming almost right angle with tectum. Intraparietes wider than parietes. Intraparietes separated from parietes by thick protruding, distinct ridges. Intraparietes convex in upper basal half. Surface with fine and distinct lines almost parallel to transverse lines of tectum. Carina light to dark brown in colour (?original colour); abraded material white. Carina of square cross section. Scutum trapezoidal, elongated. Cross section slightly convex, length about twice width. Occludent margin straight or slightly curved and basal margin at right angles. Edge of occludent margin bending inwards. Basal margin slightly concave to straight. Lateral margin extending to about two-thirds of scutal height and tergal margin in first third of scutal height. Apicobasal margin distinct and rounded. Towards lateral and tergal margins, area of scutum slightly sloping. Lateral margin convex. Tergolateral angle distinct. Inner surface with deep indentation for adductor muscle. Small indentation near occludent margin. Tergum subtriangular, flat, elongated, more than twice longer than wide. Occludent margin straight, with blunt scutal angle. Carinal margin almost straight. Apicobasal groove distinct. Surface with bold lines, V-shaped, inner surface smooth. Occludent and carinal margins bowed, indistinct protruding growth lines in inner part of tergum.

Carinal latus wide, triangular in shape with rounded, unequal sides. Apex of right carinal latus curved to left and left carinal latus curved to right. Carinal margin perpendicularly cut at right angles. Central rib extending from apex to basal margin distinct. Surface with grooves, parallel to basal margin. Upper latus triangular, equilateral. Basal scutal angle sharp and obliquely bevelled. Tergal basal angle obtuse. Apex apical, umbo subapical. Scutal margin slightly concave, tergal margin convex to almost straight. Convex basal margin thinned. Flat groove from apex along tergal margin, steep slopes in scutal part. Distinct edge near tergal and scutal margins. Between inner surface and edge, longitudinal strip ending at apex. Inner surface smooth and flat. Outer surface with growth lines parallel to basal margin.

Remarks – *Arcoscalpellum angustatum* is very close to *A. fossula* (Darwin, 1851), but is differentiated by carinal, tergal and scutal construction. The carina of *A. fossula* has more prominent ridges along the tectum and parietes are visible from above, the tergum differing by the presence of apicoscutal grooves and a more protruding apex. The scutum of *A. fossula* has a more clearly curved apex, the inner structure of near the tergal margin being closer to the apex, with deeper and longer depressions and the scutal margin closer to the apex being higher. Upper latera of *A. fossula* have undulate growth lines. *Arcoscalpellum lineatum* (Darwin, 1851) differs in showing longitudinal lines on the carinal tectum, plus narrower terga and wider scuta, while *A. maximum* (J. de C. Sowerby, 1829) is larger and the scutum has a weaker apicobasal ridge and generally finer transverse and longitudinal ornament. The carina of *A. maximum* has a well-developed apicobasal ridge.

The carinal latus of *A. angustatum* coincides with the original description by Kafka (1885) of a specimen from Kamajka. In shape, this resembles the carinal latus of *A. fossula*, which has a more curved apex, a wider median groove and better-developed lines that are parallel with the basal margin. The most strongly developed grooves parallel to

the basal margin are found in the carinal latus of *A. gracile* (Bosquet, 1854), but this has a less pronounced central rib running from the apex to the basal margin.

Occurrence (BCB) – Upper Cenomanian and lower Turonian at Velim. Žítt *et al*. (1999, p. 112, as *Scalpellum* sp.) also mentioned the occurrence of *A. angustatum* in the upper Cenomanian at Předboj and Černovičky, as well as from the lower Turonian at Velim, Kamajka, Turkaňk and Kněžívka (Žítt *et al*., 1999, p. 112, as *Scalpellum crassum* Kafka). Other records include Žítt & Nekvasilová (1994, p. 26, as *Scalpellum* sp.) from the lower Turonian at Běstvina, and Hradecká *et al.* (1994, p. 19, as *Scalpellum crassum* Kafka) from the lower Turonian at Odolena Voda.

Stratigraphic range – Albian-lower Santonian.

Palaeoecology and palaeogeography

Dynomenid crabs are assumed to have inhabited coral-rich carbonate (and siliciclastic) settings, with respect to modifications and adaptations of their claws. Their propodus/carpus and carpus/merus articulations have bulges, which leaves no openings between these articles when bent (Jagt *et al*., 2010; Van Bakel *et al*., 2012). This modification probably protected the claws when the crabs moved between coral or sponge colonies or during feeding, similar to extant dynomenids (see McLay, 1999, p. 428). Together with the possession of clumps of stiff setae at the inner and outer margins of fixed and moveable fingers which close the space between both fingers and thus help obtain food by sieving fine sediment, these modifications are characteristic of dynomenids (McLay, 1999; Jagt *et al*., 2010). Dynomenids from the BCB are also known from coral- or sponge-rich localities. Their distribution, together with cirripedes, is shown in Fig. 1, while the coral-associated fauna from Kamajka, Velim and Chrtníky are tabulated in Table 2.

Table 2. Coral assemblages from nearshore deposits, associated with dynomenid crabs (data from Eliášová, 1989, 1997a, b), Žítt *et al*. (2006) and Košťák *et al*. (2010).

Species	Kamajka	Velim	Chrtníky
Anthophyllum cylindricum (Reuss)	+	+	+
Actinastrea cribellum (Počta)	-	+	-
Synhelia gibbosa (Goldfuss)	+	+	+
Colonicyathus geinitzi Bölsche	-	+	-
Leptophyllia sp.	-	+	-
Microphyllia maeadrinoides (Reuss)	-	+	-
Columellophora velimensis Eliášová	-	+	-
Onchotrochus hatifnatus Stolarski & Eliášová	-	+	-
Arctangia(?) sp.	-	+	-
Misistellidae gen. indet.	-	+	-
Trochosmilia sp.	-	+	+
Moltkia foveolata (Reuss)	+	+	+
Moltkia solidum Počta	+	+	-
corals gen. et sp. indet	+	+	+

Stalked cirripedes are relatively common faunal elements in nearshore/shallow-water facies within the BCB. Cirripedes lived attached to the substrate in high-energy settings, near wave action, i.e., in an environment similar to the one inhabited by the modern genus *Pollicipes* which occurs mostly intertidally on wave-exposed rocky shores (Fernandes *et al*., 2010). However, both *C. glabrum* and *A. angustatum* rather appear in hemipelagic facies in the BCB (see Kočí & Kočová Veselská, 2013a). The bathymetric records of extant members of the genus *Arcoscalpellum* is 46-5,365 m (Pilsbry, 1907) or 1,555-3,028 m (Weisbord, 1977).

Entire cirripede capitula are rare because such preservation requires a tranquil environment with rapid burial by fine sediment. In nearshore, shallow-water deposits from the BCB, cirripedes are found only as disarticulated plates. The commonest types are scuta, rostra and terga. The palaeo-association of cirripedes from Velim consists of *Zeugmatolepas* n. sp., *C. glabrum*, *A. angustatum*, *C. striatum* and *S.*? *parvulum*. Other faunal elements and palaeoenvironmental relationships were discussed by Žítt *et al.* (1997a, b) (see Tables 1, 2). *Zeugmatolepas* n. sp. has a wider wall of capitular plates in comparison to *C. glabrum*, *C. striatum* and *A. angustatum* and was better adapted to a high-energy setting.

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Plate 1

Dynomenid and ?necrocarcinid crabs from the Bohemian Cretaceous Basin. Scale bars equal 5 mm.

Figs. 1, 2. *Graptocarcinus texanus* Roemer, 1887 (NM O4015), lower Turonian, Kamajka; originally described as (*Cancer*?) *modestus* Fritsch *in* Fritsch & Kafka (1887, pl. 10, fig. 12), lectotype (here designated). Carapace in dorsal view and detail of right anterolateral margin bordered by a row of granules, respectively.

Figs. 3, 4. *Graptocarcinus texanus* Roemer, 1887 (NM O7147), lower Turonian, Kamajka. Carapace in dorsal view and detail of right anterolateral margin and orbits bordered by a row of granules, respectively.

Figs. 5-7. Fragmentary carapace of ?necrocarcinid, with associated yet unrelated manus (syntype) of *Roemerus avicularis* (Fritsch *in* Fritsch & Kafka, 1887), preserved on the same matrix slab (NM O4018), lower Turonian, Kamajka. Both carapace and manus were originally described as *Necrocarcinus avicularis* Fritsch *in* Fritsch & Kafka (1887, pl. 10, fig. 13).

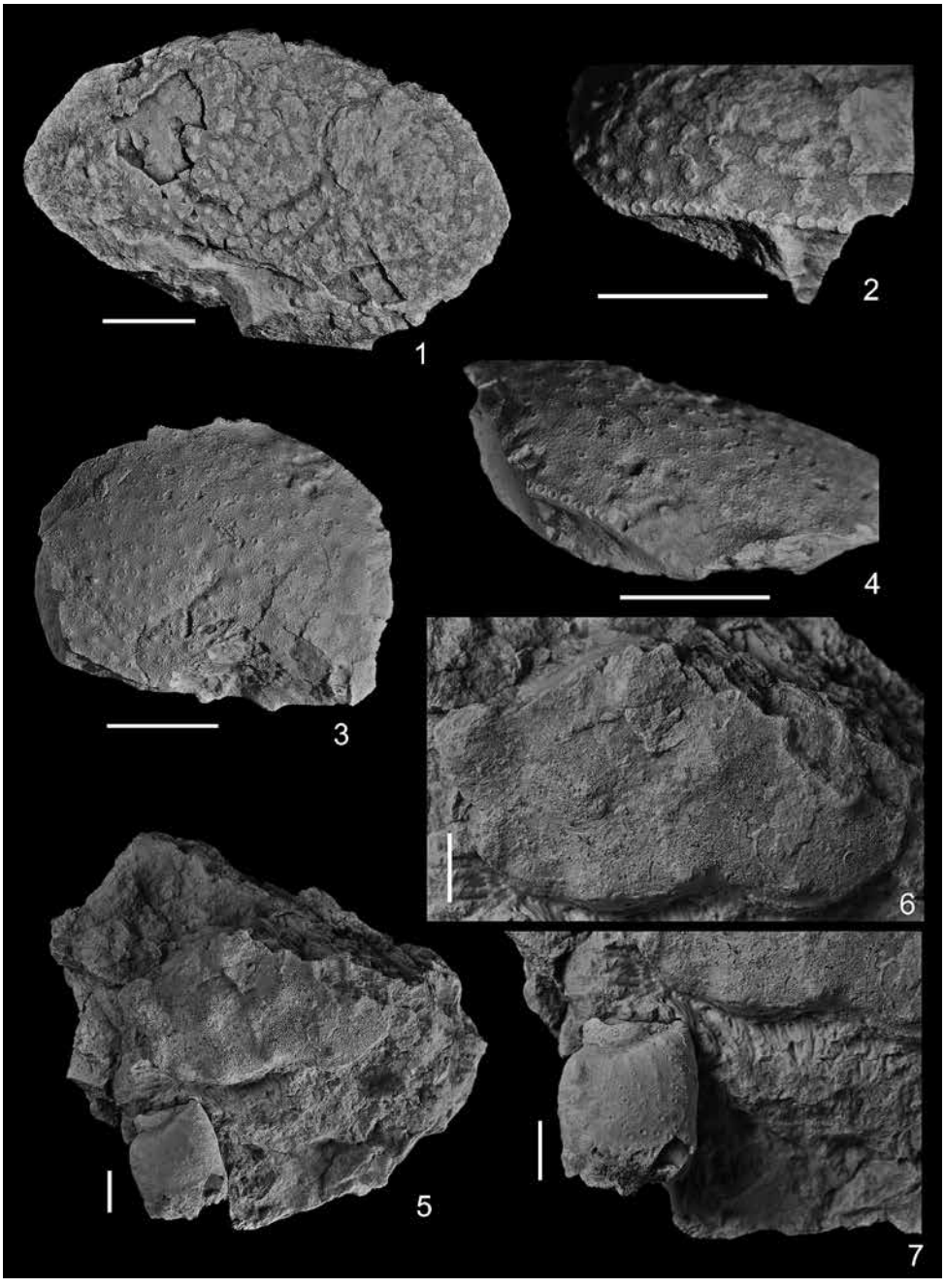
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Plate 2

Isolated claws and dactyli of *Roemerus avicularis* (Fritsch *in* Fritsch & Kafka, 1887). Scale bars equal 2 mm (Figs.1-4) and 5 mm (Figs. 5-8).
Figs. 1, 2. Isolated dactylus (collective number P/5137c), lower Turonian, Chrtníky (layer 7 according to Žítt *et al*., 2006).
Figs. 3, 4. Isolated dactylus (collective number P/5137c), lower Turonian, Velim (pocket Václav).
Fig. 5. Major cheliped lacking fixed and moveable fingers (NM O4014, syntype), lower Turonian, Kamajka; originally described as *Necrocarcinus avicularis* Fritsch *in* Fritsch & Kafka (1887, pl. 10, fig. 11).
Fig. 6. Left claw retaining both fixed and moveable fingers (NM O7148), lower Turonian, Kamajka.
Figs. 7, 8. Left manus (NM 04013, syntype), lower Turonian, Kamajka; originally described as *Necrocarcinus avicularis* Fritsch *in* Fritsch & Kafka (1887, pl. 10, fig. 10), in inner and outer views, respectively.
Fig. 9. Left claw retaining both fixed and moveable fingers (NM O4005, syntype), lower Turonian, Kamajka; originally described as *Necrocarcinus avicularis* Fritsch *in* Fritsch & Kafka, 1887.
Fig. 10. Left claw retaining both fixed and moveable fingers (NM O4004, lectotype, here designated), lower Turonian, Kamajka; originally described as *Necrocarcinus avicularis* Fritsch *in* Fritsch & Kafka (1887, pl. 10, fig. 2a-f).

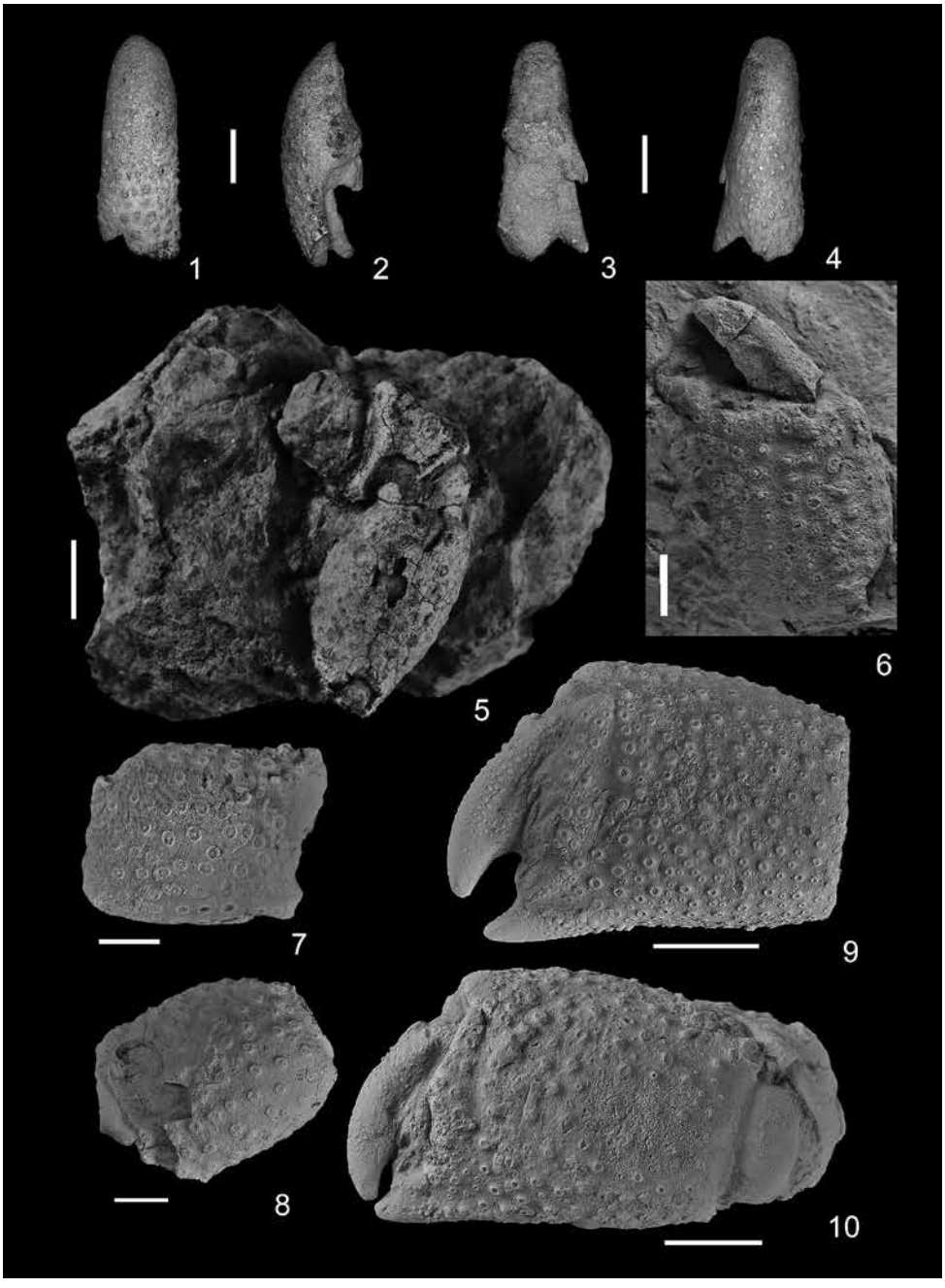
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Plate 3

'*Scillaelepas*' *conica* (Reuss, 1844), upper Cenomanian, Kaňk; all material housed in collections of the Natural History Museum (London). Scale bars equal 1 mm (Figs. 1, 2, 11-16) and 5 mm (Figs. 3-10). Photographed by H. Taylor (NHM, London) and with permission to publish.
Fig. 1. Scutum (NHM In. 16739); outer view.
Fig. 2. Scutum (NHM In. 16740); inner view.
Figs. 3, 4. Scutum (NHM In. 16742); inner and outer views, respectively.
Figs. 5, 6. Scutum (NHM In.16743); inner and outer views, respectively.
Figs. 7, 8. Scutum (NHM In. 16744); inner and outer views, respectively.
Figs. 9, 10. Scutum (NHM In. 16745); inner and outer views, respectively.
Fig. 11. Tergum (NHM In. 16753); outer view.
Fig. 12. Tergum (NHM In. 16754); outer view.
Figs. 13, 14. Carina (NHM In. 16746); outer and lateral views, respectively.
Figs. 15, 16. Carina (NHM In. 16747); lateral and outer views, respectively.

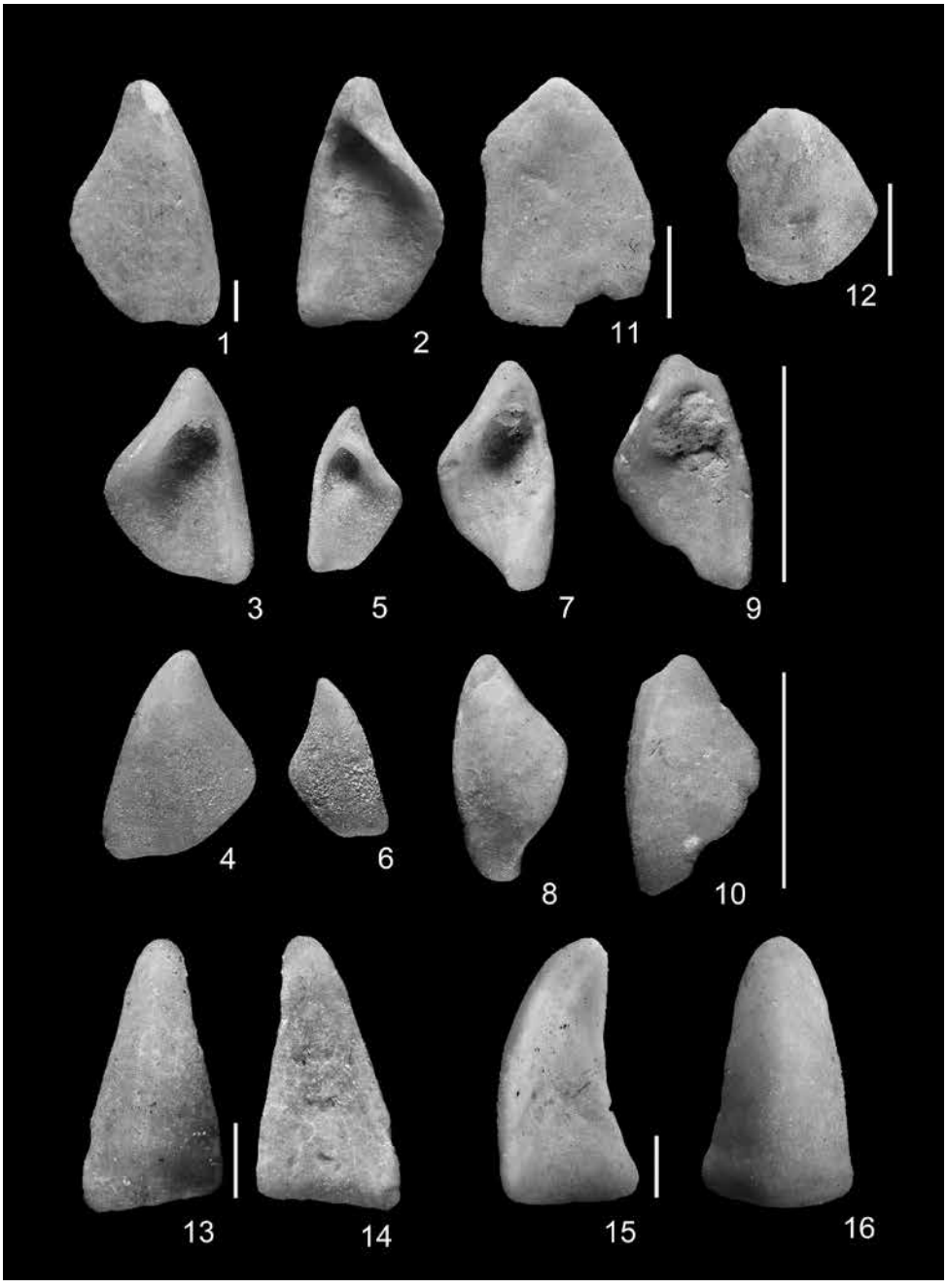
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Plate 4

Titanolepas tuberculata (Darwin, 1851), upper Cenomanian, Kamajka. Scale bar equals 0.5 mm.
Fig. 1. Tergum (NM O3407), outer view.

Smilium? *parvulum* (Withers, 1913), lower Turonian, Velim. Scale bar equals 0.5 mm.
Figs. 2, 3. Carina; outer and lateral views, respectively.

Arcoscalpellum angustatum (Geinitz, 1843), lower Turonian, Velim (pocket Václav, western part of quarry). Scale bars equal 2 mm.
Fig. 4. Left carinal latus.
Fig. 5. Right carinal latus.
Fig. 6. Carina.
Fig. 7. Left scutum.
Fig. 8. Right tergum.
Fig. 9. Upper latus.

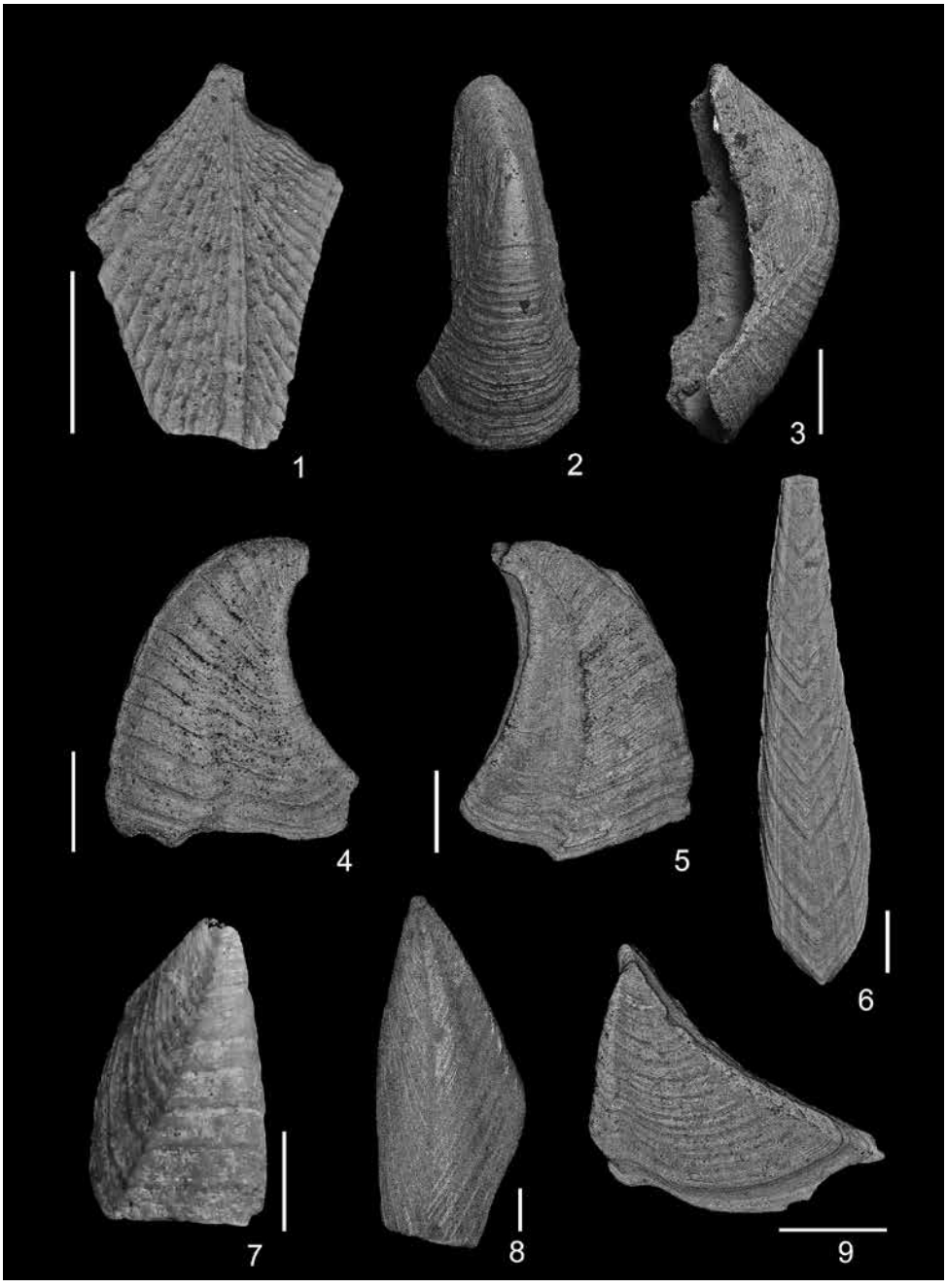
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Plate 5

Zeugmatolepas n. sp. (Kočová Veselská *et al.*, in press); ?upper Cenomanian-lower Turonian, Velim (eastern part). All scale bars equal 0.5 mm.
Figs. 1, 2. Right scutum (NM O7033); outer and inner views, respectively.
Figs. 3, 4. Left scutum (NMO7036); outer and inner views, respectively.
Figs. 5, 6. Right tergum (NM O7038); outer and inner views, respectively.
Figs. 7, 8. Left tergum (NM O7039, holotype); outer and inner views, respectively.
Figs. 9, 10. Rostrum (NM O7041); outer and inner views, respectively.
Figs. 11, 12, 13. Carina (NM O7032); outer, inner and lateral views, respectively.

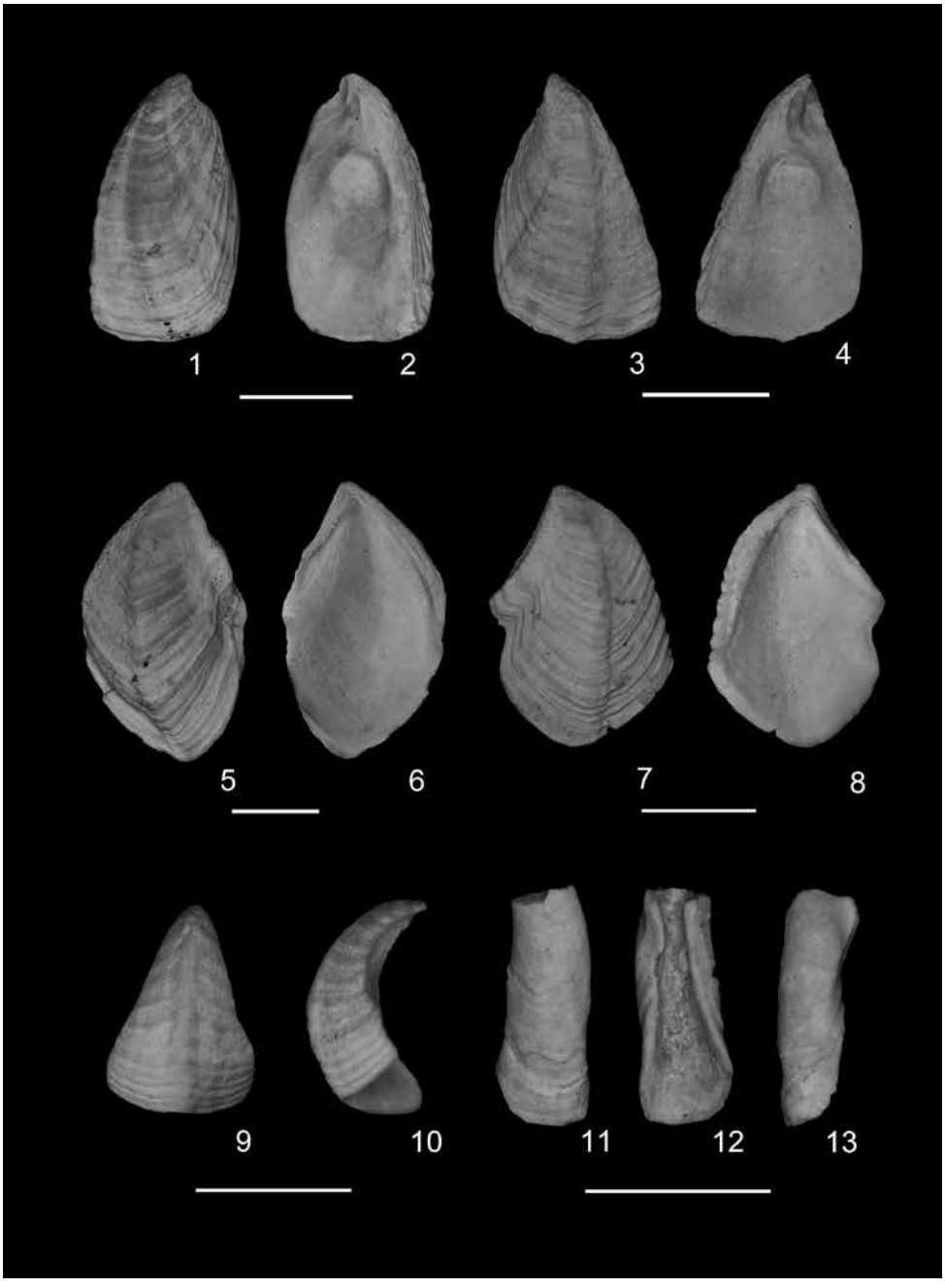
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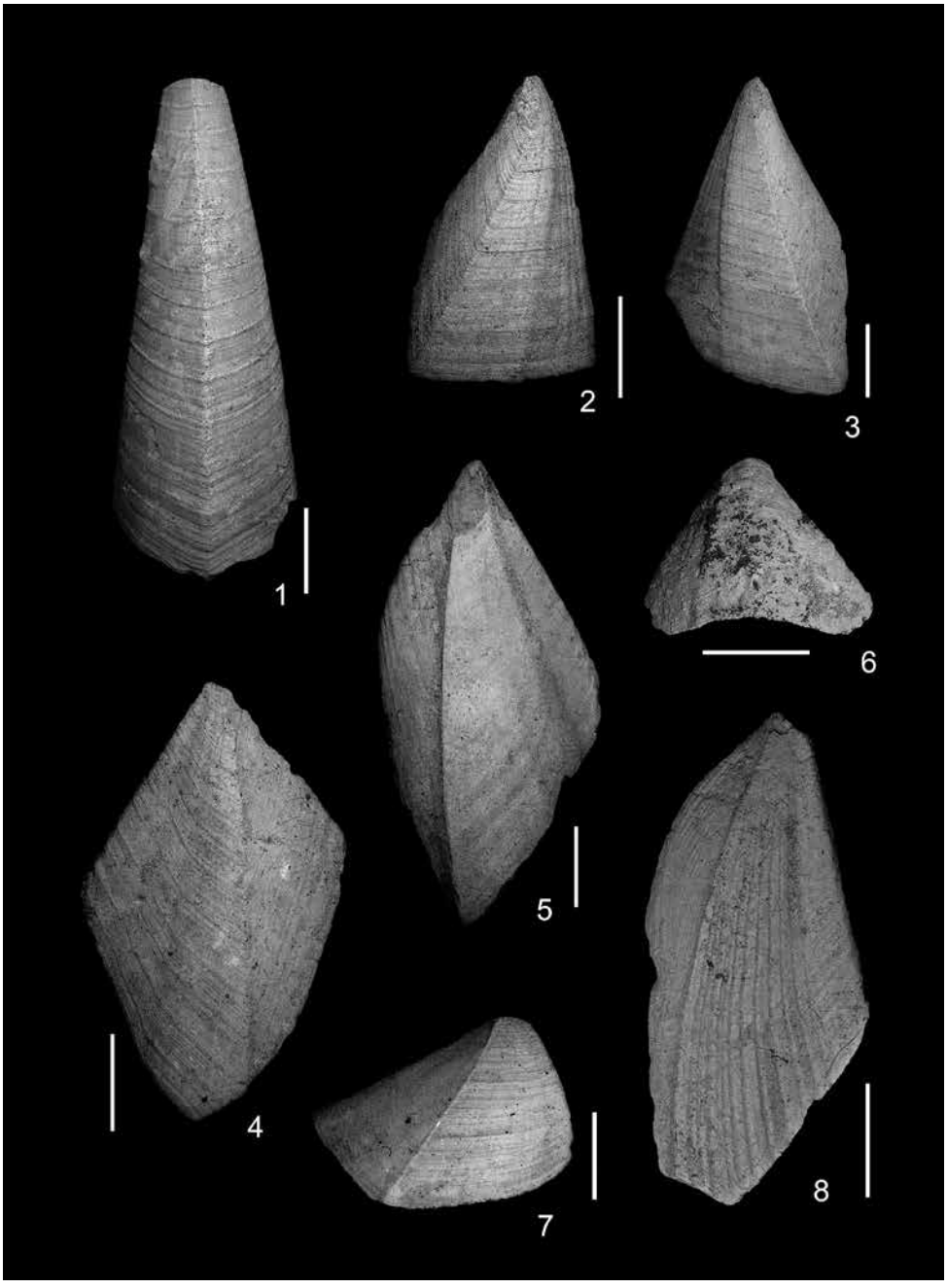
Plate 6

Cretiscalpellum glabrum (Roemer, 1841), lower Turonian, Velim (pocket Václav, western part of quarry). Scale bars equal 2 mm (Figs. 1-5, 7) and 1 mm (Fig. 6). All in collections of National Museum (Prague).
Fig. 1. Carina.
Fig. 2. Left scutum.
Fig. 3. Right scutum.
Fig. 4. Right tergum.
Fig. 5. Left tergum.
Fig. 6. Rostrum.
Fig. 7. Carinal latus.

Cretiscalpellum striatum (Darwin, 1851), lower Turonian, Velim (pocket Václav, western part of quarry). Scale bar equals 4 mm.
Fig. 8. Left tergum.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