

Notes on fossil chitons. 2. Polyplacophora from the Middle Miocene of Lăpugiu (Romania)

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Abstract

This paper reports six chiton species from the Lower Badenian (Miocene) deposits of Lăpugiu de Sus (Hunedoara, Valea Cosului, Romania): *Lepidopleurus* (L.) *cajetanus* (Poli, 1791), *Ischnochiton* (L.) *rissoi* (Payraudeau, 1826), *Chiton* (*Rhysso-plax*) *olivaceus* Spengler, 1797, *Chiton* (*Rhysso-plax*) *corallinus* (Risso, 1826), *Acanthochitona fascicularis* (Linnaeus, 1767), and *Cryptoplax weinlandi* Šulc, 1934. A table of all the fossil Polyplacophora reported in the literature from Badenian deposits in Romania (Basesti, Beius, Buituri, Costei, Islaz, and Lăpugiu) is given. *Ischnochiton rissoi* is reported from the first time from Lăpugiu and the Badenian of Romania. A morphometric analysis of intermediate valves of *Cryptoplax weinlandi* reveals clear differences between valve types. In particular, the valve II can be clearly separated by valves III-VII.

Riassunto

Sei specie di Polyplacophora sono state rinvenute nei depositi Mioceni (Badeniano inferiore) di Lăpugiu de Sus (Hunedoara, Valea Cosului, Romania). Le specie sono: *Lepidopleurus* (L.) *cajetanus* (Poli, 1791), *Ischnochiton* (L.) *rissoi* (Payraudeau, 1826), *Chiton* (*Rhysso-plax*) *olivaceus* Spengler, 1797, *Chiton* (*Rhysso-plax*) *corallinus* (Risso, 1826), *Acanthochitona fascicularis* (Linnaeus, 1767), e *Cryptoplax weinlandi* Šulc, 1934. La specie più abbondante è *Cryptoplax weinlandi*, rappresentata da 99 piastre. Si possono distinguere due gruppi di piastre intermedie, il primo con una lunghezza compresa tra 2,3 e 4,3 mm ed un rapporto larghezza/lunghezza compreso tra 0,64 e 0,78, il secondo con una lunghezza compresa tra 3,6 e 6,8 mm ed un rapporto larghezza/lunghezza compreso tra 0,35 e 0,55. Benché vi siano anche differenze nella scultura, che potrebbero far pensare a due specie distinte, il primo gruppo di piastre viene interpretato come piastre II di *C. weinlandi*, il secondo gruppo come piastre III-VII della stessa specie. Differenze nella morfologia delle piastre intermedie di specie viventi appartenenti al gen. *Cryptoplax* sono già note in letteratura, per cui si può pensare che gli stessi concetti siano applicabili anche alle specie fossili di *Cryptoplax*. Vengono infine riassunte in una tabella tutte le segnalazioni di poli-placofori fossili esistenti in letteratura per i depositi Badeniani in Romania (Basesti, Beius, Buituri, Costei, Islaz e Lăpugiu). Per quanto riguarda *Ischnochiton rissoi*, si tratta della prima segnalazione per Lăpugiu e per il Badeniano della Romania.

Key words

Mollusca, Polyplacophora, Middle Miocene, Badenian, Central Paratethys, Romania, Lăpugiu de Sus.

Introduction

The Badenian deposits of Romania are very rich in molluscs and have been extensively studied (Boettger, 1896, 1901, 1905; Reuss, 1860; Koch, 1900; Zilch, 1934). Findings of Polyplacophora were already reported from six localities (Fig. 1): Basesti (Marinescu, 1964), Beius (Rado, 1971), Buituri (Zilch, 1934; Studencka & Studencki, 1988), Costei (Boettger, 1901, 1905; Šulc, 1934; Zilch, 1934; Studencka & Studencki, 1988), Islaz (Rado & Mutiu, 1970), and Lăpugiu (Boettger, 1901; Šulc, 1934; Zilch, 1934; Studencka & Studencki, 1988). On the whole, 13 species of Polyplacophora were reported for Badenian deposits of Romania (Tab. 1), three of which from Lăpugiu: *Lepidochitona lepida* (Reuss, 1860), *Acanthochitona fascicularis* (Linnaeus, 1767), and *Cryptoplax weinlandi* Šulc, 1934.

The locality of Lăpugiu de Sus (Hunedoara District, Romania) is one of the best known (Stur, 1863; Petrescu *et al.*, 1990), and recent studies on microfossil assemblages, mainly foraminiferans (Suraru & Papp, 1993), support the assignment of these deposits to the Lower Badenian. The assemblage from this outcrop indicates an littoral to

sublittoral origin, with paleodepths from 5 to possibly 90 m (Petrescu *et al.*, 1990). Koch (1900) set up a list of 883 mollusc species from this site, which he considered to slightly differ from the fauna of similar age recorded in the Basins of Vienna (Austria) and Hungary.

Aim of this paper is to give an account for the polyplacophoran fauna from this area, and to compare these data with other Badenian polyplacophoran faunas from Romania.

Material and methods

The chiton valves were sampled at the Lăpugiu de Sus site, a small village about 6 km SW of Dobra, situated along a small creek named Valea Cosului (see Fig. 1 in Suraru & Papp, 1993). The main sediment is a relatively hard grey-blue clay, which shows a rich and well preserved molluscs assemblage. This clay can be traced in the whole creek. Following the creek S-SW about 400-500 m from the bridge reported on the map (Fig. 1 in Suraru & Papp, 1993), the creek exposed a yellow coral sand, for a stretch about 20 m long, and about one meter thick.

Fossils are presented in the whole length, but the last 6-7 m of the sand are very rich on small species, and all the chiton valves were found there. A large amount of sediment (about 40 kg) was collected and successively washed on a sieves battery. Smallest fractions (1 mm) were examined for chiton valves, using a stereomicroscope.

The valves found at Lăpuşiu de Sus are deposited in the Bruno Dell'Angelo collection, Prato (Italy). All figured specimens are deposited in the malacological collection of the Zoological Museum of the Bologna University (Italy).

Systematic account

The systematics herein used follows Dell'Angelo & Smriglio (1999), who used the taxon Lepidopleuridae Pilsbry, 1892, instead of Leptochitonidae Dall, 1889, applying the ICZN Art. 40.2, as already discussed in Dell'Angelo and Palazzi (1991).

Classis POLYPLACOPHORA Gray, 1821

Ordo NEOLORICATA Bergenhayn, 1955

Subordo LEPIDOPLEURINA Thiele, 1909

Superfamilia LEPIDOPLEUROIDEA Pilsbry, 1892

Familia LEPIDOPLEURIDAE Pilsbry, 1892 (1889)

Genus *Lepidopleurus* Risso, 1826

Subgenus *Lepidopleurus* s.s.

Lepidopleurus (Lepidopleurus) cajetanus (Poli, 1791)

Fig. 4 a

1791 *Chiton cajetanus* Poli: 10, pl. 4, figs 1-2.

1860 *Chiton decoratus* Reuss: 257, pl. 8, fig. 7.

1883 *Lepidopleurus decoratus* - de Rochebrune: 62.

1897 *Lepidopleurus cajetanus* - Sacco: 90, pl. 7, figs 26-31.

1934 *Lepidopleurus (Lepidopleurus) decoratus* - Šulc: 3.

1935 *Lepidopleurus decoratus* - Ashby & Cotton: 389.

1942 *Lepidopleurus decoratus* - Toth: 504.

1953 *Lepidopleurus decoratus* - Sieber: 184.

1958 *Lepidopleurus decoratus* - Sieber: 143.

1959 *Lepidopleurus decoratus* - Sieber: 275.

1962 *Lepidopleurus (L.) cajetanus* - Malatesta: 146, figs 1-2.

1964 *Lepidopleurus (L.) cajetanus* - Marinescu: 180, pl. 1.

1965 *Lepidopleurus decoratus* - Bałuk: 366, pl. 1, figs 1, 4.

1971 *Lepidopleurus decoratus* - Bałuk: 453, pl. 1, figs 1-4.

1977 *Lepidopleurus cajetanus* - Laghi: 95, pl. 1, figs 13-20.

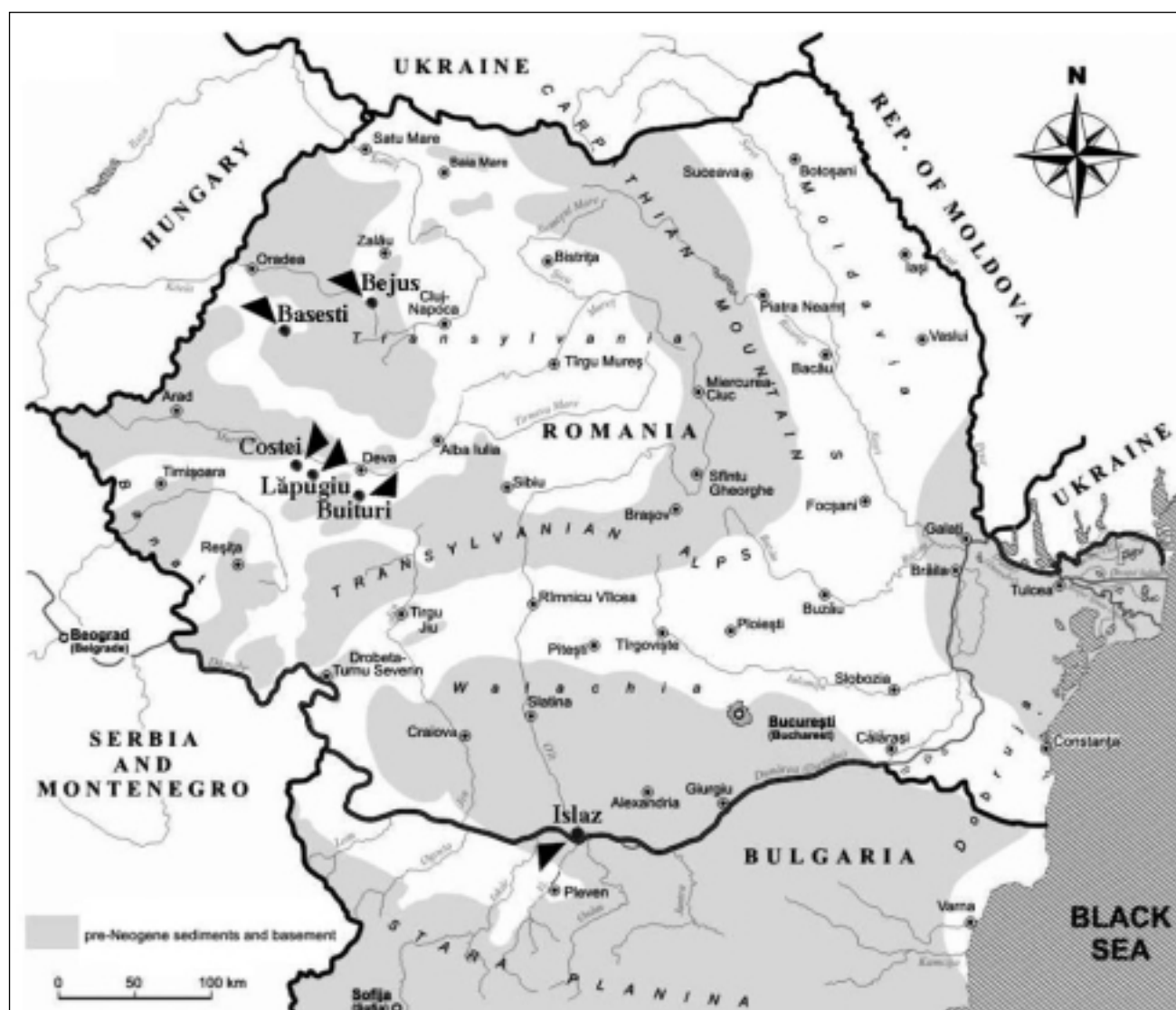


Fig. 1. Location map (from Kroh, 2005, modified).

Fig. 1. Mappa delle località (da Kroh, 2005, modificato).

- 1984 *Lepidopleurus cajetanus* - Bałuk: 284, pl. 4, figs 1-2.
 1985 *Lepidopleurus cajetanus* - Kaas & Van Belle: 32, fig. 12.
 1988 *Lepidopleurus cajetanus* - Macioszczyk: 50, pl. 1, figs 1-5.
 1988 *Lepidopleurus cajetanus* - Studencka & Studencki: 39, pl. 1, figs 1-3.
 1999 *Lepidopleurus (Lepidopleurus) cajetanus* - Dell'Angelo *et al.*: 260, pl. 1, figs 2, 4-7.
 1999 *Lepidopleurus (Lepidopleurus) cajetanus* - Dell'Angelo & Smriglio: 38, pls. 6-7, figs 10-15.
 2001 *Lepidopleurus (L.) cajetanus* - Dell'Angelo *et al.*: 145, figs 1, 4.
 2003 *Lepidopleurus cajetanus* - Kroh: 131, pl. 1, fig. 1; pl. 2, figs 2-3.
 2004 *Lepidopleurus (Lepidopleurus) cajetanus* - Dell'Angelo *et al.*: 26, pl. 7, figs 4, 8.
 2005 *Lepidopleurus (Lepidopleurus) cajetanus* - Dulai: 30, pl. 1, figs 1-10; pl. 2, figs 1-6.

Material

12 valves, 5 intermediate (maximum width 5.6 mm) and 7 tail (maximum width 5.5 mm).

Remarks

The species is characterized by a tegmentum sculptured with strong, concentric, terraced ribs on the head valve, the lateral areas of the intermediate valves (Fig. 4 a) and the postmucronal area of the tail valve. Additionally there are branching or anastomosing longitudinal chains of granules in the central and antemucronal areas. Unlike full-grown adults, juveniles of this species may show some morphological variability (Laghi, 1977). Detailed descriptions of *L. cajetanus* are given by Kaas & Van Belle (1985) and Dell'Angelo & Smriglio (1999).

Distribution

Presently *L. cajetanus* occurs in the Mediterranean and in the Atlantic Ocean, from Spain and Portugal south to Morocco and Canary Islands (Dell'Angelo & Smriglio, 1999). It was reported from the Middle Miocene of central-eastern Europe (under the name of *Chiton decoratus* Reuss, 1860) and Italy (Tortonian of Montegibbio, Modena prov., and Messinian of Borelli, Turin prov.) (Laghi, 1977; Dell'Angelo *et al.*, 1999). It is more frequent in the Plio-Pleistocene of the Mediterranean Basin (Garilli *et al.*, 2005).

Subordo ISCHNOCHITONINA Bergenhayn, 1930
 Familia ISCHNOCHITONIDAE Dall, 1889
 Subfamilia ISCHNOCHITONINAE Dall, 1889
 Genus *Ischnochiton* Gray, 1847
 Subgenus *Ischnochiton* s.str.

Ischnochiton (Ischnochiton) rissoi (Payraudeau, 1826)

Fig. 4 b

1826 *Chiton rissoi* Payraudeau: 87, pl. 3, figs 4-5.

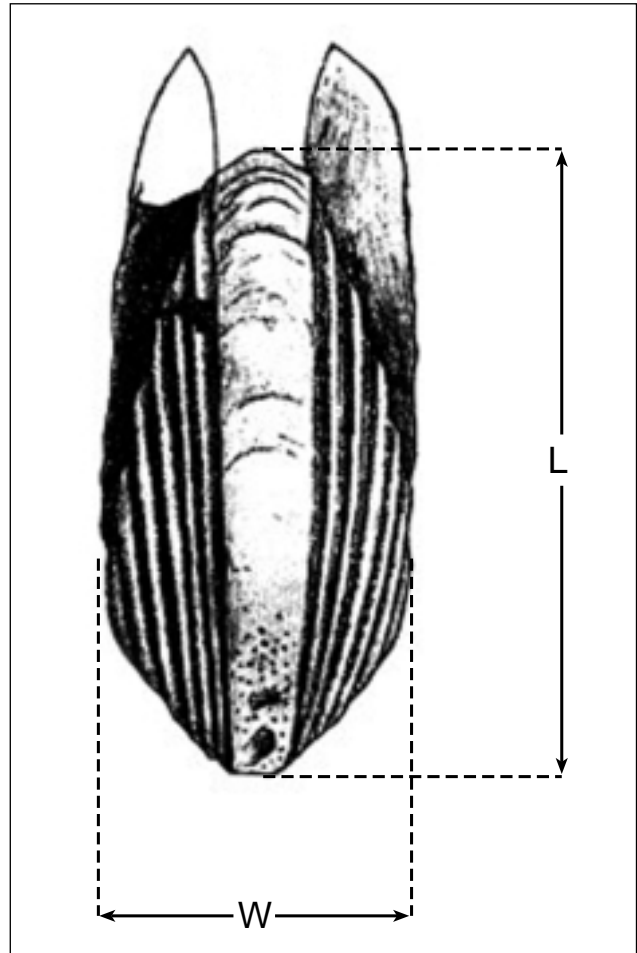


Fig. 2. Measurements of intermediate valves of *Cryptoplax weinlandi*.

Fig. 2. Misure delle piastre intermedie di *Cryptoplax weinlandi*.

- 1934 *Ischnochiton rudolticensis* Šulc: 23, pl. 2, figs 41-43.
 1935 *Ischnochiton rudolticensis* - Ashby & Cotton: 392.
 1962 *Ischnochiton (I.) rissoi* - Malatesta: 160, figs 16-17.
 1965 *Ischnochiton rudolticensis* - Bałuk: 369, pl. 1, fig. 7.
 1971 *Ischnochiton rudolticensis* - Bałuk: 458, pl. 3, figs 5-8.
 1977 *Ischnochiton (Simplischnochiton) rissoi* - Laghi: 104, pl. 1, figs 4-9.
 1984 *Ischnochiton rissoi* - Bałuk: 287, pl. 6, figs 2a-b.
 1999 *Ischnochiton (Simplischnochiton) rissoi* - Dell'Angelo *et al.*: 265, pl. 3, figs 3, 5.
 1999 *Ischnochiton (Ischnochiton) rissoi* - Dell'Angelo & Smriglio: 100, pls. 29-31, figs 40-48.
 2001 *Ischnochiton rissoi* - Dell'Angelo *et al.*: 150, figs 20, 23.
 2003 *Ischnochiton rissoi* - Kroh: 132, pl. 1, fig. 5.
 2004 *Ischnochiton (Ischnochiton) rissoi* - Dell'Angelo *et al.*: 34, pl. 4, figs 3-4.
 2005 *Ischnochiton rissoi* - Dulai: 33, pl. 3, figs 1-5.

Material

3 valves, 2 intermediate (maximum width 6 mm) and 1 tail, width 4.7 mm.

Remarks

The species is characterized by a tegmental sculpture consisting of concentric vermicular ribs, often intersect-

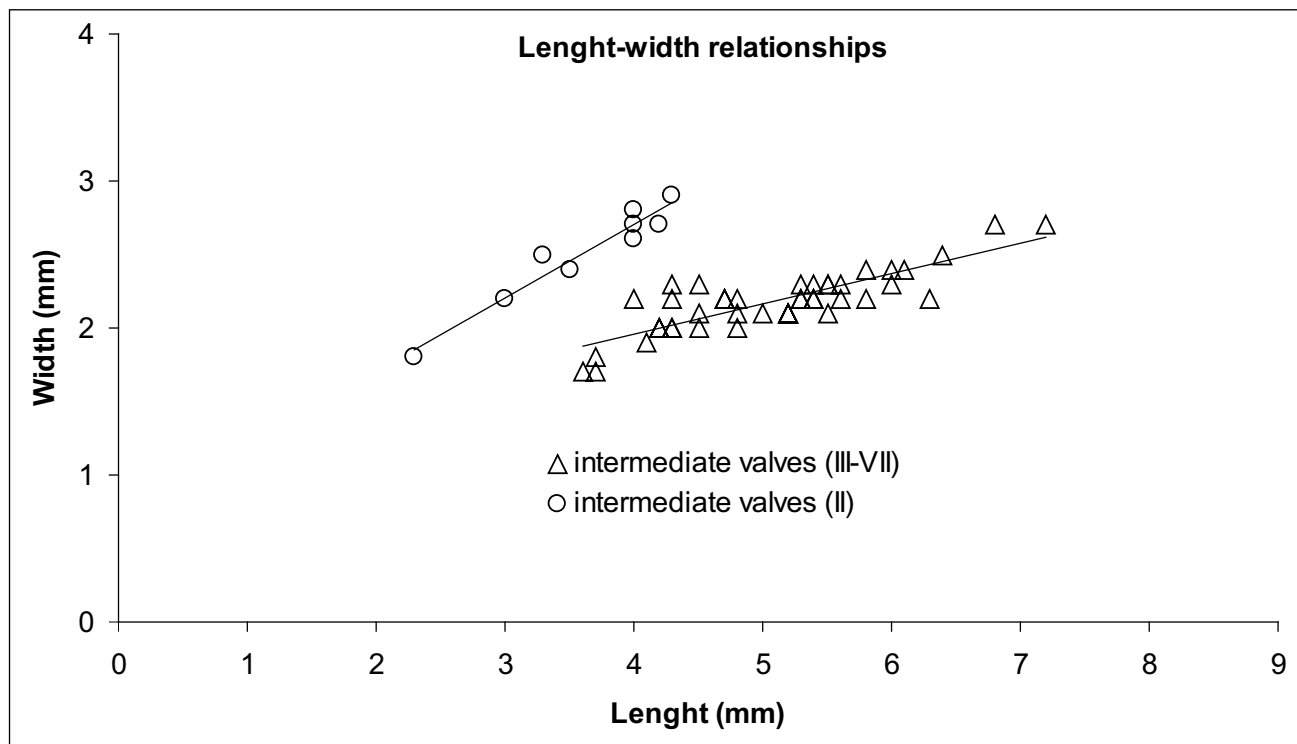


Fig. 3. Graphical representation of the length/width relationships in intermediate valves of *Cryptoplax weinlandi*.

Fig. 3. Rappresentazione grafica delle relazioni lunghezza/larghezza nelle piastre intermedie di *Cryptoplax weinlandi*.

ed by fine radial furrows, on the head valve, the lateral areas of the intermediate valves and the postmucronal area of the tail valve (Fig. 4 b). The ribs continue longitudinally on the central areas of the intermediate valves and on the antemucronal area of the tail valve. The species is highly variable, with a complicated synonymy.

Detailed descriptions of *I. rissoi* are given by Kaas & Van Belle (1990) and Dell'Angelo & Smriglio (1999).

Distribution

Presently *I. rissoi* lives only in the Mediterranean Sea. Some Atlantic records (Canary, Selvagens and Azores Islands) need confirmation (Dell'Angelo & Smriglio, 1999). It has been reported from the Middle Miocene (Badenian) of the Central Paratethys (under the name of *Ischnochiton rudolticensis* Šulc, 1934), the Tortonian of Northern Apennines, the Messinian of Borelli (Turin prov., Italy) (Laghi, 1977; Dell'Angelo *et al.*, 1999) and many Italian and Spanish Pliocene localities (Dell'Angelo *et al.*, 2004). It is more frequent in Pleistocene of South Italy and scarcely recorded from other Italian localities (Garilli *et al.*, 2005).

Familia CHITONIDAE Rafinesque, 1815
Subfamilia CHITONINAE Rafinesque, 1815
Genus *Chiton* Linnaeus, 1758
Subgenus *Rhyssoplax* Thiele, 1893

Chiton (Rhyssoplax) olivaceus Spengler, 1797
Figs 4 d, f

1828 *Chiton siculus* Gray: 5.

1860 *Chiton siculus* - Reuss: 257, pl. 8, figs 1-3.

1883 *Gymnoplax bohemicus* de Rochebrune: 63.

1934 *Chiton bohemicus* - Šulc: 25, pl. 2, figs 48, 50-54.

1942 *Chiton bohemicus* - Toth: 504.

1962 *Chiton (Chiton) olivaceus* - Malatesta: 161, figs 17-18.

1964 *Chiton bohemicus* - Marinescu: 180, pl. 2; pl. 3, fig. 1.

1965 *Chiton bohemicus* - Bałuk: 368, pl. 1, figs 5-6.

1968 *Chiton bohemicus* - Stancu & Andreescu: 459.

1977 *Chiton olivaceus* - Laghi: 109, pl. 2, figs 5-8, 13.

1980 *Chiton rudelsdorfensis* Van Belle, 1980: 69.

1988 *Chiton olivaceus* - Macioszczyk: 54, pl. 3, figs 4-6.

1999 *Chiton (Rhyssoplax) olivaceus* - Dell'Angelo & Smriglio: 169, pls. 56-57, figs 86-96.

1999 *Chiton (Rhyssoplax) olivaceus* - Dell'Angelo *et al.*: 270, pl. 4, figs 1-8.

2001 *Chiton olivaceus* - Dell'Angelo *et al.*: 152, fig. 28.

2005 *Chiton (Rhyssoplax) olivaceus* - Dulai: 38, pl. 3, figs 6-8.

Material

39 valves, 3 head (width 5.4 mm), 31 intermediate (maximum width 9 mm) and 5 tail (maximum width 6.2 mm).

Remarks

Chiton olivaceus is the most common and best known Mediterranean species, easily recognizable by its characteristic sculpture of rather coarse but very variable radial grooves on terminal valves and lateral areas and of longitudinal grooves on pleural areas. The variability of

the fossil forms, both in the morphology of the valves and in the sculpture, is so vast that former authors established various names: *Gymnoplax bohemicus* de Rochebrune, 1883 (= *Chiton rudelsdorfensis* Van Belle, 1980) from the Vienna Basin (Austria), *Chiton zibinicus* Doderlein, 1862 from the Modena Basin, and *Chiton miocenicus* Michelotti, 1847 from the hills around Turin (both Italy). Some authors have considered these fossil taxa as ancestors of *Chiton olivaceus* (e.g. Malatesta, 1962), others as synonyms of *C. olivaceus* (e.g. Laghi, 1977). Our valves (Figs 4d, f) match the characteristics of living *C. olivaceus*. A revision of the fossil species of the genus *Chiton*, including the study of the type material, is necessary in order to provide a clear opinion about these taxa.

A detailed description of *C. olivaceus* is given by Dell'Angelo & Smriglio (1999).

Distribution

Presently, *Chiton olivaceus* occurs in the whole Mediterranean, in the Marmara Sea and in the Atlantic, both on the southern coast of Portugal and at Tangiers (Dell'An-

gelo & Smriglio, 1999). It was reported from the Middle Miocene of central-eastern Europe (under the name of *Gymnoplax bohemicus* de Rochebrune, 1883), and from the Tortonian of the Northern Apennines (Montegibbio, Modena prov., Italy, and Rio di Bocca d'Asino, Alessandria prov., Italy, unpublished data) and in the Messinian of Borelli (Turin prov., Italy) (Laghi, 1977; Dell'Angelo *et al.*, 1999). From the Pliocene the species is recorded from various Italian and French localities, and in the Pleistocene it is present, with greater frequency, in many localities of the Mediterranean Basin (Garilli *et al.*, 2005).

Chiton (Rhyssoplax) corallinus (Risso, 1826)

Fig. 4 c

- 1826 *Lepidopleurus corallinus* Risso: 268.
 1860 *Chiton denudatus* Reuss: 259, pl. 8, figs 14-15.
 1934 *Chiton (Clathropleura) corallinus denudatus* - Šulc: 24, pl. 2, figs 44-45.
 1958 *Chiton (Clathropleura) corallinus denudatus* - Sieber: 144.
 1962 *Chiton (Chiton) corallinus* - Malatesta: 163, figs 20-21.
 1971 *Chiton denudatus* - Bałuk: 462, pl. 5, figs 9-11.

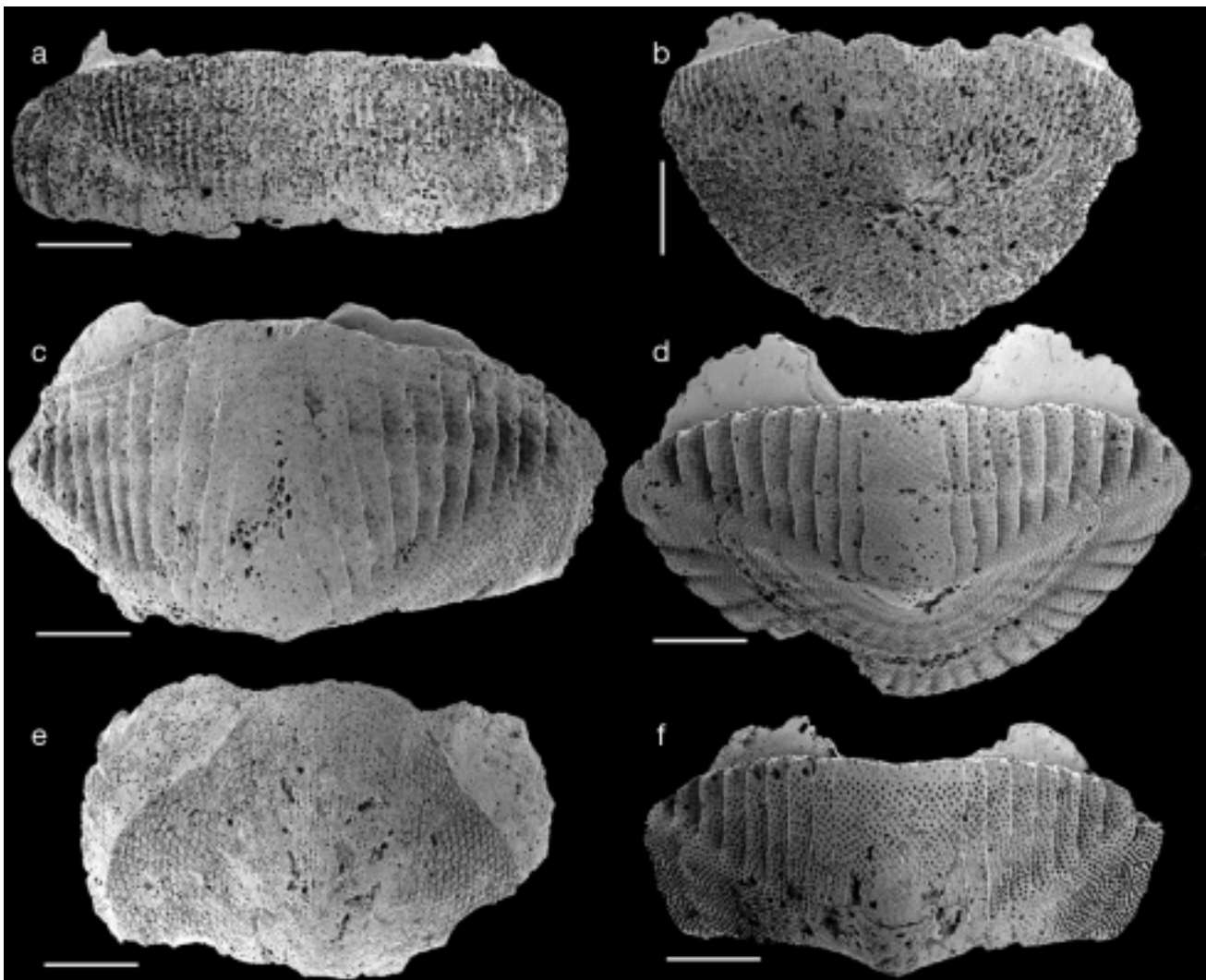


Fig. 4. a. *Lepidopleurus cajetanus*, intermediate valve; b. *Ischnochiton rissoi*, tail valve; c. *Chiton corallinus*, intermediate valve; d. *Chiton olivaceus*, tail valve; e. *Acanthochitona fascicularis*, intermediate valve; f. *Chiton olivaceus*, intermediate valve. Scale bars a, b, d-f 1 mm, c 500 μ m.

Fig. 4. a. *Lepidopleurus cajetanus*, piastra intermedia; b. *Ischnochiton rissoi*, piastra posteriore; c. *Chiton corallinus*, piastra intermedia; d. *Chiton olivaceus*, piastra posteriore; e. *Acanthochitona fascicularis*, piastra intermedia; f. *Chiton olivaceus*, piastra intermedia. Scala a, b, d-f 1 mm, c 500 μ m.

- 1977 *Chiton corallinus* - Laghi: 109, pl. 2, figs 9-12.
 1984 *Chiton corallinus* - Bałuk: 290.
 1988 *Chiton corallinus* - Macioszczyk: 54, pl. 3, figs 1-3.
 1988 *Chiton corallinus* - Studencka & Studencki: 41, pl. 3, figs 1-4.
 1999 *Chiton (Rhyssoplax) corallinus* - Dell'Angelo & Smriglio: 174, pls. 58-59, figs 97-107.
 2001 *Chiton corallinus* - Dell'Angelo *et al.*: 152, fig. 25.
 2003 *Chiton corallinus* - Kroh: 133, pl. 1, figs 2-3.
 2004 *Chiton (Rhyssoplax) corallinus* - Dell'Angelo *et al.*: 39, pl. 3, figs 4, 7.
 2005 *Chiton corallinus* - Dulai: 36, pl. 4, figs 1-4.

Material

3 intermediate valves, maximum width 5.5 mm.

Remarks

The species is characterized by having a smooth head valve, lateral areas of intermediate valves and postmucronal area of tail valve, while the pleural areas are sculptured on each side by 7-10 longitudinal small folds that leaning outwards. Our material (Fig. 4 c) matches the characteristics of the species well.

A detailed description of *C. corallinus* is given by Dell'Angelo & Smriglio (1999).

Distribution

Presently, *Chiton corallinus* occurs only in the Mediterranean Sea (Dell'Angelo & Smriglio, 1999). This species was reported from the Middle Miocene of central-eastern Europe (under the name of *Chiton denuatus* Reuss, 1860) and from the Tortonian of Montegibbio (Modena prov., Italy) (Laghi, 1977). It is more frequent in the Italian and Mediterranean Basin that is of Plio-Pleistocene origin (Garilli *et al.*, 2005).

Subordo ACANTHOCHITONINA Bergenhayn, 1930
 Familia ACANTHOCHITONIDAE Simroth, 1894
 Subfamilia ACANTHOCHITONINAE Simroth, 1894
 Genus *Acanthochitona* Gray, 1821

Acanthochitona fascicularis (Linnaeus, 1767)

Fig. 4 e

- 1767 *Chiton fascicularis* Linnaeus: n. 1106.
 1826 *Acanthochites communis* Risso: 268.
 1860 *Chiton (Acanthochites) fascicularis* var. - Reuss: 260, pl. 8, figs 4-6.
 1883 *Acanthochites faluniensis* de Rochebrune: 60.
 1897 *Acantochiton costatus* - Sacco: 91, pl. 7, figs 36-37 [non figs 33-35 = *Craspedochiton altavillensis* (Se-guenza, 1876), *fide* Dell'Angelo *et al.*, 1999: 283].
 1934 *Acanthochitona faluniensis* - Šulc: 17, pl. 1, fig. 29; pl. 2, figs 30-32.
 1935 *Acanthochitona faluniensis* - Ashby & Cotton: 391.
 1942 *Acanthochitona faluniensis* - Toth: 504.
 1959 *Acanthochitona faluniensis* - Sieber: 275.

- 1962 *Acanthochitona communis* - Malatesta: 166, figs 24-25.
 1970 *Acanthochiton falunensis* (sic!) - Rado & Mutiu: 145, pl. 7, figs 6, 8, 9, 10.
 1971 *Acanthochitona faluniensis* - Bałuk: 463, pl. 12, figs 10-15.
 1971 *Acanthochitona faluniensis* - Rado: 178.
 1977 *Acanthochitona faluniensis* - Jakubowski & Musiał: 78, pl. 3, fig. 3.
 1977 *Acanthochitona communis* - Laghi: 110, pl. 3, figs 13-19.
 1979 *Acanthochitona communis* - Jakubowski & Musiał: 51, pl. 2, fig. 3.
 1984 *Acanthochitona faluniensis* - Bałuk: 291, pl. 8, figs 1-5.
 1985 *Acanthochitona fascicularis* - Kaas: 585, figs 1-6.
 1988 *Acanthochitona faluniensis* - Macioszczyk: 55, pl. 3, figs 8-9.
 1988 *Acanthochitona faluniensis* - Studencka & Studencki: 41, pl. 4, fig. 3.
 1998 *Acanthochitona fascicularis* - Tomašových: 362, pl. 1, figs 1-6.
 1999 *Acanthochitona fascicularis* - Dell'Angelo *et al.*: 273, pl. 5, figs 1, 3-5; pl. 6, figs 3, 4, 6.
 1999 *Acanthochitona fascicularis* - Dell'Angelo & Smriglio: 192, pls. 64-65, figs 113-123.
 2001 *Acanthochitona fascicularis* - Dell'Angelo *et al.*: 153, figs 30, 33.
 2001 *Acanthochitona faluniensis* - Dulai: 43, pl. 2, figs 1-3; pl. 3, figs 1-6.
 2003 *Acanthochitona faluniensis* - Kroh: 134, pl. 1, figs 6-7.
 2004 *Acanthochitona fascicularis* - Dell'Angelo *et al.*: 40, pl. 3, fig. 8; pl. 4, fig. 1.
 2005 *Acanthochitona faluniensis* - Dulai: 39, pl. 4, figs 5-10; pl. 5, figs 1-4.

Material

5 intermediate valves, maximum length 6.2 mm.

Remarks

A. fascicularis is an extremely variable species with a very complicated synonymy. It is characterized by the tegmentum uniformly covered with small roundish granules arranged along orderly arched lines on the valves, except for the jugal area, and by its flat or slightly concave surface (Fig. 4 c).

A detailed description of *A. fascicularis* is given by Dell'Angelo & Smriglio (1999).

A. faluniensis de Rochebrune, 1883, which substantially differs from *A. fascicularis* by having a proportionally less number of slightly larger roundish granules, was recorded from the Miocene of central-eastern Europe, and was, in our opinion rightly, considered by Laghi (1977) and Dell'Angelo *et al.* (1999) a junior synonym of *A. fascicularis*. This statement was not accepted by Bałuk (1984).

Our valves have larger granules than extant Mediterranean specimens show, so they are more similar to those morphotypes that were reported under the name *A. faluniensis* by earlier authors.

Distribution

Presently *A. fascicularis* occurs in the whole Mediterranean and in the Atlantic, from the British Channel and the Bretagne to the Azores and the Canary Islands (Dell'Angelo & Smriglio, 1999). It was reported from the Middle Miocene (Badenian) of central-eastern Europe, Tortonian of Montegibbio (Modena prov., Italy) and Messinian of Borelli (Turin prov., Italy) (Laghi, 1977; Dell'Angelo *et al.*, 1999). It is recorded from the Italian and Mediterranean Basin (Plio-Pleistocene), being locally very frequent (Garilli *et al.*, 2005).

Familia CRYPTOPLACIDAE H. & A. Adams, 1858
Genus *Cryptoplax* de Blainville, 1818

Cryptoplax weinlandi Šulc, 1934

Fig. 5

- 1901 *Cryptoplax weinlandi* (Rolle) - Boettger: 180 (*nomen nudum*).
1934 *Cryptoplax weinlandi* Šulc: 21, pl. 2, figs 36-40.
1934 *Cryptoplax weinlandi* - Zilch: 199, pl. 1, figs 18-22.
1935 *Cryptoplax weinlandi* - Ashby & Cotton: 391.
1942 *Cryptoplax weinlandi* - Toth: 504.
1956 *Cryptoplax weinlandi* - Sieber: 238.
1958 *Cryptoplax weinlandi* - Sieber: 144.
1959 *Cryptoplax weinlandi* - Sieber: 275.
1964 *Cryptoplax weilandi* (sic!) - Marinescu: 183, pl. 4.
1970 *Cryptoplax weilandi* (sic!) - Rado & Mutiu: 145, pl. 7, figs 7, 11.
1971 *Cryptoplax weinlandi* - Bałuk: 466, pl. 6, figs 1-8.
1971 *Cryptoplax weilandi* (sic!) - Rado: 178.
1977 *Cryptoplax weinlandi* - Laghi: 114.
1978 *Cryptoplax Teinlandi* (sic!) - Florei, 1978: 21.
1982 *Cryptoplax weinlandi* - Ruggieri: 81, fig. 1.
1984 *Cryptoplax weinlandi* - Bałuk: 294.
1985 *Cryptoplax weilandi* (sic!) - Zanaroli, 1985: 119, pl. 3, figs 2-4.
1988 *Cryptoplax weinlandi* - Studencka & Studencki: 43, tab. 2.
1993 *Cryptoplax weinlandi* - Suraru & Papp: 34, pl. 7, fig. 50.
2001 *Cryptoplax weinlandi* - Dulai: 45, pl. 2, figs 4-6; pl. 3, figs 1-6.
2003 *Cryptoplax weinlandi* - Kroh: 135, pl. 1, figs 8-12.
2005 *Cryptoplax viciani* - Dell'Angelo *et al.*: 11.
2005 *Cryptoplax weinlandi* - Dulai: 40, pl. 5, figs 5-12; pls 6-7; pl. 8, figs 1-12.

Material

99 valves, 1 head (length 3 mm), 85 intermediate (maximum length 6.8 mm) and 13 tail (maximum length 5 mm).

Remarks

The species is characterized by the elongate valves, the smooth jugal area and having the pleurolateral areas or-

namented by a few (up to six per side) longitudinal, slightly undulated ribs, which occur in the tail valve also. A detailed description of *Cryptoplax weinlandi* is given by Bałuk (1971).

Length (L) and width (W) of the valves (Fig. 2) were measured on intact intermediate valves (n = 52).

Fig. 3 shows the length-width relationships. There are two lots of valves, the first with a length varying between 2.3 and 4.3 mm (open circle), and a width/length ratio between 0.64 and 0.78, and the second (open triangles) with a length varying between 3.6 and 6.8 mm, and a width/length ratio between 0.35 and 0.55. The two lots also differ in sculpture: in the first lot, the valves are larger and there are more longitudinal, slightly undulated ribs in the pleurolateral areas (up to 10 per side); lateral view is different as well. At the beginning of our study, we believed that two species are involved and we were prone to describe a new species. In fact, in the Abstract presented to the IV International Congress of the European Malacological Societies (Naples, Italy) (Dell'Angelo *et al.*, 2005: 11), the new species name, *Cryptoplax viciani* was introduced. However, further studies on living *Cryptoplax* species allowed us to reconsider this hypothesis.

The genus *Cryptoplax* is in fact very characteristic because, unlike the others Polyplacophora where "the contours of the individual valves have been determined largely by purely mechanical factors" (Pilsbry, 1901), in grown-up individuals some valves are widely separated, and this imply different opportunities of growth, particularly in the sense of length, and cause the fact that intermediate valves can differ from each other in layout and dimension. This fact has been widely studied in living chitons (i.e. Pilsbry, 1901; Iredale & Hull, 1927): consequently it is possible to think that the same considerations are applicable to fossil *Cryptoplax* species too.

Fischer-Piette & Franc (1960: fig. 1567) illustrate the 8 valves of *Cryptoplax dupuisi* Ashby, 1931, which clearly illustrate the morphological differences of the valves. For comparison we illustrate three intermediate valves (II, III, IV) of a living specimen of *Cryptoplax iredalei* Ashby, 1923, from Yorke Peninsula, Point Soutter (Australia, Fig. 6).

The intermediate valves belonging to the first lot (with width/length ratio varying between 0.64 and 0.78) may be therefore interpreted as valves II of *Cryptoplax weinlandi*. No significant difference has been noted in the tail valves found, and this is a further fact in favour this supposition.

The intermediate valves III-VII of *Cryptoplax weinlandi* (n = 43) can be clearly distinguished from the intermediate valves II (n = 9) in a width-length relationship plot, thanks to clearly different regression lines ($y = 0.2066x + 1.1277$, $R = 0.8316$, $p < 0.001$ and $y = 0.5x + 0.7$, $R = 0.9671$, $p < 0.001$ respectively) (Fig. 3).

The available head valve has a width/length ratio of 0.97, according with the values reported by Bałuk (1971, 1984: $0.87 \div 1.00$) and by Laghi (1977: 1.00).

Bałuk (1971, 1984) reports 0.44 for the largest intermediate valve found in the Korytnica clays (Poland), match-

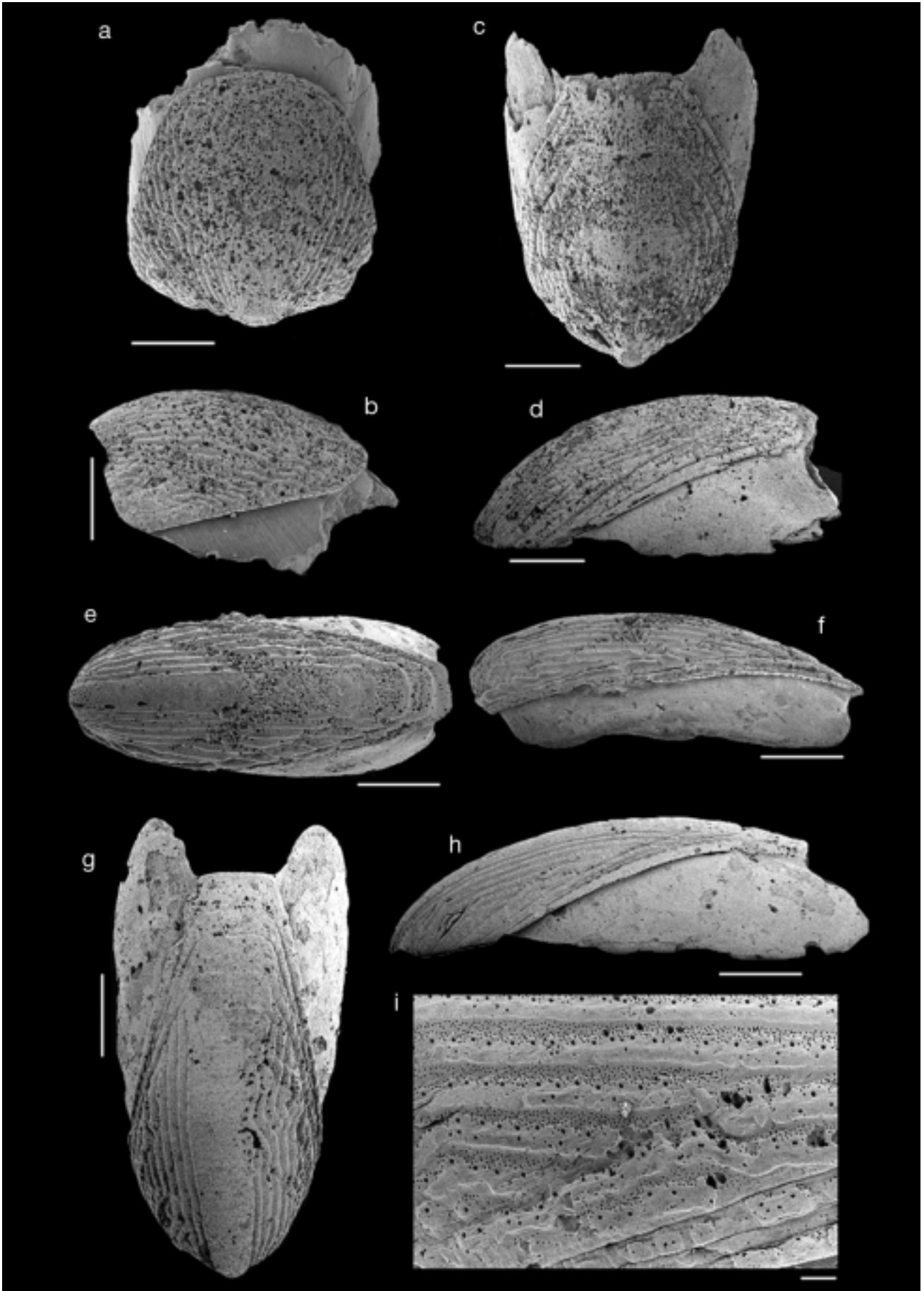


Fig. 5. *Cryptoplax weinlandi*: **a.** dorsal view of a head valve; **b.** lateral view of a head valve; **c.** dorsal view of an intermediate valve II; **d.** lateral view of an intermediate valve II; **e.** dorsal view of a tail valve; **f.** lateral view of a tail valve; **g.** dorsal view of an intermediate valve III-VII; **h.** lateral view of an intermediate valve III-VII; **i.** intermediate valve III-VII, detail of sculpture. Scale bars a-h 1 mm, i 100 μ m.

Fig. 5. *Cryptoplax weinlandi*. **a.** vista dorsale di una piastra anteriore; **b.** vista laterale di una piastra anteriore; **c.** vista dorsale di una piastra intermedia II; **d.** vista laterale di una piastra intermedia II; **e.** vista dorsale di una piastra posteriore; **f.** vista laterale di una piastra posteriore; **g.** vista dorsale di una piastra intermedia III-VII; **h.** vista laterale di una piastra intermedia III-VII; **i.** piastra intermedia III-VII, dettaglio della scultura. Scala a-h 1 mm, i 100 μ m.

ing with the values of our intermediate valves III-VII. An intermediate valve II has been illustrated by Zilch, 1934 (coming just from Lăpugiu), and probably also the valve illustrated in Marinescu, 1964 (pl. 4, fig. d as a tail valve) is a valve II of *Cryptoplax weinlandi*. Dulai (2005) reached the same conclusion studying a lot of intermediate valves (with a width/length ratio between 0.63 and 0.68) from the Badenian of Hungary (Bánd and Devecser), concluding that these were valves II of *Cryptoplax weinlandi* (Dulai, 2005: pl. 7, figs 1-15), well distinguishable by the others intermediate valves III-VII (with a width/length ratio between 0.37 and 0.43) (Dulai, 2005: pl. 6, figs 1-4).

Cryptoplax weinlandi was first mentioned by Boettger (1901) to be described by Rolle, but, as reported by Šulc (1934) and Zilch (1934), the description of this species was never published by Rolle (the name was known only from his unpublished manuscript).

There are two other *Cryptoplax* species described for the European Miocene. *Cryptoplax lanceolatus* Laghi, 1977, based on an intermediate valve and a tail valve from the Tortonian of Montegibbio (Modena prov., Italy) has a different sculpture and very small size. *Cryptoplax margitae* Dulai, 2001, based on two intermediate valves from the Badenian of Hungary (one from the borehole Szokolya-2, Börzsöny Mts, the other from Bánd, Bakony Mts), has granulated ribs on pleurolateral areas while they are not undulated in *C. weinlandi*. O.G. Costa (1854) described the new species *Chitonellus gigas* on the base of an intermediate valve found at the Pleistocenian outcrop of Cannitello (Reggio Calabria prov., Italy). The figure of the valve given by Costa (1854: pl. 28, fig. 10) cannot be referred to the genus *Cryptoplax* (= *Chitonellus* Lamarck, 1819), so the generic attribution of Costa's species remains uncertain. The species is not present in the Paleontological Museum of the Napoli University, where Costa's collection is stored (M. Cretella, pers.com.)

Distribution

Cryptoplax weinlandi is known from the Middle Miocene of central-eastern Europe, Romania, Czechoslovakia, Hungary, Austria and Poland (Dulai, 2001), and from the Late Miocene (Tortonian) of Northern Apennines, Italy (Montegibbio, and Montebanzone, Modena prov.: Laghi, 1977; Rio di Bocca d'Asino, Alessandria prov.: unpublished data), Vigoleno (Piacenza prov.: unpublished data), and from the Upper Miocene of Petralia Sottana (Palermo prov., Italy: Ruggieri, 1982).

Results and discussion

Polyplacophora remains have been reported from many outcrops of Badenian deposits in the Central Paratethys (Studencka & Studencki, 1988), although quite rare. On the whole, thirteen species were reported (Tab. 1) (Studencka & Studencki, 1988; Rado, 1971; Rado & Mutiu, 1971; this study), two of which (*Lepidopleurus* sp. and *Chiton* sp.) classified only at the generic level.

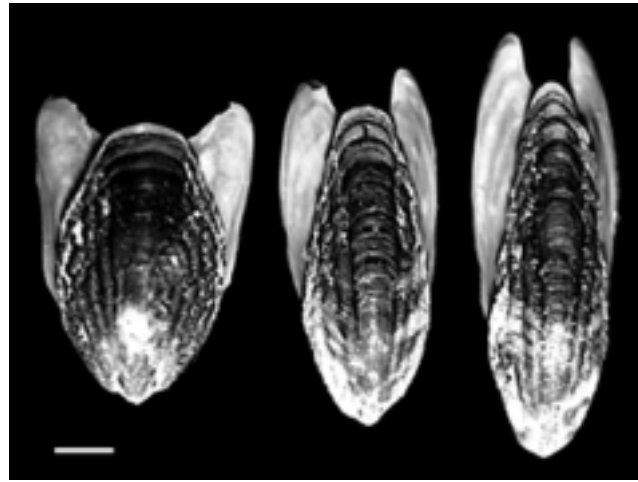


Fig. 6. *Cryptoplax iredalei* Ashby, 1923 (Australia), intermediate valves II, III, IV (from left to right). Scale bar 1 mm. (Valve II: length = 5.35 mm, width = 3.10 mm; valve III: length = 6.10 mm, width = 2.44 mm; valve IV: length = 7.10 mm, width = 2.20 mm).

Fig. 6. *Cryptoplax iredalei* Ashby, 1923 (Australia), piastra intermedia II, III, IV (da sinistra a destra). Scala 1 mm. (Piastra II: lunghezza = 5,35 mm, larghezza = 3,10 mm; piastra III: lunghezza = 6,10 mm, larghezza = 2,44 mm; piastra IV: lunghezza = 7,10 mm, larghezza = 2,20 mm).

The species reported as *Lepidochitona lepida*, and *Chiton miocenicus* Michelotti, 1847, have to be considered only with a provisional generic assignment and are in need of revision (Dell'Angelo, unpublished).

This paper originates from the study of 161 chiton valves, collected at Lăpugiu de Sus (Badenian of Romania), corresponding to a total of six species that belong to 5 different genera: *Lepidopleurus* (*L.*) *cajetanus* (Poli, 1791), *Ischnochiton* (*I.*) *rissoi* (Payraudeau, 1826), *Chiton* (*Rhyssoplax*) *olivaceus* Spengler, 1797, *Chiton* (*Rhyssoplax*) *corallinus* (Risso, 1826), *Acanthochitona fascicularis* (Linnaeus, 1767), and *Cryptoplax weinlandi* Šulc, 1934.

Cryptoplax weinlandi represents the most common species (61% of total valves number). Before this study, only three species were reported from this locality: *Lepidochitona lepida* (Reuss, 1860), *Acanthochitona faluniensis* (de Rochebrune, 1883), and *Cryptoplax weinlandi*. No *Lepidochitona* valves were found by us at Lăpugiu, suggesting as more species are expected. *Ischnochiton rissoi* is reported for the first time in Badenian of Romania.

Five of the six species found at Lăpugiu are recorded from Miocene to present (Mediterranean Sea), while the occurrence of *Cryptoplax weinlandi* is limited to the Middle (Badenian) and Late (Tortonian) Miocene of Central Paratethys and Mediterranean bioprovinces.

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Species	Literature data						Present data
	Basesti	Beius	Buituri	Costei	Islaz	Lăpuşiu	Lăpuşiu
<i>Lepidopleurus cajetanus</i> (Poli, 1791)	x (1)		x (1)	x (1)			x
<i>Lepidopleurus boettgeri</i> Šulc, 1934				x			
<i>Lepidopleurus</i> sp.					x		
<i>Hanleya hanleyi</i> (Bean in Thorpe, 1844)				x (2)			
<i>Ischnochiton rissoi</i> (Payraudeau, 1826)							x
<i>Lepidochitona lepida</i> (Reuss, 1860)				x		x	
<i>Chiton corallinus</i> (Risso, 1826)				x (3)			x
<i>Chiton olivaceus</i> Spengler, 1797	x (4)		x (4)	x (4)			x
<i>Chiton</i> sp.				x			
<i>Chiton miocenicus</i> Michelotti, 1847	x						
<i>Acanthochitona fascicularis</i> (Linnaeus, 1767)	x (6)	x (5)	x (5)	x (5)	x (5)	x (5)	x
<i>Craspedochiton altavillensis</i> (Seguenza, 1876)				x (7)			
<i>Cryptoplax weinlandi</i> Šulc, 1934		x	x	x	x	x	x

Tab. 1. List of chiton species from Romania Badenian outcrops. In parentheses are reported the names used in the original papers: 1) *Lepidopleurus decoratus* (Reuss, 1860); 2) *Hanleya multigranosa* (Reuss, 1860); 3) *Chiton denudatus* Reuss, 1860; 4) *Chiton bohemicus* (de Rochebrune, 1883); 5) *Acanthochitona faluniensis* (de Rochebrune, 1883); 6) *Cryptoconchus steinabrunensis* (Šulc, 1934); 7) *Acanthochites profascicularis* Boettger, 1905.

Tab. 1. Elenco delle specie di poliplacofori dai giacimenti Badeniani della Romania. I taxa usati nei lavori originali sono indicati tra parentesi: 1) *Lepidopleurus decoratus* (Reuss, 1860); 2) *Hanleya multigranosa* (Reuss, 1860); 3) *Chiton denudatus* Reuss, 1860; 4) *Chiton bohemicus* (de Rochebrune, 1883); 5) *Acanthochitona faluniensis* (de Rochebrune, 1883); 6) *Cryptoconchus steinabrunensis* (Šulc, 1934); 7) *Acanthochites profascicularis* Boettger, 1905.

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