



CRUCIBRISSUS AND WAURNIA, TWO RARE ECHINOIDS IN THE EOCENE OF NORTH-EASTERN ITALY

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Abstract: A few specimens of *Crucibrissus integer* (De Loriol, 1891), the type-species of *Crucibrissus* Lambert, 1920, have been recently collected in the Priabonian of Sossano, near Vicenza (Veneto Region). This species was so far known only by the type specimen, whose whereabouts are unknown. The new material available for study enables to complete the morphological description of *C. integer*, confirming the presence of a latero-anal fasciole and showing the structure of the apical system and of the plastron, which were so far unknown. Based on these new acquisitions, *Crucibrissus* is transferred to the family Prenasteridae Lambert, 1905.

Three specimens attributable to *Waurnia nelsoni* (McCoy, 1882), the type species of *Waurnia* McNamara & Philips, 1984, have also been collected at Sossano. They represent the first record of this genus outside Australia and show that a hood-like aboral projection over the posterior test face may be present in this genus.

Crucibrissus shows close similarities with *Brissomorpha* Laube, 1871, and *Waurnia* McNamara & Philip, 1984. These prenasterids share large test and periproct, narrow petals and the characteristic overarching hood to the periproct. These features distinguish them from *Prenaster alpinus* Desor, 1853, the type species of *Prenaster* Desor, 1853, that is relatively frequent in the Eocene of Veneto. The morphological differences recognised among *Brissomorpha*, *Crucibrissus* and *Waurnia* have a significance at species level only, consequently, they are placed in the same genus. Consequently, the two species from Sossano are here recombined as *Brissomorpha integer* (De Loriol, 1891) and *Brissomorpha nelsoni* (McCoy, 1882).

In the Priabonian of Sossano, *Brissomorpha* inhabited upper Circalittoral environment, at about 50-100 m depth. Based on their morphology, these echinoids were detritivore and lived only partially burrowing in the soft fine-grained marly sediments of the Priabona Formation.

Key words: Echinoidea, Prenasteridae, Priabonian, north-eastern Italy.

Riassunto: CRUCIBRISSUS E WAURNIA, DUE RARI ECHINOIDI DELL'EOCENE DEL VENETO.

Alcuni esemplari di *Crucibrissus integer* (De Loriol, 1891), la specie-tipo del genere *Crucibrissus* Lambert, 1920, sono stati recentemente raccolti nell'Eocene superiore della cava inattiva di calcare di Sossano (Vicenza). Di questa specie era noto sinora solo il tipo, del quale si sono perse le tracce. La località tipo è Galantiga presso Montecchio Maggiore (Vicenza). Il nuovo materiale disponibile per lo studio proviene dall'orizzonte tipico per questa specie (la Formazione di Priabona) e consente di completare la descrizione di questo echinoide, che è ancora poco conosciuto e di collocazione sistematica incerta. Il genere, infatti, viene attualmente considerato come *nomen dubium* in Kroh & Mooi (2023). In base alle nuove acquisizioni, *Crucibrissus* viene assegnato alla famiglia Prenasteridae Lambert, 1905.

Anche tre esemplari attribuiti a *Waurnia* McNamara & Philips, 1984, sono stati raccolti nella cava di Sossano: essi rappresentano la prima segnalazione di questo genere al di fuori dell'Australia.

Il confronto con gli altri rappresentanti della famiglia Prenasteridae consente di individuare un gruppo composto da tre generi molto simili tra loro, *Brissomorpha* Laube, 1871, *Crucibrissus* e *Waurnia*, che si distinguono da



Prenaster alpinus Desor, 1853, la specie-tipo del genere, per le dimensioni decisamente maggiori della teca e del periprocto, per i petali più stretti e per la presenza di un caratteristico prolungamento dell'interambulacro 5 aborale che sovrasta il periprocto. I tre prenasteridi in oggetto vengono assegnati ad un unico genere, *Brissomorpha* Laube, 1871, che gode della priorità temporale, è stato recentemente ridescritto da Kroh (2005) ed è rappresentato da materiale tipico disponibile presso il Museo di Storia Naturale di Vienna. Le due specie riconosciute a Sossano vengono quindi ricombinate rispettivamente come *Brissomorpha integer* (De Loriol, 1891) e *B. nelsoni* (McNamara & Philips, 1984).

In base alle loro caratteristiche morfologiche, si trattava di organismi detritivori che vivevano parzialmente infossati nel sedimento a grana piuttosto fine che caratterizzava i fondali del Priaboniano dei Colli Berici.

Parole chiave: Echinoidea, Prenasteridae, Priaboniano, Veneto.

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Introduction

A large number of echinoids have been collected in the limestone quarry of Sossano in the Berici Hills (Vicenza Province; Fig. 1), above all during the extraction activity. Some of them are here attributed to two rare spatangoids: *Crucibrissus integer* (De Loriol, 1891), the type-species of the genus *Crucibrissus* Lambert, 1920, and *Waurnia* McNamara & Philips, 1984, a genus so far known only from the Oligocene of Australia.

The type locality of *Crucibrissus integer* was a Priabonian outcrop near Galantiga, a small village close to Montecchio Maggiore (Vicenza Province), about 10 km north of Sossano. Since the Upper Eocene marly limestones outcropping at Sossano belong to the Priabona Formation, the specimens from this locality belong to the type horizon for this species.

The systematic position of *Crucibrissus* is still uncertain and debated. It was tentatively assigned to the family Macropneustidae by Smith & Kroh (2011) and is actually considered as “uncertain, *nomen dubium*” in Kroh & Mooi (2023), because relevant morphological characters are unknown in the type species. The type specimen of *C. integer* is wanting and represents the sole specimen so far known of this species.

Waurnia is considered as junior synonym of *Brissomorpha* Laube, 1871, in Kroh (2005) and Kroh & Mooi (2023).

The new material available to study enables to complete the morphological description of the type species of *Crucibrissus* and to discuss the systematic position of this genus and the relationships with similar taxa, in particular with *Prenaster*, *Waurnia* and *Brissomorpha*.

Material and methods

Morphological abbreviations: TL, TW, TH = respectively length, width, and height of the test. Da = distance of the anterior margin of the apical disc from the anterior test margin. Dp = distance of the anterior edge of the peristome opening from the anterior test margin. Pc = maximum dimension of the periprocto. Ps = width of the peristome. St = length of the sternal plates. Wa, Wp = respectively width of anterior and posterior paired petals. The measure of the angle between oral ambulacra II-IV and I-V has been taken in plan projection of the aboral test surface.

Measurements with \approx are considered as approximate.

Fm = Formation.

Institutional abbreviations: MCV = Museo Civico “Dal Lago”, Valdagno; NHMW = Natural History Museum, Vienna; NMV = Natural History Museum, Victoria (Australia); SRC = Collection Sanchez Roig (Cuba).

The systematic palaeontology follows Kroh & Mooi (2023).

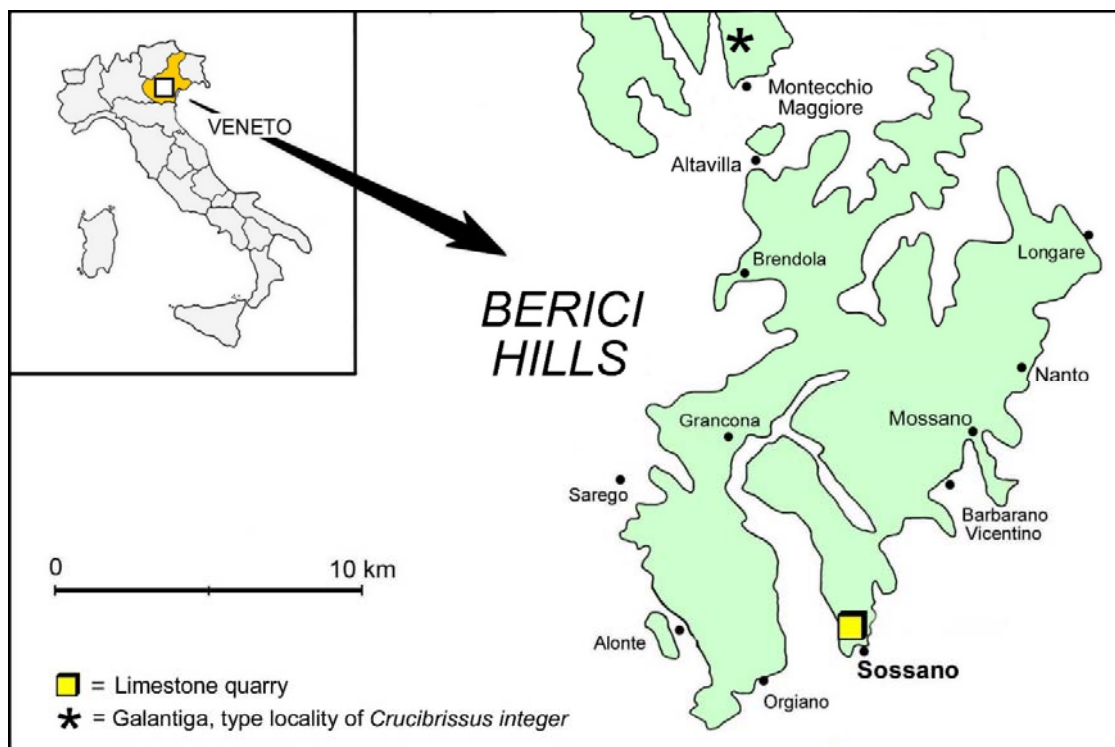


Figure 1 – Location map of the finding locality, the inactive limestone quarry of Sossano (Vicenza Province).

Figura 1 – Mappa della località di ritrovamento, la cava inattiva di calcare di Sossano (Vicenza).

Material studied: on the whole, it consists of four specimens collected by one of the authors (F.C.) in the Priabonian of Sossano (Vicenza), housed at the Museo Civico “Dal Lago”, Valdagno (Vicenza):

- *Crucibrissus*: a large-sized specimen (inventory code MCV 23/851, WL = 82 mm), missing the posterior part of the test; the pathway of the peripetalous fasciole and the structure of the oral face are visible enabling to take a partial scheme of the plastron.
- *Waurnia*: three specimens (MCV 23/848-849-850), with rather large-sized test (TL = 71 mm in MCV 23/848). Some parts of the test surface are worn or encrusted by tenacious sediment. Although the test is very thin in these echinoids, MCV 23/848 is almost undeformed.

Another specimen of *Crucibrissus* from the Sossano quarry (T.440; TL = 76 mm) was examined in a private collection: the oral surface is embedded in tenacious sediment, but the aboral face and the lateral profile are well preserved and almost undeformed.

The type specimen of *Crucibrissus integer* (TL = 70 mm), from the Upper Eocene of Galantiga, is wanting. It was illustrated by De Loriol (1891, pl. 1, fig. 1); the original drawings are here reported in Figure 3.

Crucibrissus cabrerai Sanchez Roig (1953), Upper Eocene of Cuba: only one of the specimens originally described by Sanchez Roig (SRC.4191) was available for study when Kier (1984) re-examined the type material. It was illustrated by Sanchez Roig (1953; pl. 21). Kier proposed it as lectotype; however, the test is poorly preserved, highly abraded and missing the posterior part of the test.

We utilised illustration and description of lectotype and paralectotype of *Brissomorpha fuchsi* Laube, 1871 (NHMW 1866.XX.18-19), from the Lower Burdigalian Zogelsdorf Formation of Gauderndorf (Austria), provided by Kroh (2005).

Lectotype (NMV P12211) and two paralectotypes (NMV P12212, I22D) of *Waurnia nelsoni* (McCoy, 1882), Janjukian (Upper Oligocene) of Waurn Ponds (Australia), were figured by McNamara & Philips (1984).



Figure 2 – Panoramic view of the limestone quarry of Sossano (Vicenza Province).

Figure 2 – Panoramica della cava di calcare di Sossano (Vicenza).

Finding locality

The Priabonian outcrops are limited in the surroundings of Galantiga, the type locality of *Crucibrissus integer*, thus reducing the possibility of collecting new topotypic material.

The limestone quarry of Sossano, in the Berici Hills, is the only other finding locality known of this rare echinoid; it is located about 10 km south of the type locality.

Geostratigraphy and palaeoenvironment of the Eocene deposits in this area have been studied by Fabiani (1908), Ungaro (1978) and Mietto (1988, 2003). The limestone deposits corresponding to the marine transgression which occurred during the Upper Eocene leading to the covering of the Bartonian volcanic ridge are extensively exposed in this area. The stratigraphic unit corresponding to this event is the Priabona Formation (Upper Eocene, Priabonian). The quarry is actually inactive; despite the recent extensive environmental restoration works, the Middle Eocene deposits, about 50 m thick, are still well visible (Fig. 2). At the top of the exposed section there are marly limestones (Priabonian), grey on the fresh fracture and yellowish when exposed to atmospheric agents. They are well stratified and rich in macrofossils, mainly consisting of nummulites, bryozoans and less frequent bivalves, crustaceans and fish teeth. Echinoids are also rather frequent and mainly represented by specimens of *Schizaster*, *Gitolampas*, *Echinolampas* and less frequent *Clypeaster* and *Trachypatagus*.

The fossil material under study attributed to *Crucibrissus* and *Waurnia* has been collected from the Priabonian marly limestones, as well as the rare specimens of *Arachniopleurus* and *Scholechinus* recently described from this echinoid-rich locality (Borghi & Bottazzi, 2022, Borghi *et al.*, 2022).

Previous work

Brissomorpha fuchsi Laube, 1871, the type-species of *Brissomorpha* Laube, 1871, based on Lower Miocene fossils from Austria, was recently transferred to *Prenaster* Desor, 1853, because the morphological differences appeared not sufficient to separate it at genus level (Kroh, 2005).

Pericosmus nelsoni McCoy, 1882, was instituted on the basis of fossil material from the Upper Oligocene of Australia and was subsequently proposed as the type-species of *Waurnia* McNamara & Philips, 1984.

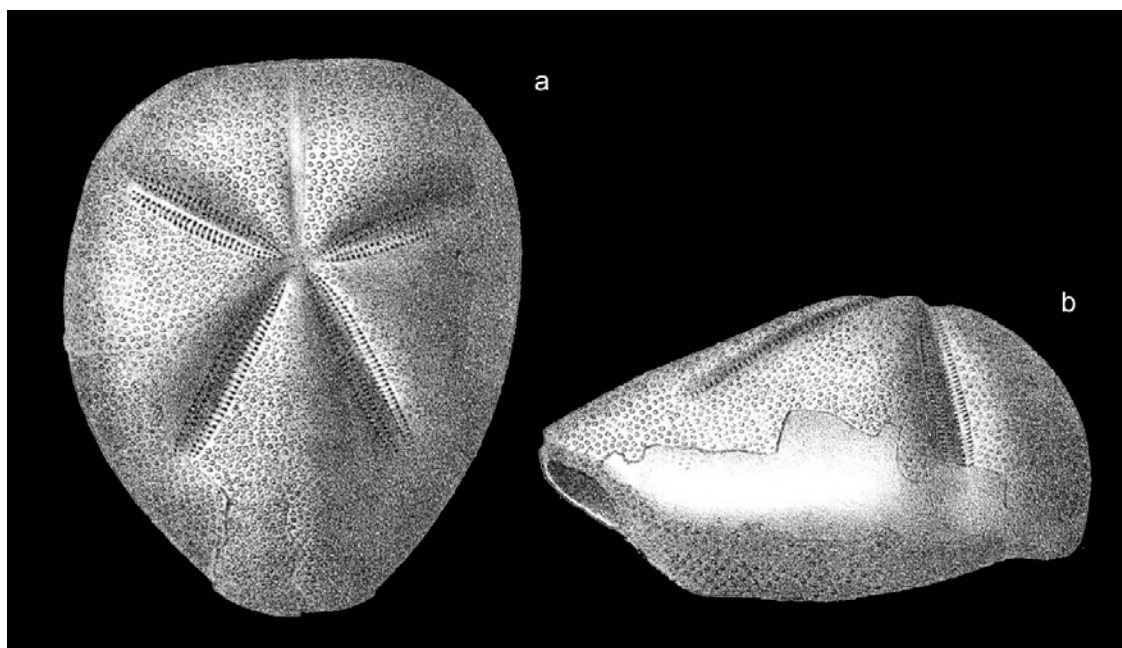


Figure 3 – Type specimen of *Macropneustes integer* De Loriol (1891), TL= 70 mm, upper Eocene, Galantiga (Vicenza); original illustration by De Loriol (1891, tab. 1, fig. 1): a) aboral view, b) lateral view. Whereabouts unknown.

Figura 3 – Esempio tipo di *Macropneustes integer* De Loriol (1891), TL= 70 mm, Eocene superiore di Galantiga (Vicenza); illustrazione originale di De Loriol (1891, tav. 1, fig. 1): a) vista aborale, b) vista laterale. L'ubicazione dell'esemplare è sconosciuta.

De Loriol (1891) described *Macropneustes integer* on the basis of a single specimen (Fig. 3) from the Eocene of Galantiga, the poor preservation of which prevented him from describing relevant morphological characters, such as the pathway of the peripetalous fascioles, the possible presence of other fascioles, the labrum shape, the structure of the plastron and of the apical system. Nevertheless, Lambert (1920) proposed it as the type-species of a new genus, *Crucibrissus*, characterised by the absence of the latero-anal fasciole.

Meffert (1931) attributed a new species to *Crucibrissus*, *C. abichi*, based on poorly-preserved fossils from the Lutetian of Armenia. After Mortensen (1950), the description of *C. abichi* was not detailed and further material was needed to discuss the validity of that taxon; additionally, since the structure of the apical system and of the labrum were still unknown in *Crucibrissus*, Mortensen preferred to place it in *incertae sedis*, but “probably close to the Hemiasteridae”.

Sanchez Roig (1953) described a new species, *Crucibrissus cabrerai* from the Upper Eocene of Cuba. Later on, Kier (1984) proposed a new combination for this taxon, *Brissus cabrerai*, despite only a single poorly preserved specimen remained in the Sanchez Roig collection.

Fischer (1966) tentatively placed *Crucibrissus* in the family Toxasteridae, based on the supposed lack of the latero-anal fasciole. However, in the original description De Loriol (1891) underlined that it was not possible to say if this fasciole was present, due to poor preservation of the only known specimen.

After Smith & Kroh (2011), *Crucibrissus* looks very similar to *Trachypatagus*, but “it will remain impossible to place it until oral plating is determined”. Additionally, they considered *Waurnia* McNamara & Philip, 1984 as “subjective junior synonym” of *Brissomorpha* Laube, 1871.

On the whole, *Crucibrissus* is still poorly known and its systematic position is uncertain. It is actually considered as “*nomen dubium* (incompletely known, placement uncertain)” in Kroh & Mooi (2023).

Waurnia is indicated as “*unaccepted*” in Kroh & Mooi (2023) and its type-species has been recombined as *Prenaster nelsoni* (McCoy, 1882).



Systematic palaeontology

Order Spatangoida Claus, 1876
 Suborder Paleopneustina Markov & Solovjev, 2001
 Family Prenasteridae Lambert, 1905
 Genus *Brissomorpha* Laube, 1871

[= *Crucibrissus* Lambert, 1920, p. 27, type-species *Macropneustes integer* De Loriol, 1891, p. 15; = *Waurnia* McNamara & Philip, 1984, p. 341, type-species *Pericosmus nelsoni* McCoy, 1882].

Type-species: *Brissomorpha fuchsi* Laube, 1871, p. 73, by original designation.

Description (from Smith & Kroh, 2011, emended):

- Test ovate, large-sized, without anterior sulcus. In profile relatively depressed with a strongly overarched hood to the periproct. Bluntly pointed to rear.
- Apical disc ethmolytic, with 4 gonopores; closer to anterior test margin than to centre.
- Anterior ambulacrum narrow and flush; pore-pairs small and rudimentary.
- Paired ambulacra petaloid, flush to weakly sunken, very narrow (max Wa and Wp < 5% TL) and open distally; the anterior pair form an angle of about 180°, the posteriors are much less divergent; the two pore columns are almost parallel; anterior pair extending most of the distance to the ambitus in plain view; posterior pair may be much shorter.
- Periproct large (Pc > 18% TL), oval with opening taller than wide, located high in the short posterior face
- Peristome wider than long; kidney-shaped with projecting labrum.
- Labral plate very short and wide; sternal plates large and shield-like, hardly indented at posterior by ambulacral zones. Episternal plates offset.
- No large primary tubercles differentiated aborally.
- Peripetalous fasciole present, passing beneath the ambitus around the anterior and at some distance (3-4 plates) beneath the anterior paired petals. Latero-anal fasciole present, separating from the peripetalous just behind the anterior petals.

Remarks: *Brissomorpha* Laube, 1871 is close to *Crucibrissus* Lambert, 1920 and *Waurnia* McNamara & Philip, 1984. The new fossil material from Sossano enables to describe morphological characters which were so far unknown in the type specimen of *Crucibrissus integer* (De Loriol, 1891): the latero-anal fasciole is present and separates from the peripetalous just behind the anterior paired petals (Fig. 5b), the labrum is wide and very short (Fig. 5c), the plastron is amphisternous, the apical disc is ethmolytic with 4 gonopores (Fig. 5d). Thus, the relationship of *Crucibrissus* with the Toxasteridae, as hypnotised by Fisher (1966), or with the Hemiasteridae, as tentatively proposed by Mortensen (1950), can be ruled out. These features indicate that *Crucibrissus* belongs to the family Prenasteridae Lambert, 1905, a family established for taxa with peripetalous fasciole passing beneath the margin anteriorly and well under (at least 3-4 plates interposed) the tip of the anterior paired petals. In the Schizasteridae, instead, the fasciole passes just beneath the base of the anterior petals.

Brissomorpha, *Crucibrissus* and *Waurnia* differ from *Prenaster alpinus* Desor, 1853, the type-species of *Prenaster*, by much larger test and periproct, narrower paired petals and overarched periproct (Figs. 3b, 6b, 7d; Kroh, 2005, fig. 73c).

Kroh (2005), when restudying the type material of *Brissomorpha fuchsi* Laube, 1871, proposed to synonymise *Brissomorpha* and *Waurnia* with *Prenaster*. However, the differences above seen between the group of prenasterids under study and *Prenaster* (Tab. 1) seem worth maintaining them as separate.

The differences recognised among *Crucibrissus*, *Brissomorpha* and *Waurnia* are:

- *Brissomorpha* has shorter posterior petals extending only halfway from the apical disc to the ambitus; additionally, the pore pairs do not extend beyond the posterior petals (*vide* Kroh, 2005).
- *Crucibrissus* has petals slightly more sunken than in the other two genera (Fig. 4a), the apical disc is a little farther from the anterior test margin.

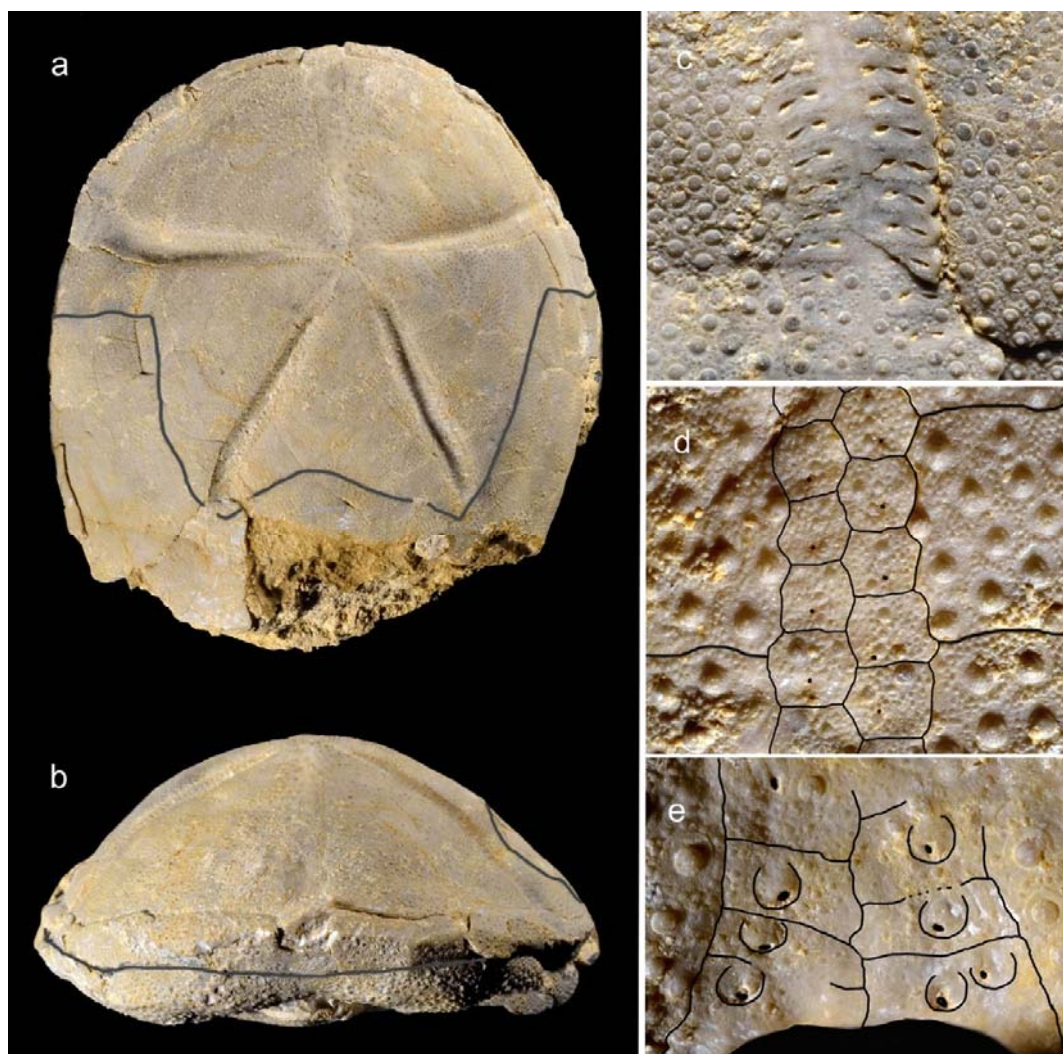


Figure 4 – *Brissomorpha integer* (De Loriol, 1891), Priabonian of Sossano (MCV 23/851), WL = 82 mm: aboral view (a), frontal view (b), detail of the lateral ambulacrum IV (c) and of the ambulacrum III in frontal (d) and oral (e) views.

Figura 4 – *Brissomorpha integer* (De Loriol, 1891), Priaboniano di Sossano (MCV 23/851), WL = 82 mm: vista aborale (a), frontale (b), dettaglio dell'ambulacro laterale IV (c) e dell'ambulacro III in vista frontale (d) e orale (E).

- In *Waurnia* and *Crucibrissus* the couple of pores in the paired petals are slightly more spaced and extend beyond the posterior petals.

Since these differences are here considered as valid only at species level, *Crucibrissus* and *Waurnia* are treated as junior synonyms of *Brissomorpha* Laube, 1871, which gains priority and is represented by available type material (NHMW) recently redescribed and illustrated by Kroh (2005).

Species included:

- *Brissomorpha fuchsi* Laube, 1871, Lower Burdigalian of Austria.
- *Brissomorpha integer* (De Loriol, 1891), Priabonian of Italy.
- *Brissomorpha nelsoni* (McCoy, 1882), Priabonian of Italy, Upper Oligocene of Australia.

Distribution: Upper Eocene-Lower Miocene, Europe and Australia.

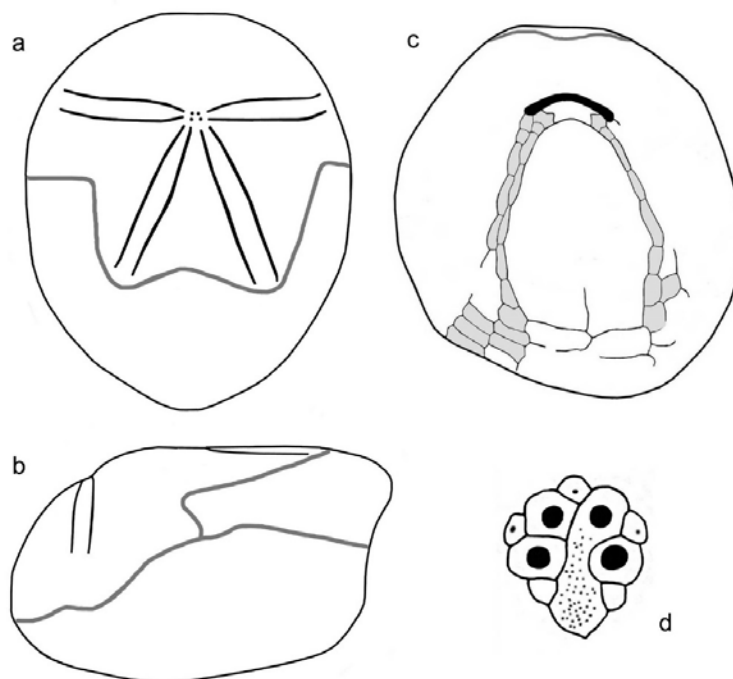


Figure 5 – *Brissomorpha integer* (De Loriol, 1891), Priabonian of Sossano: scheme of the peripetalous (a) and latero-anal (b) fasciole. MCV 23/851 (WL = 82 mm): scheme of the plastron plating (c) and of the apical system (d).

Figura 5 – *Brissomorpha integer* (De Loriol, 1891), Priaboniano di Sossano: schema della fasciola peripetala (a) e della latero-anale (b). MCV 23/851 (WL = 82 mm): schema del piastrone (c) e dell'apparato apicale (d).

	<i>Prenaster alpinus</i>	<i>Brissomorpha fuchsi</i>	<i>Brissomorpha integer</i>	<i>Brissomorpha nelsoni</i>
Large-sized test (TL > 70 mm)		X	X	X
Small test (TL < 40 mm)	X			
Petals almost flush with test surface “ weakly sunken	X	X	X	X
Poriferous series in the posterior petals:			X	X
- extending beyond petals	X	X		
- not extending beyond petals				
Paired petals width:				
- very narrow (Wa, Wp < 5% TL)	X	X	X	X
- rather narrow (Wa, Wp = 7-10% TL)				
Periproct:				
- may be overarched		X	X	X
- never overarched	X			
Periproct: Pc always > 18% TL		X	X	X
Pc always < 15% TL	X			

Table 1 – Main morphological differences among the four prenasteridids under study.

Tavola 1 – Differenze morfologiche principali rilevate tra i quattro prenasterididi esaminati.



Brissomorpha integer (De Loriol, 1891)

(Figs. 3-6)

Type material: the type, the sole specimen studied by De Loriol (1891), from the Priabonian of Galantiga, near Montecchio Maggiore (Vicenza Province), TL = 70, TW = 62, TH = 42 mm. Whereabouts unknown.

Material examined: two specimens (MCV 23/851; T.440) from Sossano (Vicenza Province), from the type-horizon, the Upper Eocene Priabona Formation.

Description: large sized test; in particular, the width of MCV 23/851 (TW = 82 mm) enables to extrapolate a TL ≈ 95-100 mm. Test outline ovoid, bluntly pointed to rear. Slightly indented groove present only adapically (Figs. 3a, 4a, 6a). Maximum height a little behind the apical disc (Figs. 3b, 6b). Apical system ethmolytic (Fig. 5d), with four gonopores opening very close together, closer to the anterior test margin than to the centre (Ap = 25-28% TL). The frontal ambulacrum is narrow, almost flush with the test surface, weakly sunken only adapically (Figs. 3a, 4a); it has oblique couples of minute pores arranged in simple series (Fig. 4d). Aborally, paired petals long, very narrow (max Wa and Wp < 5% TL), almost straight and weakly sunken, slightly flexuous only towards the distal end (Fig. 4a). The anterior pair is almost transversely oriented. The posterior petals are much less divergent (50°-60°); they are slightly longer than the anteriors and extend shortly over half-way to ambitus. The pore pairs are elongated, with the interporiferous zone almost as wide as a poriferous one (Fig. 4c). The poriferous series extend beyond the posterior petals and the peripetalous fasciole. Labrum very short and wide (Fig. 5c); sternal plates long (St ≈ 45% TL), sub-triangular and flanked by narrow ambulacral plates. Peristome wide (Ps = 18% TL) and close to the anterior test margin (Dp = 18% TL). Phyllodes well developed (Fig. 4e). Periproct large (Pc ≈ 20% TL), positioned at the summit of the posterior face and overarched.

Tuberculation dense and uniform, made of small perforate and crenulate tubercles; slightly enlarged tubercles are found in the paired anterior interambulacra flanking the frontal ambulacrum (Fig. 4d). In the oral face,

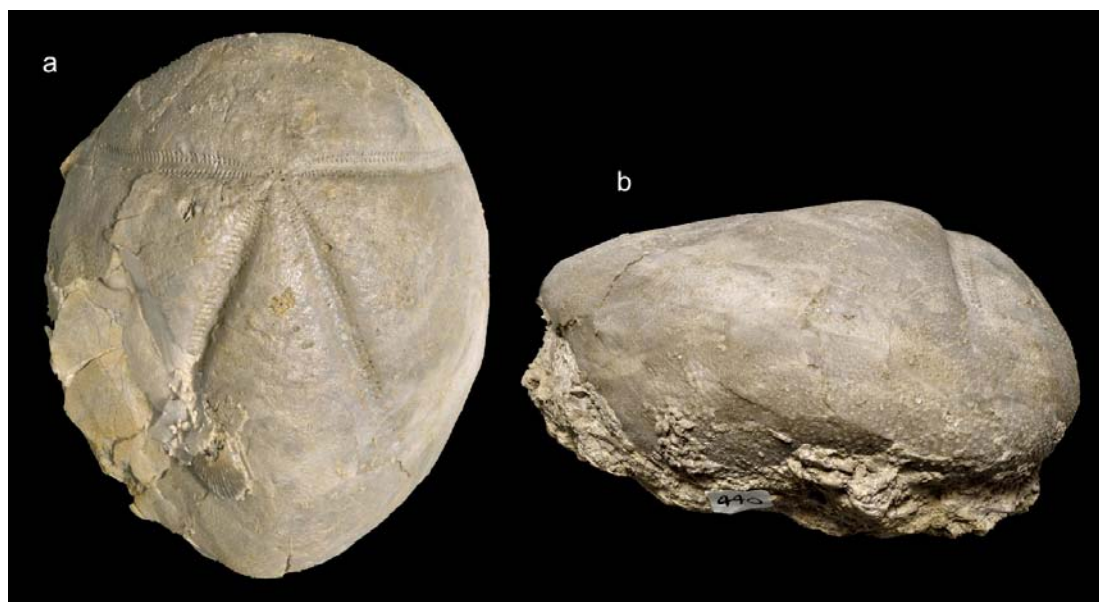


Figure 6 – *Brissomorpha integer* (De Loriol, 1891), Priabonian, Sossano (T.440), TL = 76 mm. Aboral (a) and lateral (b) views.

Figura 6 – *Brissomorpha integer* (De Loriol, 1891), Priaboniano, Sossano (T.440), TL = 76 mm. Vista aborale (a) e laterale (b).



tubercles are more spaced and slightly larger, covering also the labrum and the plastron, where they are arranged in series, leaving only the ambulacral areas almost naked. Peripetalous fascioles present, passing beneath the ambitus around the anterior of the test and at some distance (3-4 plates) beneath the anterior paired petals. Latero-anal fascioles present, separating from the peripetalous just behind the anterior petals (Figs. 5b).

Remarks: *B. nelsoni* (Mc Coy, 1882) differs from *B. integer* by petals almost flush with the test surface and the apical disc slightly closer to the anterior test margin ($Ap \approx 20-25\%$ TL). *B. fuchsi* Laube, 1871 has shorter posterior petals, extending only halfway from the apical disc to the ambitus, the apical disc is slightly closer to the anterior test margin ($Ap \approx 20\%$ TL).

The poor preservation of the type material of *C. abichi* Meffert, 1931, Lutetian of Armenia, and *C. cabrerai* Sánchez Roig, 1953, Eocene of Cuba, prevents reliable comparison. In particular, since the fascioles were not visible in the lectotype of *C. cabrerai*, this species was tentatively assigned by Kier (1984) to a different genus (*Brissus*).

Prenaster alpinus Desor, 1853, relatively frequent in the Eocene of Veneto, differs by much smaller test (TL not exceeding 35- 40 mm), narrower petals, periproct smaller (always $< 15\%$ TL) and never overarched.

Distribution: Upper Eocene of Galantiga and Sossano, Veneto Region (Italy).

Brissomorpha nelsoni (McCoy, 1882)
(Fig. 7a-d)

Type material: lectotype (NMV P12211) and two paralectotypes (NMV P12212, I22D), Janjukian (Upper Oligocene) of Waurn Ponds (Australia).

Material examined: three specimens (MCV 23/848, 23/849, 23/850), Upper Eocene, Priabona Fm, Sossano (Vicenza).

Description: test large-sized (mean TL = 72 mm at Sossano), ovoid with elongate outline (TW = 83% TL) and bluntly pointed to rear. Test rather high (TH = 61% TL) with maximum height almost subcentral. A strongly overarching hood to the periproct may be present (Fig. 7d). Anterior notch absent. The paired aboral interambulacra are not inflated. Apical disc ethmolytic, positioned well anterior of centre ($Ap = 20-22\%$ TL). Ambulacrum III hardly sunken, very narrow; with pore-pairs uniserial almost vertically aligned; pores and tubercles much smaller than those in the adjacent interambulacral areas. Paired petals parallel-sided, very narrow (max Wa and Wp $< 4\%$ TL) and almost flush with the test surface (Fig. 7a). Anterior pair extending to ambitus; posterior pair shorter and extending shortly over half-way to ambitus. The angle between the two anterior petals is about 180° , the posteriors are much less divergent ($50^\circ-60^\circ$). In the pore series, the inner pores are subcircular or slightly transversely elongated, the outer pores may be drop-shaped; the pores are not conjugate. Poriferous series extend beyond the posterior petals and the peripetalous fascioles. Peristome large ($Ps = 18\%$ TL), and close to the anterior test margin ($Dp = 18\%$ TL). Phyllodes well developed. The labral plate is short and wide, projecting anteriorly. Plastron moderately convex and wide (45% TL). Periproct large, longitudinally oval. Tuberculation dense and uniform, made of small perforate and crenulate tubercles. Aborally, no primary tubercles differentiated; slightly enlarged tubercles are found only in the anterior interambulacra 2 and 3, flanking the frontal ambulacrum. In the oral face, the tubercles are more spaced and slightly larger, covering the labrum and the plastron, where they are arranged in series, and leaving only the ambulacral areas almost naked. Peripetalous fascioles present, passing beneath the ambitus around the anterior and at some distance (3-4 plates) beneath the anterior paired petals. Latero-anal fascioles present, separating from the peripetalous just behind the anterior petals (Fig. 7c).

Remarks: the slight morphological differences between the specimens from Sossano and Australia do not enable a separation at species level. This is the first record of this species outside Australia.

Distribution: Upper Eocene of Veneto (Italy), Upper Oligocene of Australia (McNamara & Philip, 1984).

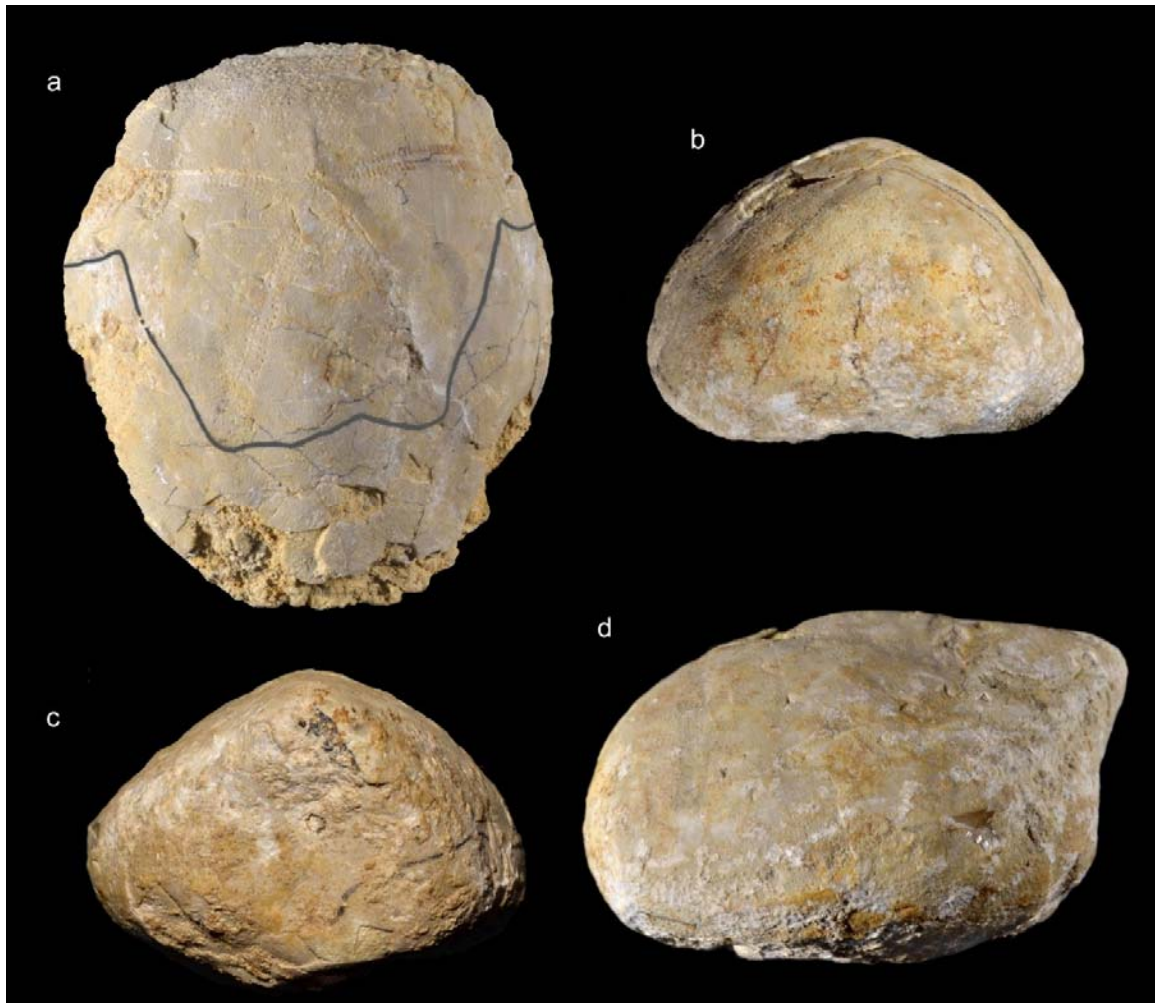


Figure 7 – *Brissomorpha nelsoni* (McCoy, 1882), Priabonian of Sossano. Specimen MCV 23/849 (TL = 71 mm): aboral view (a). Specimen MCV 23/848 (TL = 72 mm): frontal (b), posterior (c) and lateral (d) views.

Figura 7 – *Brissomorpha nelsoni* (McCoy, 1882), Priaboniano di Sossano. Esemplare MCV 23/849 (TL = 71 mm); vista aborale (a). Esemplare MCV 23/848 (TL = 72 mm): vista frontale (b), posteriore (c) e laterale (d).

Palaeoecological remarks

Brissomorpha integer and *B. nelsoni* from Sossano share morphological features which are useful guides when trying to know whether or not a fossil spatangoid burrowed (Smith 1980a, 1980b, 1984):

- The presence of well-developed aboral fascioles (peripetalous and latero-anal in *Brissomorpha*) is typical of spatangoids living (completely or partially) buried in soft sediments.
- The frontal ambulacrum III is very shallow or almost flush with the test surface, it is not flanked by tubercles much larger than the others; additionally, pores in the adapical region are very small, consequently there were no tube feet specialized in the construction of a shaft up to the surface. These features indicate a hearth-urchin living either epifaunally, or burrowed in coarse grained sediments, or only partially burrowed in fine sediments, without constructing a vertical tunnel (Smith, 1984).
- There is a correlation between aboral tubercles density and the grade of sediment inhabited: a dense and uniform development of aboral tubercles, as in the studied specimens of *Brissomorpha*, is indicative of an infaunal (at least partial) mode of life in fine-grained sediment.



- The enlarged pores in the oral ambulacra surrounding the peristome supported specialized tube feet used for feeding: they picked up and transported gravel-sized particles to the mouth (Smith, 1980b). Therefore, *Brissomorpha* was a detritivore organism.

On the whole, the morphology of *B. integer* and *B. nelsoni* indicates a limited burrowing activity in these echinoids: they likely lived only partially burrowing in the fine-grained marly limestones of the Priabona Fm in the Berici Hills.

These echinoids lived in the upper Circalittoral, at about 50-100 m depth, in well oxygenated environments (Bassi, 1995) characterized by a noticeable taxonomic diversity. This is corroborated by the frequent occurrence of echinoids which were typical inhabitants of shallow waters, such as *Gitolampas*, *Echinolampas* and *Trachypatagus*.

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