



A new record of the Late Cretaceous cirripede *Eoverruca hewitti* (Verrucomorpha, Proverrucidae) from southern Poland

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Abstract

Isolated valves of proverrucid cirripedes (Thoracica, Verrucomorpha) from upper lower Campanian strata exposed at Jeżówka, near Wolbrom (southern Poland), are shown to be conspecific with the type (and sole) species of the genus *Eoverruca*, *E. hewitti* Withers, 1935. This species was first recorded from the upper Santonian (*Marsupites testudinarius* Zone, *Uintacrinus* Band in Withers's terminology) at East Harling, Norfolk and at Wattisfield, Suffolk (eastern England). To our knowledge, there have been no subsequent records of this taxon. In general, proverrucids are rare fossils, with but a handful of species known to date from the upper Turonian to upper Maastrichtian (and possibly lower Paleocene) of northwest Europe (Rügen, Germany; eastern England; the Liège-Limburg Basin in northeast Belgium and southeast Netherlands; present record from southern Poland). In part, this undoubtedly reflects collection failure; because of diminutive size, valves of *E. hewitti* have probably been frequently overlooked. In addition, the species may have had special ecological requirements, and thus be restricted to particular facies types. The present material originates almost exclusively from glauconite-rich levels just below a hardground, with none or very few other cirripede species associated.

Key words: Cirripedia, Verrucomorpha, Proverrucidae, *Eoverruca hewitti*, Campanian, Cretaceous, southern Poland, palaeoecology

Introduction

When erecting the genus *Eoverruca*, with type species *E. hewitti*, Withers (1935: 338) had 64 isolated valves from the 'Middle Senonian' of chalk pits at East Harling, near Thetford (Norfolk), and at Wattisfield, east of Bury St Edmunds (Norfolk, eastern England), at his disposal. On the basis of valve types recognised (carina, rostrum, fixed and movable scutum, fixed and movable tergum and lateral valves), he was able to reconstruct this genus (Withers, 1935: figs 37, 38), which he assigned to the Verrucidae Darwin, 1854. As noted by Withers (1935: 31–33), the genus, and sole species, was confined to the 'Middle Senonian'. It was characterised by having, 'at least two latera on one side, but the carina and rostrum are but slightly asymmetrical, and in this they are not so far removed from the pedunculate type as is *Proverruca*. On the other hand the fixed scutum and tergum have developed interlocking ribs, and in this it is in advance of *Proverruca*. All the valves have a remarkable resemblance to those of the primitive sessile form *Pycnolepas*, and they differ so much from *Proverruca* that it is evident that *Eoverruca* must have come from a different stock to that of *Proverruca*.' Withers

(1935: 339) also noted that, despite their very small size (e.g., largest carina measuring 1.9 mm, largest tergum 2.4 mm, largest scutum 1.7 mm and length of lateral valves not exceeding 0.7 mm), his material of *E. hewitti* probably belonged to mature individuals. This assumption is fully corroborated by the present specimens.

The type lot of *E. hewitti* is from the so-called 'Uintacrinus Band' of the *Marsupites* Zone (Withers, 1935: 59–60), a 60-foot thick unit of soft white chalk underlying levels with *Marsupites* proper. At the type locality of East Harling, this rock, 'is rather firm, but scrubbing with a soft brush under water soon brings to light numerous minute valves of *Eoverruca hewitti* (Pl. XLIV, figs 9–18), which, except for a single valve of *Proverruca vinculum*, is the only Cirripede that has been found there.' In modern stratigraphic terminology, this means that the type material of *E. hewitti* is of late Santonian age, from the zone with *Uintacrinus socialis* (see 'Discussion' below).

Here we present a small faunule (some 30 isolated valves) of proverrucids discovered when handpicking residues of samples taken from a section exposed at Jeźówka, near Wolbrom (southern Poland, Miechów Trough; see Fig. 1). Ostracod and foraminiferal faunas from this section were analysed by two of us for their master's theses (Jablęka, 2006; Witek, 2006). A preliminary zonation of the Jeźówka section, based on ammonoid and coleoid cephalopods, inoceramid bivalves and echinoids, was published by Jagt *et al.* (2004). The present record of *E. hewitti* from samples 3, 4A, 4B and 5 (see Fig. 1C) is a marked range extension, both geographically and stratigraphically. The Polish occurrence is at least 1350 km to the east and is younger than the types of *E. hewitti* for a minimum of five biozones in the north German subdivision (see Gale *et al.*, 1995; Schönfeld *et al.*, 1996). The latter would correspond to around four million years, following strontium isotope calibration (McArthur *et al.*, 1993a, b, 1994; Gale *et al.*, 1995) between sections in North America (Western Interior) and northern Europe.

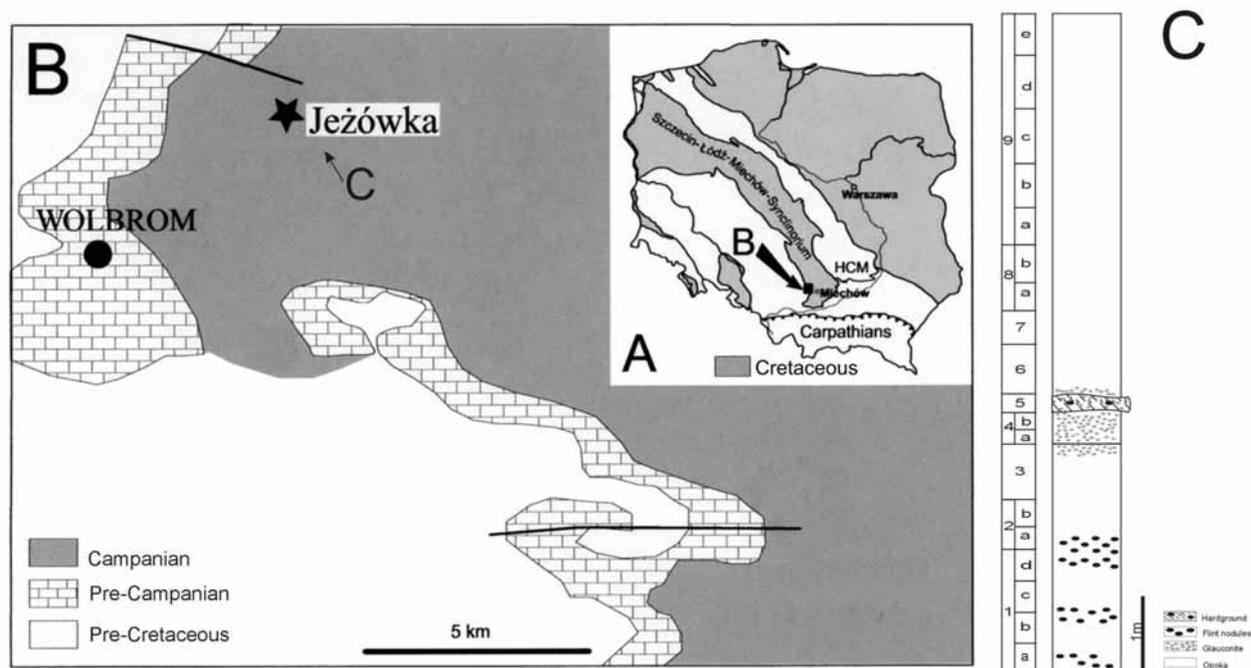


FIGURE 1. Map of Poland (inset A), showing the extent of Cretaceous strata; arrow denotes the Miechów area); B shows the outcrop at Jeźówka, while C presents a simplified log of the section exposed there with numbered sample series in the left-hand column. Samples 3, 4A, 4B and 5 have yielded specimens of *Eoverruca hewitti* Withers, 1935 (see also Table 1).

Of note, palaeoecologically speaking, is the fact that at the type locality of *E. hewitti* only a single valve of another cirripede species was found and this picture is more or less similar in southern Poland. In samples 4A,

4B and 5, *Eoverruca hewitti* is the sole cirripede present, while sample 3 has yielded rare *Zeugmatolepas cretae* (Steenstrup, 1837) and indeterminate remains (Table 1). It is thus quite feasible that *E. hewitti* had special ecological requirements and was more or less restricted to certain facies types. To test this, additional sampling is needed, across facies types of coeval (late Santonian-early Campanian) age and across northern Europe.

Institutional abbreviations: NHM, The Natural History Museum, Department of Palaeontology, London, England (formerly British Museum [Natural History]); NHMM, Natuurhistorisch Museum Maastricht, Maastricht, the Netherlands.

TABLE 1. Cirripede taxa recognised in samples from the upper lower and upper Campanian at Jezówka, Miechów Trough, southern Poland (see Fig. 1). Numbers refer to sample series (subsets denoted by letters, as in Fig. 1C); all material is contained in the collections of the Natuurhistorisch Museum Maastricht, under registration number NHMM 2006 024.

9E	<i>Arcoscalpellum fossula</i> (Darwin, 1851), <i>Brachylepas naissantii</i> (Hébert, 1855)
9D	<i>Arcoscalpellum fossula</i> (Darwin, 1851), arcoscalpelline (?nov. sp.), <i>Brachylepas naissantii</i> (Hébert, 1855), <i>Cretiscalpellum</i> gr. <i>striatum</i> (Darwin, 1851)
9B	<i>Arcoscalpellum</i> sp., arcoscalpelline (?nov. sp.), ?brachylepadid, indeterminate fragments, <i>Virgiscalpellum</i> sp.
9A	<i>Arcoscalpellum fossula</i> (Darwin, 1851), <i>Brachylepas naissantii</i> (Hébert, 1855), ?zeugmatolepidid, <i>Virgiscalpellum</i> sp.
8B	<i>Arcoscalpellum fossula</i> (Darwin, 1851), <i>Cretiscalpellum</i> gr. <i>striatum</i> (Darwin, 1851), ?stramentid, <i>Virgiscalpellum</i> sp., <i>Zeugmatolepas cretae</i> (Steenstrup, 1837)
8A	<i>Arcoscalpellum fossula</i> (Darwin, 1851), arcoscalpelline (?nov. sp.), ?zeugmatolepidid, ?stramentid, <i>Zeugmatolepas cretae</i> (Steenstrup, 1837)
7	<i>Arcoscalpellum fossula</i> (Darwin, 1851)
5	<i>Eoverruca hewitti</i>
4B	<i>Eoverruca hewitti</i>
4A	<i>Eoverruca hewitti</i>
3	<i>Eoverruca hewitti</i> , indeterminate fragments, <i>Zeugmatolepas cretae</i> (Steenstrup, 1837)
2B	<i>Loriculina?</i> sp., ?stramentid
2A	<i>Virgiscalpellum</i> sp., <i>Zeugmatolepas cretae</i> (Steenstrup, 1837)
1D	<i>Arcoscalpellum fossula</i> (Darwin, 1851), arcoscalpelline (?nov. sp.), <i>Brachylepas naissantii</i> (Hébert, 1855), <i>Virgiscalpellum</i> sp., <i>Zeugmatolepas cretae</i> (Steenstrup, 1837)
1C	<i>Brachylepas</i> sp.
1B	arcoscalpelline (?nov. sp.), <i>Zeugmatolepas cretae</i> (Steenstrup, 1837)

Systematic palaeontology

Order Sessilia Lamarck, 1818

Suborder Verrucomorpha Pilsbry, 1916

Diagnosis. ‘Sessile thoracican cirripedes with asymmetrical shell wall comprising fixed scutum, fixed tergum, rostrum and carina, closed by movable scutum and movable tergum (Verrucidae), sometimes including rostrolatus and carinolatus on movable side (Proverrucidae), or basal whorls of imbricating plates (Neoverrucidae); basis membranous or calcareous’ (Buckeridge, 1997: 127).

Family Proverrucidae Newman *in* Newman & Hessler, 1989

Diagnosis. ‘The primary wall is in contact with the substratum and is provided with two overlapping latera protecting the rostro-carinal suture on the movable side’ (Newman *in* Newman & Hessler, 1989: 268).

Genus *Eoverruca* Withers, 1935

Diagnosis. Verrucomorphs with two lateral valves present on rostro-carinal side, rostrum and carina almost symmetrical, and interlocking ribs developed on fixed and movable scuta and terga (modified from Withers, 1935: 338).

Type species. *Eoverruca hewitti* Withers, 1935, by monotypy.

Eoverruca hewitti Withers, 1935

(Figs 2, 3)

Original description. *Eoverruca hewitti* Withers, 1935: 338, text-figs 37, 38; pl. 44, figs 9–18.

Types. The holotype (NHM In. 27598) is a fixed scutum (Withers, 1935: pl. 44, fig. 9a, b), 1.7 mm in length, from the upper Santonian (*Uintacrinus socialis* Zone) of East Harling, Norfolk, eastern England. Withers (1935) had a total of 64 valves; all of these are contained in the collections of the Natural History Museum, Department of Palaeontology (London), under registration numbers NHM In. 27280-27281, In. 27595-27607 and In. 27725-27748.

Material examined. NHMM 2006 024/1-30, comprising carinae, a single rostrum, movable and fixed scuta, movable terga, a single fixed ?tergum as well as lateral valves; all from samples 3, 4A, 4B and 5 taken at the Jeżówka section (Fig. 1C; Table 1).

Description. Valves with transverse ridges sharp-edged, prominent, somewhat overhanging, and undulating on rostrum and carina; a few longitudinal ridges are seen on rostrum and carina; transverse ridges project as sharp points on outer margins of valves.

Carina (Fig. 2G, I) small (0.95–1.0 mm in length), semi-cylindrical, slightly asymmetric; length *c.* 1.5 times width (but damaged); barely bowed inwards; transversely strongly convex and well rounded; ornament of prominent, smooth transverse ridges (at least nine, as preserved), of varying width and narrow, step-like, occasionally undulating interspaces; basal margin irregular (but damaged), concave, and faintly produced laterally below every transverse ridge; apical portion damaged, but estimated to have projected freely to *c.* one-third the length from apex; basal portion concave.

Rostrum (Fig. 2H) small (0.85 mm in length, 0.7 in width, as preserved), semi-conical; basal margin irregular (but damaged); barely bowed inwards; transversely strongly convex to semi-carinate; estimated to have projected freely to *c.* half its length from apex; ornament as in carina, less well marked, with interspaces more or less flush with transverse ridges in single specimen available.

Fixed scutum (Fig. 2J) small (1.15 mm in length, 1.05 mm in width as preserved), triangular (but damaged), faintly curved on tergal side, faintly convex transversely; apico-basal ridge slightly raised, flat-topped, widening markedly towards basal margin, near-equal in width to occludent side of valve; tergal side obliquely inclined inwards, narrow, with two articular ribs; ornament of transverse ridges, projecting beyond both occludent and tergal margins, straight to undulating, with interspaces either narrow or of equal width; occludent side with additional longitudinal striation radiating from apical portion towards basal margin; striae more or less of similar strength. Inner side abraded, but apical portion estimated to have projected freely to *c.* one-third of length of valve.

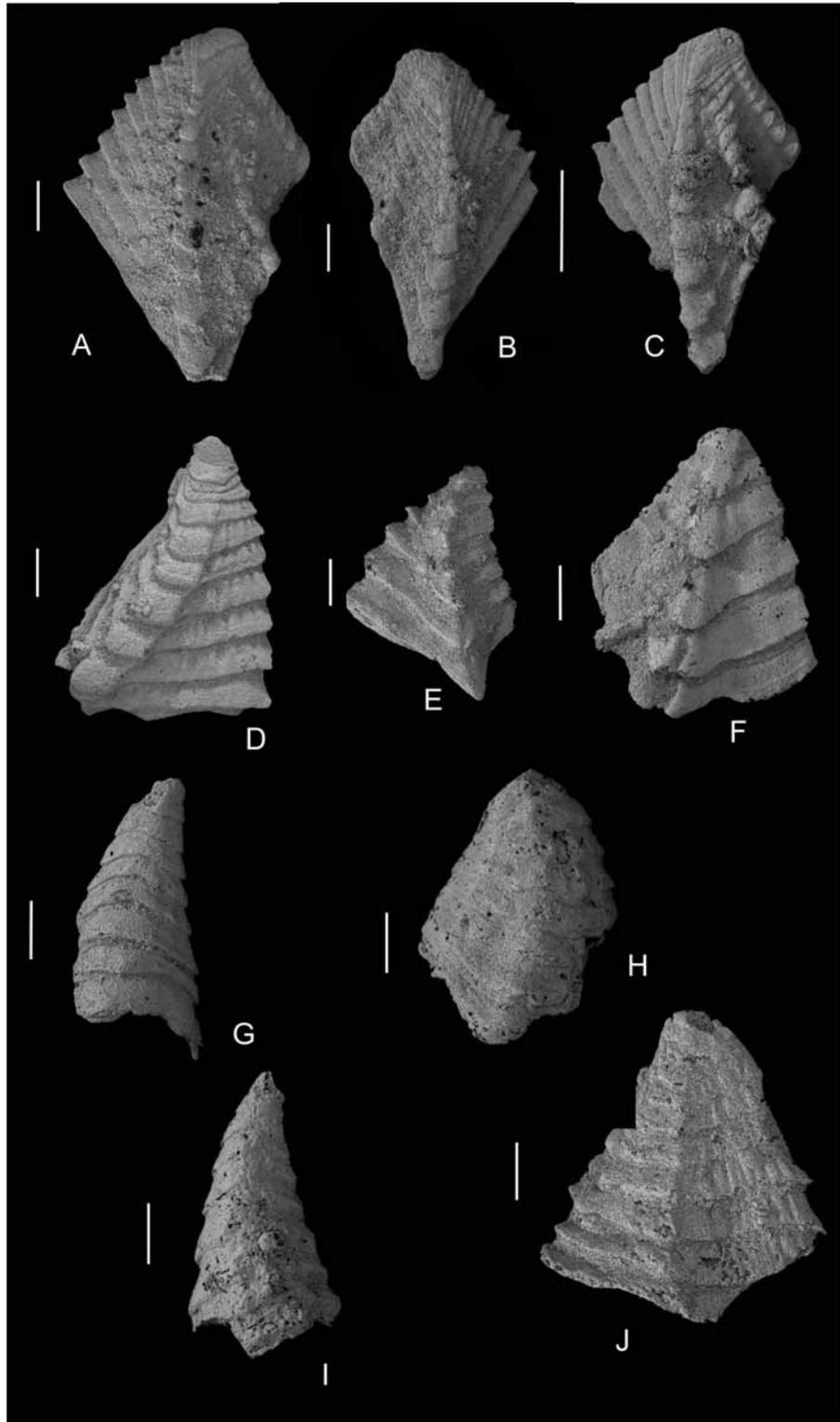


FIGURE 2. *Eoverruca hewitti* Withers, 1935. All specimens from the upper lower Campanian at Jeżówka (Miechów Trough, southern Poland), from samples 3, 4A and 4B (see Fig. 1, Table 1). A, movable tergum (NHMM 2006 024/1); B, movable tergum (NHMM 2006 024/2); C, movable tergum (NHMM 2006 024/3); D, movable scutum (NHMM 2006 024/4); E, ?fixed tergum (NHMM 2006 024/5); F, lateral valve (NHMM 2006 024/6); G, carina (NHMM 2006 024/7); H, rostrum (NHMM 2006 024/8); I, carina (NHMM 2006 024/9); J, fixed scutum (NHMM 2006 024/10). All SEM; scale bars equal 200 μm , except in C, where it represents 500 μm . Note premordial valve in D [compare *Vulcanolepas osheai* (Buckeridge, 2000: fig. 4F, G); see also Southward & Jones, 2003].

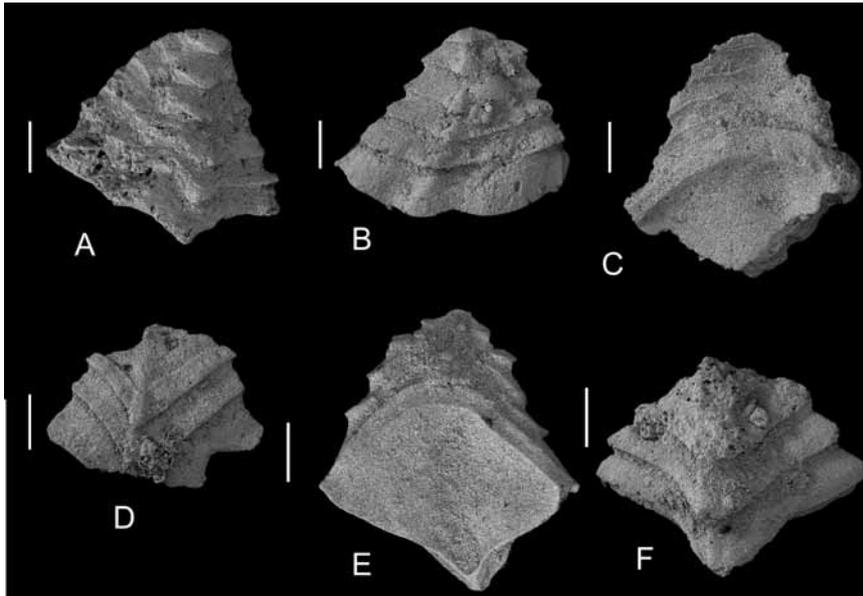


FIGURE 3. *Eoverruca hewitti* Withers, 1935. All specimens from the upper lower Campanian at Jeżówka (Miechów Trough, southern Poland), from samples 3, 4A and 4B (see Fig. 1, Table 1). A, lateral valve (NHMM 2006 024/11), B, lateral valve (NHMM 2006 024/12); C, lateral valve, interior (NHMM 2006 024/13); D, lateral valve (NHMM 2006 024/14); E, lateral valve, interior (NHMM 2006 024/15); F, lateral valve (NHMM 2006 024/16). All SEM; scale bars equal 200 μm .

Movable scutum (Fig. 2D) small (1.3 mm in length), narrower than fixed scutum; apico-basal ridge also narrower, prominently raised and of near-equal width towards basi-tergal angle; prominent growth ridges not downturned on occludent margin; ornament of transverse ridges, straight to slightly undulating, with longitudinal striation on occludent side, similar, more subdued, to that of fixed scutum (Fig. 2J); prominent premordial valve with irregular basal margin in one specimen (Fig. 2D, NHMM 2006 024/4), reminiscent of the one seen in *Vulcanolepas osheai* (see Buckeridge, 2000: fig. 4F, G; Southward & Jones, 2003; Yamaguchi *et al.*, 2004).

Fixed ?tergum (Fig. 2E) small (0.95 mm in length, damaged), subrhomboidal, faintly convex transversely; apico-basal ridge narrow, raised, produced at basal margin; ornament of transverse ridges, undulating and projecting laterally; scutal side damaged, leaving no trace of articular ribs.

Movable tergum (Fig. 2A–C) small (between 1.4 and 1.8 mm in length), elongate; apico-basal ridge central, fairly narrow, increasing in width towards basal angle, of regular curvature; carinal margins of equal length, forming *c.* 70 degrees angle; occludent margin concave, shorter than scutal margin; two articular ribs on scutal side, one prominent and extending from apex to middle of scutal; depression on scutal side of this, separating it from rounded occludent margin forming second rib; ornament of transverse ridges, straight, produced markedly along upper carinal margin, more or less subdued between articular ribs on scutal side.

Lateral valves (Figs. 2F, 3A–F) small, with thin edges (overall width between 0.9 and 1 mm), of varying height, and of two types; one with basal angle positioned near-centrally and, on inner surface, *c.* one-third of valve height marked with few, prominent growth lines; the other with basal angle close to one side and more than upper half with such lines; ornament of pronounced transverse ridges and (sub)central ridge, similar to other valves.

Discussion

Discovery of these cirripede valves came as some surprise, since the monotypical genus *Eoverruca* was thus

far known exclusively from the upper Santonian of Suffolk and Norfolk. Material picked from other samples taken at Jeżówka comprises mostly long-ranging cirripede species, well known from across northern Europe (see Table 1), with the exception of possibly new species of a thin-shelled arcoscappelline and a zeugmatolepidid (*sensu* Newman, 2004).

Although originally assigned to the Verrucidae, *Eoverruca hewitti* has lateral valves, and the carina and rostrum are brachylepadid-like (close, in particular, to the genus *Pycnolepas* Withers, 1914a), and thus could not be maintained in that family, an observation that led Newman (*in* Newman & Hessler, 1989) to introduce the family Proverrucidae. Verrucids are the most derived amongst the verrucomorphans; the oldest forms have been recorded from the Santonian of Western Australia (Buckeridge, 1983; 1996). In Campanian and Maastrichtian strata in northern Europe, verrucids are common, albeit not diverse. A far greater diversity has been recorded amongst Cenozoic and extant forms (Buckeridge, 1983; 1997; Buckeridge & Finger, 2001; Young, 1993; 1998a–d; 2000; 2002a, b; 2003; 2004; Young & Ross, 2002; Young *et al.*, 2003; Carriol & Dieni, 2005; Jagt & Buckeridge, 2005; Koike *et al.*, 2006).

In stark contrast, proverrucids are rare fossils and every new find warrants publication. The known range of the family Proverrucidae is upper Turonian to upper Maastrichtian (and possibly lower Paleocene), and records include two or three species of the genus *Proverruca* Withers, 1914b (see Withers, 1923; 1935) and the monospecific genus, *Eoverruca*. As noted above, Withers (1935) explicitly recorded his material from the so-called ‘*Uintacrinus* Band’, underlying the *Marsupites* Zone. This means that the type lot of *E. hewitti* is definitely of late Santonian age, being from the zone with *Uintacrinus socialis*. Peake & Hancock (1970: 311–312) noted that fossils in the ‘Zone of *Uintacrinus*’ generally were rare, including mostly sponges, bivalves, some ostracods and three cirripede species, *Proverruca vinculum* Withers, 1914b, *E. hewitti* and *Arcoscappelum fossula* (Darwin, 1851). It is now known that the crinoid genus *Uintacrinus* Grinnell, 1876 contains two species, the type (*U. socialis* Grinnell, 1876, of which *U. westfalicus* Schlüter, 1878 is a junior synonym) being of late Santonian age, while the other species, *U. anglicus* Rasmussen, 1961, is restricted to the basal Campanian (Gale *et al.*, *in press*; see also Mitchell, 1995). Similar to the other uintacrinid genus *Marsupites* Miller, 1821, *Uintacrinus* shows a near-worldwide distribution, and, despite the fact that both genera are now considered to have been benthic (Milsom *et al.*, 1994), they provide prime index fossils for the uppermost Santonian-lowermost Campanian. Throughout their range, these crinoids are associated with coleoid and ammonoid cephalopods and inoceramid bivalves (Christensen, 1991; Cobban, 1995; Gale *et al.*, 1995, *in press*; Hancock & Gale, 1996; Jarvis *et al.*, 2002; Łukowiak & Gorzelak, 2006), ensuring tight biostratigraphic control. The present material from southern Poland extends the known range of *E. hewitti* considerably, both geographically and stratigraphically. Current records show it to extend at least into the upper lower Campanian. Jagt *et al.* (2004: 583) suggested that at Jeżówka strata were coeval with the northwest German *papillosa* and *conica/papillosa* zones (and possibly higher; Schönfeld *et al.*, 1996), and that the hardground might constitute (a) portion(s) of the *gracilis/mucronata* and *conica/mucronata* zones, spanning the lower/upper Campanian boundary. Following calibration between North American and European key sections by strontium isotopes, this would mean a range extension for *E. hewitti* of at least four million years (McArthur *et al.*, 1993a, b; 1994).

As far as the palaeoecology of *E. hewitti* is concerned, it is interesting to note that Withers (1935: 58) remarked that, with the exception of a single valve of *Proverruca vinculum*, *E. hewitti* was the only cirripede species found at the type locality of East Harling. In southern Poland, the picture is similar; samples from Jeżówka which yielded most of the material of *E. hewitti* contain no other cirripedes (samples 4A, 4B and 5), with the exception of sample 3 (Table 1). Samples taken from both below and above the hardground have not yielded any specimens of *E. hewitti* (Fig. 1C; Table 1). It may be postulated that *E. hewitti* had special ecological requirements. To test this, additional sampling is called for, both of various facies types and from as many localities across Europe as possible.

Cirripede species recognised in samples from Jeżówka are listed in Table 1. Most are long-ranging taxa,

such as the arcoscaltelline *Arcoscaltellum fossula*, the calanticid *Cretiscaltellum* gr. *striatum* (Darwin, 1851), the brachylepadid *Brachylepas naissantii* (Hébert, 1855) and the zeugmatolepadid *Zeugmatolepas cretae*. Others may be new species, but more material is needed; examples are a zeugmatolepidid close to *Tetrinis* Hirt, 1992 and a thin-shelled arcoscaltelline. In general, records of Late Cretaceous cirripedes from Poland are few and far between in the literature (see e.g., Collins & Radwański, 1982). Material available from the Miechów area and from Chełm (eastern Poland; A.M. Bitner and M. Machalski collections at Polska Akademia Nauk, Instytut Paleobiologii, Warszawa) is currently under study; it includes *Zeugmatolepas cretae*, *Verruca prisca* Bosquet, 1854, as well as various scaltellids. From a number of localities in the Wisła River valley (central Poland), representatives of calanticids (*Scillaelepas* spp.) and scaltellids [*Arcoscaltellum fossula*, *A. gracile* (Bosquet, 1854) and *Virgiscaltellum* spp.] are known (A. Radwański, pers. comm., March 1996).

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