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The Terrestrial Isopods (Oniscidea) of Greece. 15th Contribution: Genera *Echinarmadillidium* and *Paxodillidium (Armadillidiidae)**)

By Helmut Schmalfuss, Stuttgart and Spyros Sfenthourakis, Athens

With 44 figures

Summary

The genus *Echinarmadillidium* Verhoeff, 1901 is redefined. Two new species, representing the first records of the genus from Greece, are described and figured: *E. cycladicum* **n. sp.** from 13 of the southern Aegaean islands and *E. armathianum* **n. sp.** from the island Armathia in the Karpathos archipelago.

The genus *Paxodillidium* Schmalfuss, 1985 is diagnosed. The diagnostic characters of *Paxodillidium schawalleri* Schmalfuss, 1985 are figured. New records of the species are given for four Greek Ionian islands.

All records of the treated species are mapped.

Zusammenfassung

Die Definition der Gattung *Echinarmadillidium* Verhoeff, 1901 wird präzisiert. Zwei neue Arten, die ersten Nachweise der Gattung aus Griechenland, werden beschrieben und abgebildet: *E. cycladicum* **n. sp.** von 13 Inseln der südlichen Ägäis, und *E. armathianum* **n. sp.** von der Insel Armathia im Karpathos-Archipel.

Die Gattung *Paxodillidium* Schmalfuss, 1985 wird diagnostiziert. Die diagnostischen Merkmale von *Paxodillidium schawalleri* Schmalfuss, 1985 werden abgebildet. Neunachweise der Art von vier griechischen ionischen Inseln werden mitgeteilt.

Alle Nachweise der behandelten Arten werden kartiert.

Contents

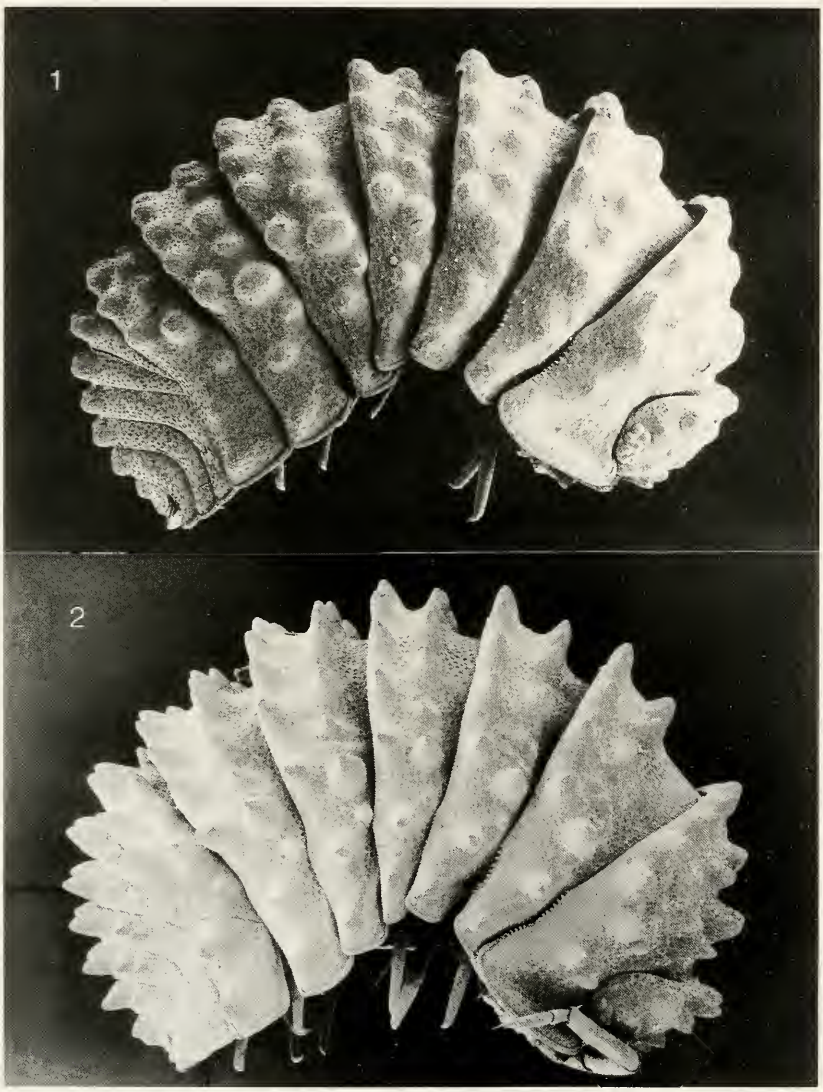
*) 14th contribution: Stuttgarter Beitr. Naturk. (Ser. A) Nr. 509: 23 pp. (1994).

1. The genus *Echinarmadillidium* Verhoeff, 1901

Type-species: *Armadillidium fruxgalii* Verhoeff, 1900.

VERHOEFF (1901: 34) institutes the genus *Echinarmadillidium*, basing it on the species *fruxgalii* which was described the year before by the same author as *Armadillidium fruxgalii* (VERHOEFF 1900: 128). The following diagnostic characters are given for the new genus:

1. With schisma on pereion-epimera I and II.
2. With groove along margin of epimera I.



Figs. 1–2. *Echinarmadillidium cycladicum* n. sp. – 1. Specimen from island Levitha (SMNS T317); – 2. Specimen from island Serifos (SMNS T314).

3. Distal segment of antennular flagellum more than 5 times longer than proximal one.
4. Telson terminally truncate.

VERHOEFF describes a number of characters concerning the mouthparts which will not be considered here because they are shared by other genera of the Armadillidiidae. The subsequent key to identify the then known genera and subgenera of this family is useless because the terminology is dubious and there is not a single figure to clarify the morphological situation.

Taking into account the new Greek species described in the present paper, we can accept the characters 1–4 mentioned above for a diagnose of the genus *Echinarmadillidium*, adding the following ones:

Figs. 3–4. *Echinarmadillidium cycladicum* n. sp.; head and pereion-tergite I in lateral view, same specimens as in figs. 1 and 2.

5. Head morphology of *Armadillidium*-type, with well-developed linea frontalis and with linea antennalis reduced laterally.
6. Tergites with pronounced and individualized tubercles, with a row of 8 to 10 tubercles along the posterior margin of the cephalothorax.

Phylogenetically *Echinarmadillidium* belongs to the *Armadillidium*-group. The genus *Armadillidium* is, however, possibly not a monophyletic unit, so before this question is solved nothing can be said about precise relationships inside this group.

Until today two species of *Echinarmadillidium* were known: *E. fruxgalii* (Verhoeff, 1900) and *E. strouhali* Verhoeff, 1939, both from the southwestern corner of the former Yugoslavia. Figures for *E. fruxgalii* are given by VERHOEFF (1939), for *E. strouhali* by STROUHAL (1934) (where it was identified as *E. fruxgalii*).

E. absoloni Strouhal, 1934 was later considered a separate genus *Cyphodillidium* Verhoeff, 1939, and *E. strouhali* Frankenberger, 1938 (not Verhoeff, 1939) was transferred to the genus *Macrotelsonia* (ARCANGELI 1939), belonging to the family Tendosphaeridae.

Rather surprisingly, our new findings prove the presence of the genus *Echinarmadillidium* on many islands of the southern Aegaean. This demonstrates once more that the faunistic investigation of the Aegaean islands is far from being completed, in spite of the fact that swarms of naturalists from many countries have been collecting there during the past hundred years. For the time being we consider these Aegaean populations to belong to two new species which are described and figured on the following pages.

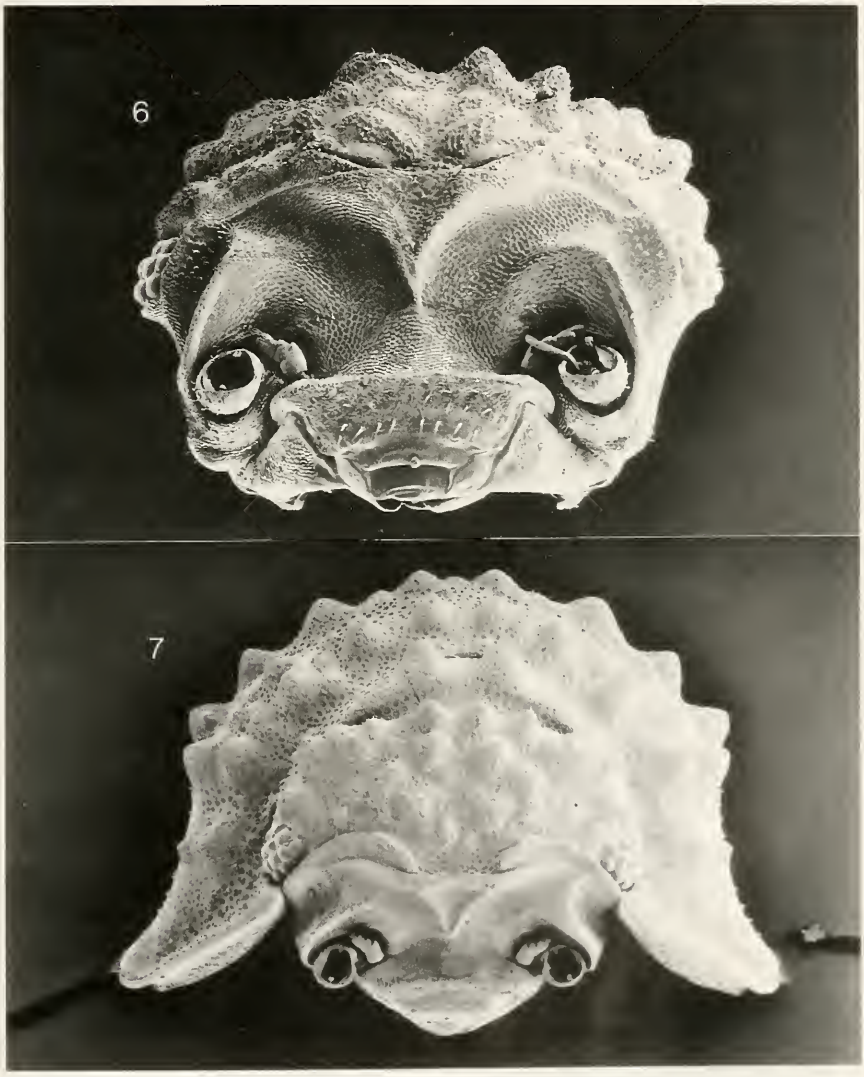
1.1. *Echinarmadillidium cycladicum* n. sp.

Holotype: ♂, 2.5 mm long, Greece, Aegaean island Anafi, near Megalos Rukunas, leg. SFENTHOURAKIS 2. II. 1992 (ZMUA).

Paratypes: 3 ♂♂, 26 ♀♀ (all without marsupium), same data as holotype (6 ♀♀: SMNS T312; 2 ♂♂, 20 ♀♀: ZMUA). – 1 ♀ without marsupium, island Pakhia 8 km S Anafi, leg.

Fig. 5. As fig. 1, micro-structure of tergite surface.

SFENTHOURAKIS 21. III. 1993 (ZMUA). – 4 ♂♂, 4 ♀♀ without marsupium, island Eastern Ftena 4 km S Anafi, leg. SFENTHOURAKIS 22. III. 1993 (ZMUA). – 6 ♀♀ without marsupium, island Folegandhros, leg. MYLONAS II. 1980 (ZMUA). – 3 ♀♀ without marsupium, island Ios, 1 km W village Ios, leg. SCHMALFUSS 9. V. 1991 (SMNS T318). – 3 ♀♀ without marsupium, island Anidhros 15 km SW Amorgos, leg. SFENTHOURAKIS 20. III. 1993 (ZMUA). – 1 ♂, 2 ♀♀ without marsupium, island Amorgos, in front of Nikuria, leg. SFENTHOURAKIS 30. III. 1992 (1 ♀: SMNS T315; 1 ♂, 1 ♀: ZMUA). – 1 ♀ without marsupium, island Kinaros 25 km NE Amorgos, leg. SFENTHOURAKIS 15. I. 1990 (ZMUA). – 5 ♂♂, 60 ♀♀ (6 with marsupium), island Levitha 40 km NE Amorgos, leg. SFENTHOURAKIS 16. I. 1990 [9 ♀♀ (one with marsupium): SMNS T317; 5 ♂♂, 51 ♀♀: ZMUA]. – 3 ♂♂, 36 ♀♀ without marsupium,



Figs. 6–7. *Echinarmadillidium cycladicum* n. sp. from island Anafi (SMNS T312). – 6. Head in frontal view; – 7. Head and pereion-tergite I in frontodorsal view.

island Antiparos, eastern part, leg. SFENTHOURAKIS 18. XI. 1990 (ZMUA). – 2 ♂♂, 1 ♀ without marsupium, island Sifnos, Kamares, leg. SFENTHOURAKIS 13. II. 1990 (ZMUA). – 1 ♂, 1 ♀ without marsupium, island Sifnos, Kastro, leg. SFENTHOURAKIS 10. II. 1990 (ZMUA). – 15 ♂♂, 17 ♀♀ without marsupium, island Serifos, Megalo Livadhi, leg. SFENTHOURAKIS 16. II. 1990 (1 ♂, 4 ♀♀: SMNS T314; 14 ♂♂, 13 ♀♀: ZMUA). – 2 ♀♀ without marsupium, island Sikinos, leg. MYLONAS 23. I. 1980 (SMNS T313). – 1 ♂, 5 ♀♀ (2 with marsupium), island Dhia 15 km N Iraklio/Crete, pothole Petrokotsifu, leg. PARAGAMIAN 13. IV. 1989 (1 ♂, 2 ♀♀: SMNS T320, 3 ♀♀: coll. PARAGAMIAN).

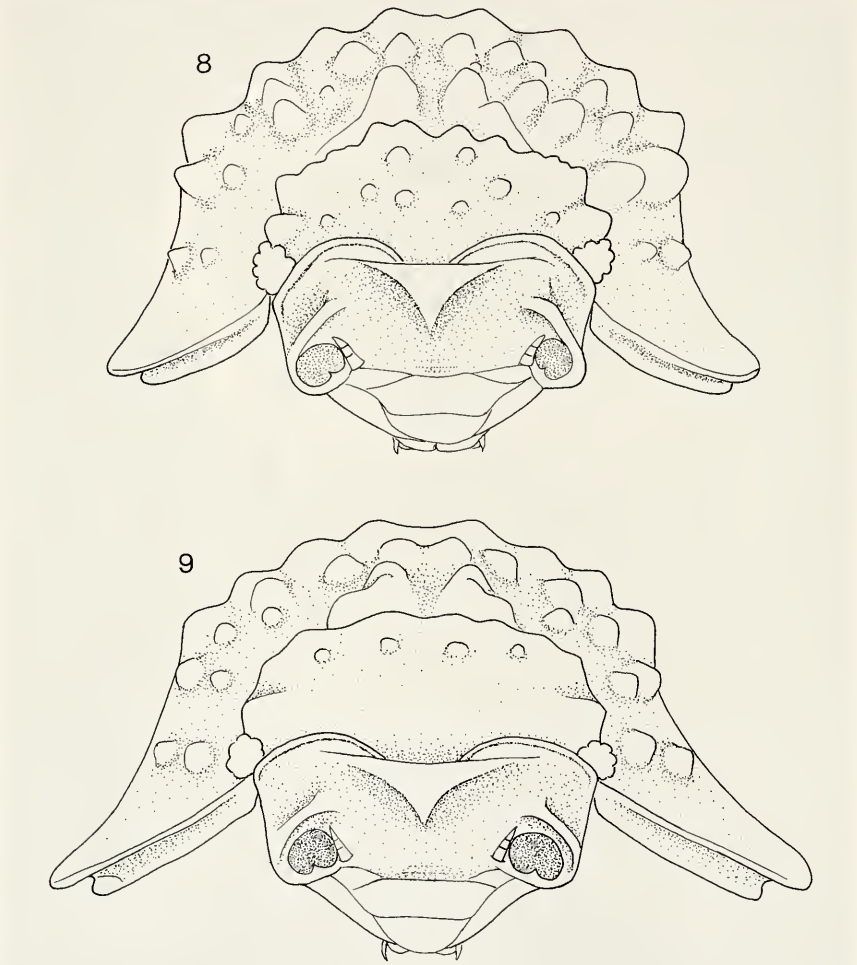


Fig. 8. *Echinarmadillidium cycladicum* n. sp.; ♀ without marsupium, 5 mm long, head and pereion-tergite I in frontodorsal view.
Fig. 9. *Echinarmadillidium armathianum* n. sp.; ♀ without marsupium, 6 mm long (holotype).

Description

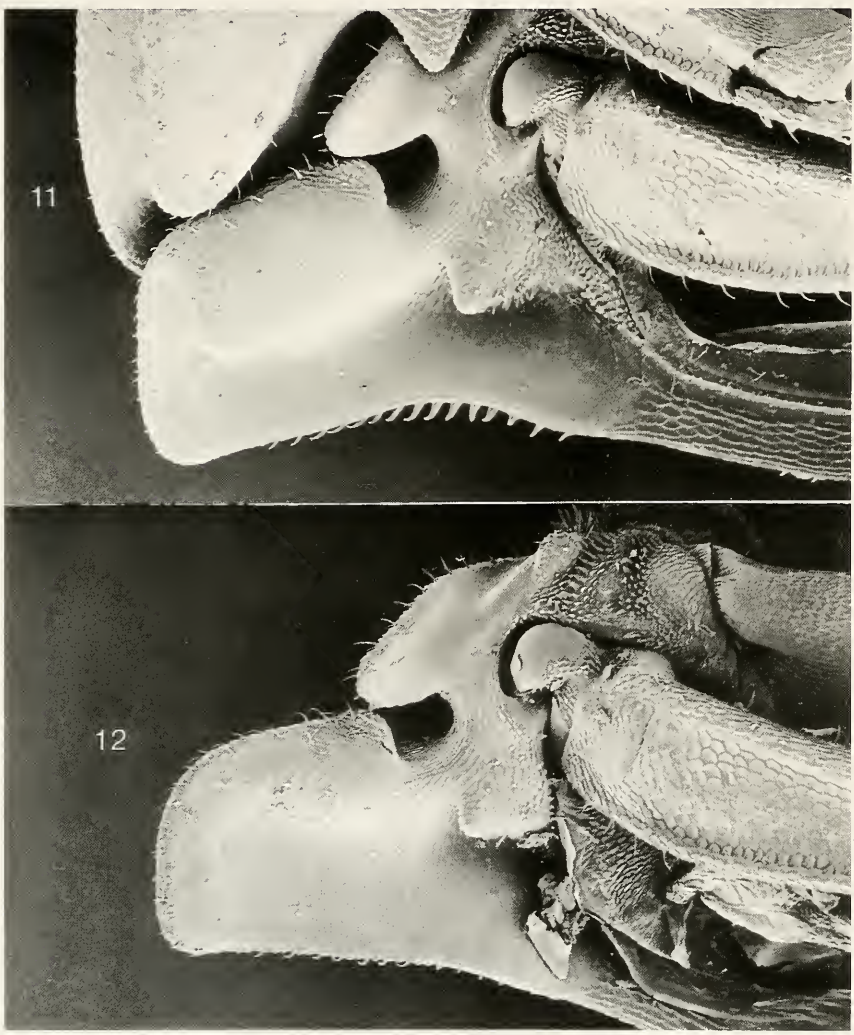
Dimensions: Females up to 8 mm long, males only half this size.

Coloration: White, with violet brown pigmentation on the middle parts of pereion-tergites, the epimera of the pleon and the telson. Since all samples were found in light sandy substrate, the spotty pigmentation might help to dissolve the body shape, a strategy directed against optically orientating predators, e. g. birds.

Tergal cuticular structures: All tergal parts are covered with pronounced tubercles (figs. 1–4, 6–8, 13). The head bears a row of 8 tubercles on the hind margin. The pereion-tergites have two rows of tubercles, each row consisting again of 8 tubercles, the posterior row being more pronounced. Tergite I has an additional frontal pair of large tubercles. The pleon-tergites are equipped with two tubercles along the midline (figs. 14). On the telson there are three tubercles arranged in a triangle (fig. 16). The pereion-epimera and the lateral parts of the pleon-tergites have a varying number of very slight tubercles. The number of tubercles is the same in big adults and in juveniles only half the adult size. In the specimens from Sifnos and Serifos the

Fig. 10. *Echinarmadillidium cycladicum* n. sp., as fig. 6; pereion-epimera I and II in ventral view.

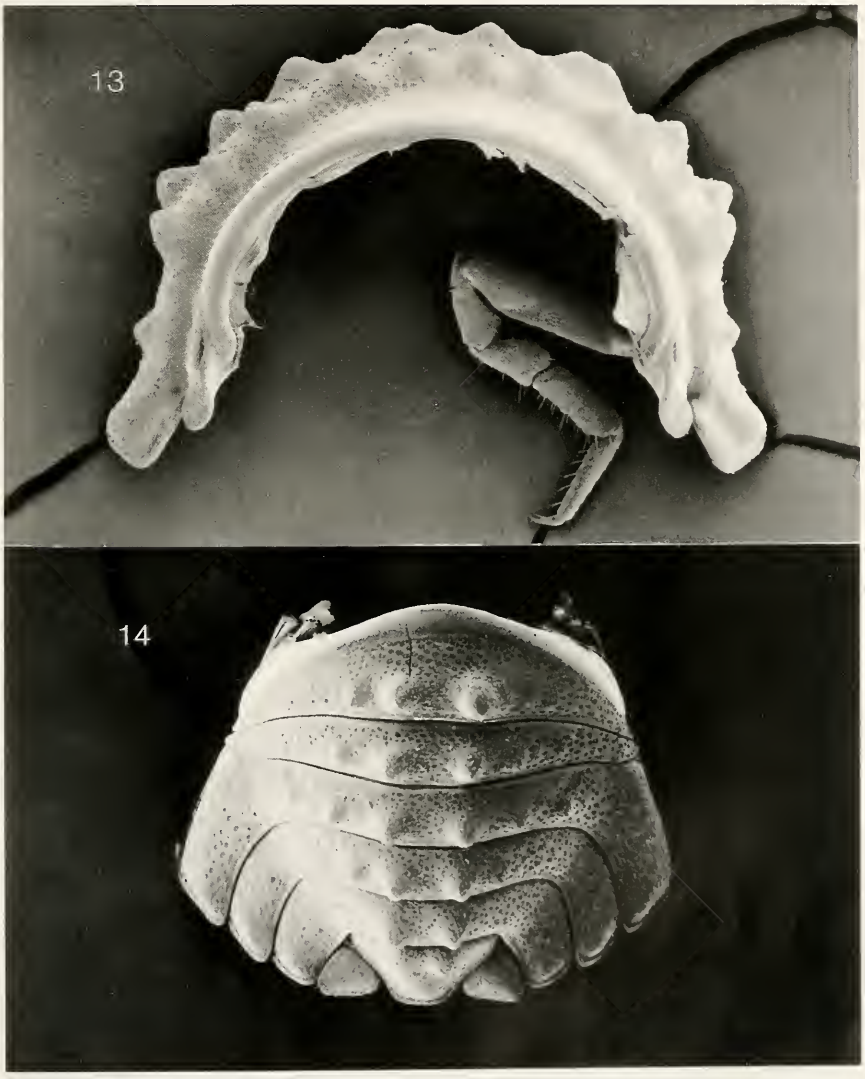
tuberculation is higher and the tubercles are apically sharply pointed, not rounded as in the samples from the other islands; also the small lateral tubercles are more pronounced and pointed and thus more conspicuous. Functionally the tuberculation could be interpreted as a reinforcement of the tergites, avoiding easy crushing by certain predators (compare SCHMALFUSS 1975) and/or as a device to minimize contact area with wet substrate as it was ascribed to the longitudinal ridges in a number of endogean isopod genera (SCHMALFUSS 1977). So for the different tuberculation of the Serifos-Sifnos population differences in micro-habitats or in predator-pressure should be responsible.



Figs. 11–12. *Echinarmadillidium cycladicum* n. sp., as fig. 6. – 11. Epimeron II in ventral view; – 12. Epimeron III in ventral view.

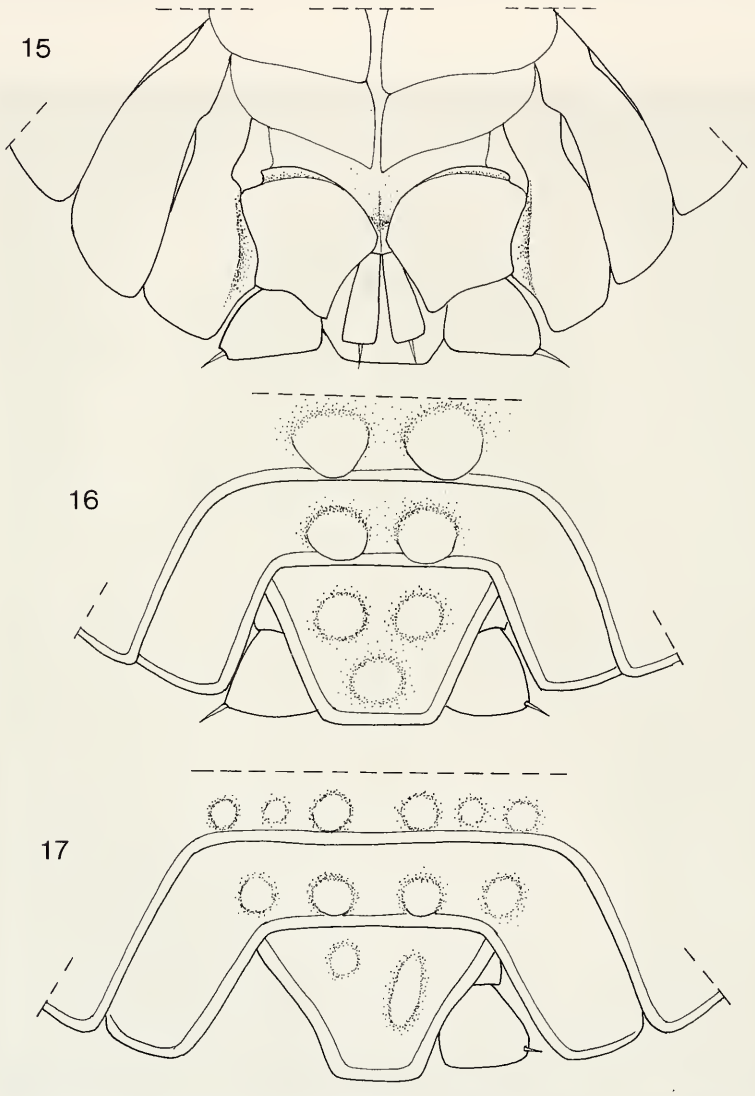
Head morphology of *Armadillidium*-type, with well-developed postscutellar ridge (= linea frontalis) forming the fronto-lateral corners of the head, while the scutellar ridge (= linea antennalis) does not reach the lateral corners (figs. 6–8). Eyes in adult specimens with around 11 ommatidia.

Pereion-epimera I with schisma and ventral groove, the exterior lobe of the schisma reaching farther behind than the interior one (fig. 10). Epimera II with interior lobe (fig. 10–11). Epimera II, III and (less pronounced) IV frontally with a very peculiar invagination (figs. 10–12). The triangular cones behind the leg-articulation guarantee a safe fixing of the tergites towards each other during enrollment and



Figs. 13–14. *Echinarmadillidium cycladicum* n. sp., as fig. 6. – 13. Pereion-tergite II in frontal view; – 14. Pleon, dorsal view.

thus the stability of the enrolled animal. They are present also in other genera of the Armadillidiidae. Dorsally the hind margins of epimera I and II and the frontal parts of epimera II and III bear a row of modified triangular setae that have the shape of shark-teeth (figs. 3–4, 11). The function is unknown, but perhaps these structures and the invaginations mentioned above are part of a modified water-conducting system. These two characters (invaginations and shark-teeth setae) are also present in



Figs. 15–16. *Echinarmadillidium cycladicum* n. sp. from island Levitha. – 15. ♀, 7 mm long, terminal part of pleon, ventral view; – 16. as fig. 15, dorsal view.
Fig. 17. *Echinarmadillidium armathianum* n. sp., ♀ (holotype), 6 mm long, terminal part of pleon, dorsal view.

E. armathianum, but, according to the descriptions, seem to be lacking in the Yugoslavian species of *Echinarmadillidium*.

Telson terminally truncate (figs. 14–16).

Antennula three-jointed, with a terminal bunch of aesthetasks (fig. 18). Antenna stout and short, flagellum with distal joint about three times as long as proximal one (fig. 19–21).

Male pereiopod I see fig. 23, merus and carpus without dense brush of stout spines as present in many species of *Armadillidium*. Pereiopod VII see figs. 24–27, without conspicuous sexual modifications.

Shape of male pleopod-exopodite very variable (figs. 28–33), always with an indented margin of the respiratory field. Female exopodite I consisting only of respiratory part (fig. 37). Male endopodite I see fig. 34. Male exopodite II with usual elongate medial part (fig. 36), female exopodite II see fig. 38. Male endopodite II barely longer than endopodite I, with abruptly thinner distal part (fig. 35). Uropods see fig. 15.

Data on ecology and reproduction

All samples were found on calcarious sandy substrate at or near the sea-shore.

Of 167 females examined only 8 have a marsupium. Six are part of a sample of 60 females collected on the island Levitha in mid-January, two have been found in April. The material has been collected between November and April, so these data suggest a main reproductive period in mid-winter, with a peak perhaps in December.

Fig. 18. *Echinarmadillidium cycladicum* n. sp. from island Anafi (SMNS T312), antennula.

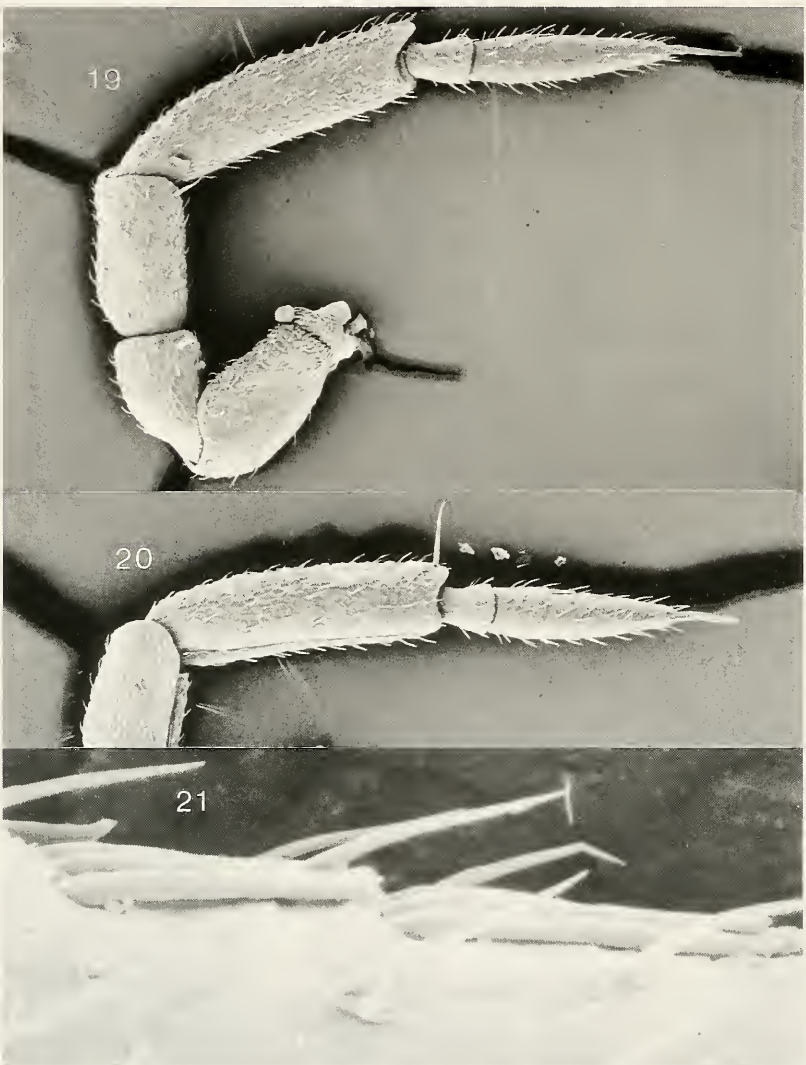
1.2. *Echinarmadillidium armathianum* **n. sp.**

Holotype: ♀ without marsupium, Greece, Karpathos archipelago (SE-Aegaean), island Armathia, leg. PIEPER 19. IV. 1983.

Description

Dimensions: 6 x 3 mm.

Coloration: Posterior parts of tergites with light violet-brown pigmentation, conspicuously differing from the coloration pattern of *E. cycladicum*.



Figs. 19–21. *Echinarmadillidium cycladicum* n. sp. from island Serifos (SMNS T314), ♂. – 19–20. Antenna from upper and lower side; – 21. Aesthetascs on flagellum.

Morphologically very similar to *E. cycladicum*, but with pronounced differences concerning the inclination of the epimera; in *armathianum* they are conspicuously flatter, so the animal is wider than specimens of *cycladicum* of comparable length (compare figs. 8–9). There are slight differences in the head morphology, and the antenna shows clearly different proportions (figs. 19, 22). The pleon-tergite V has 4 tubercles, compared to 2 in *cycladicum* (figs. 16–17). Since only one female is known nothing can be said about male sexual characters.

Data on ecology and reproduction

The single specimen has been collected on the presently uninhabited island of Armathia, which has a size of about 3 x 1.5 km. It consists mainly of calcarious

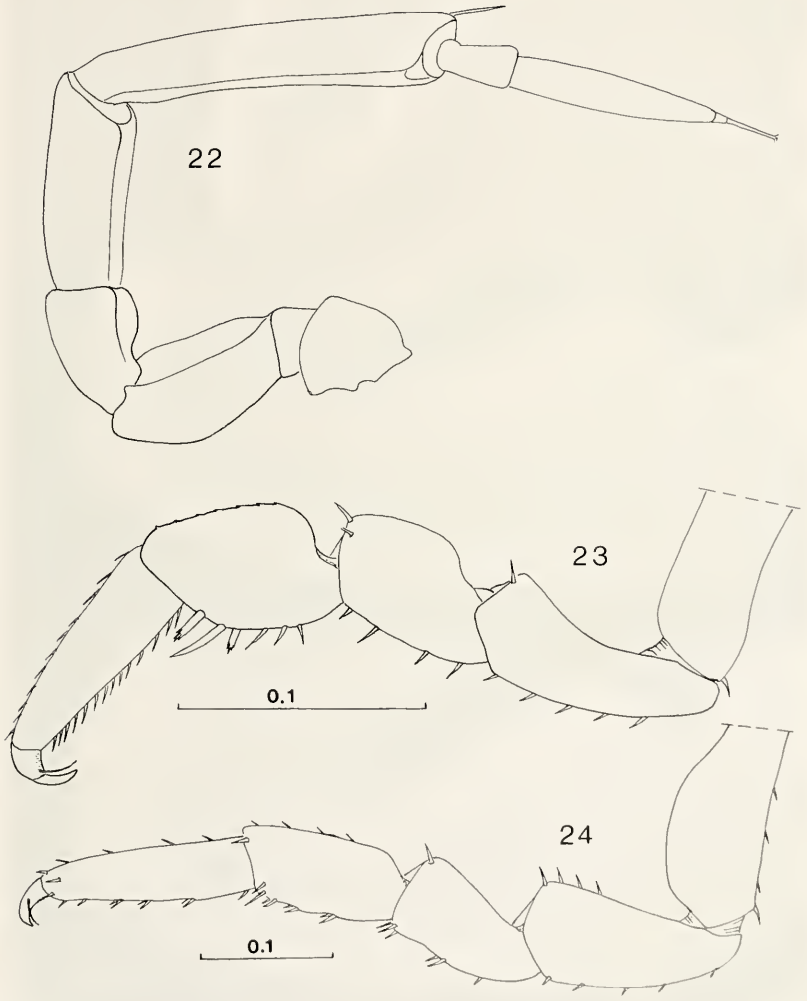
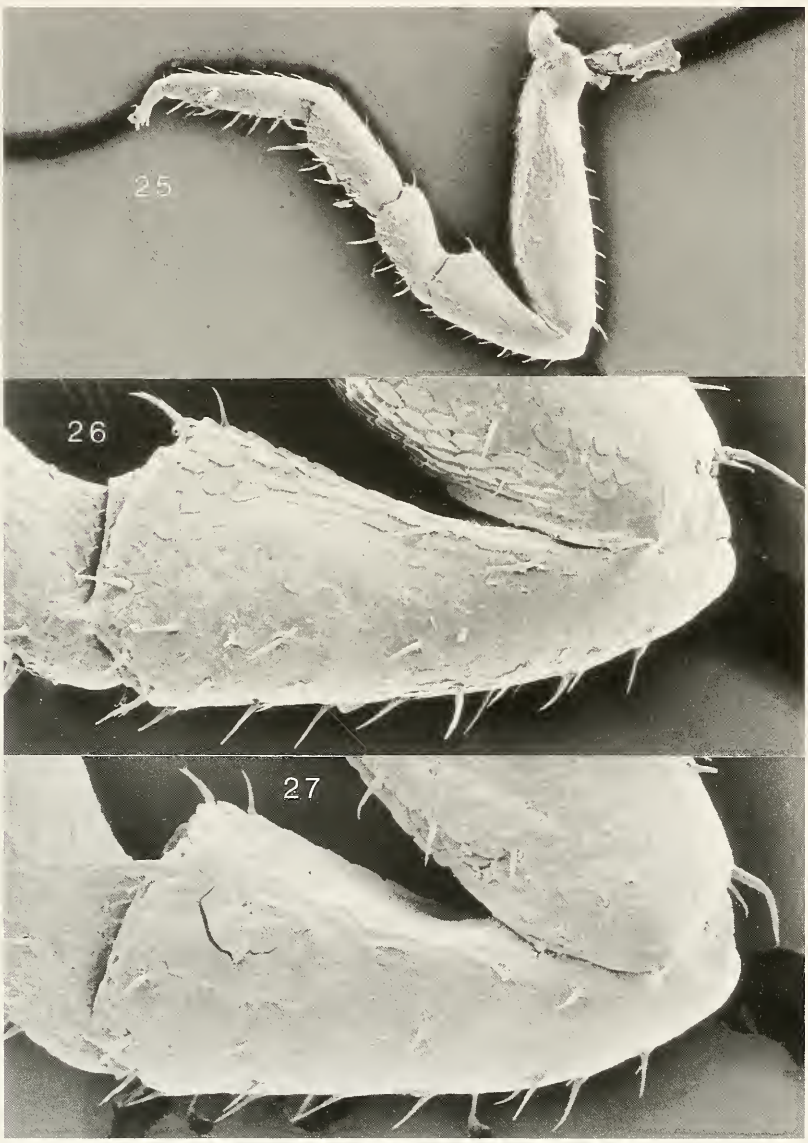


Fig. 22. *Echinarmadillidium armathianum* n. sp., ♀ (holotype), antenna.
Figs. 23–24. *Echinarmadillidium cycladicum* n. sp.; ♂ 2.5 mm long, from Anafi (holotype). – 23. Pereiopod I; – 24. Dito, pereiopod VII. – Scales in [mm].

rocks, and abandoned houses show that in the past at least temporarily it was inhabited by a small human population. The island is covered by phrygana vegetation and is grazed by goats. There is a distance of about 3 km between Armathia and Kasos Island. Although Kasos and Karpathos have been intensively investigated for terrestrial isopods no *Echinarmadillidium* specimens have been found on these bigger islands of the archipelago. The exact locality where the animal has been found on Armathia cannot be reconstructed.

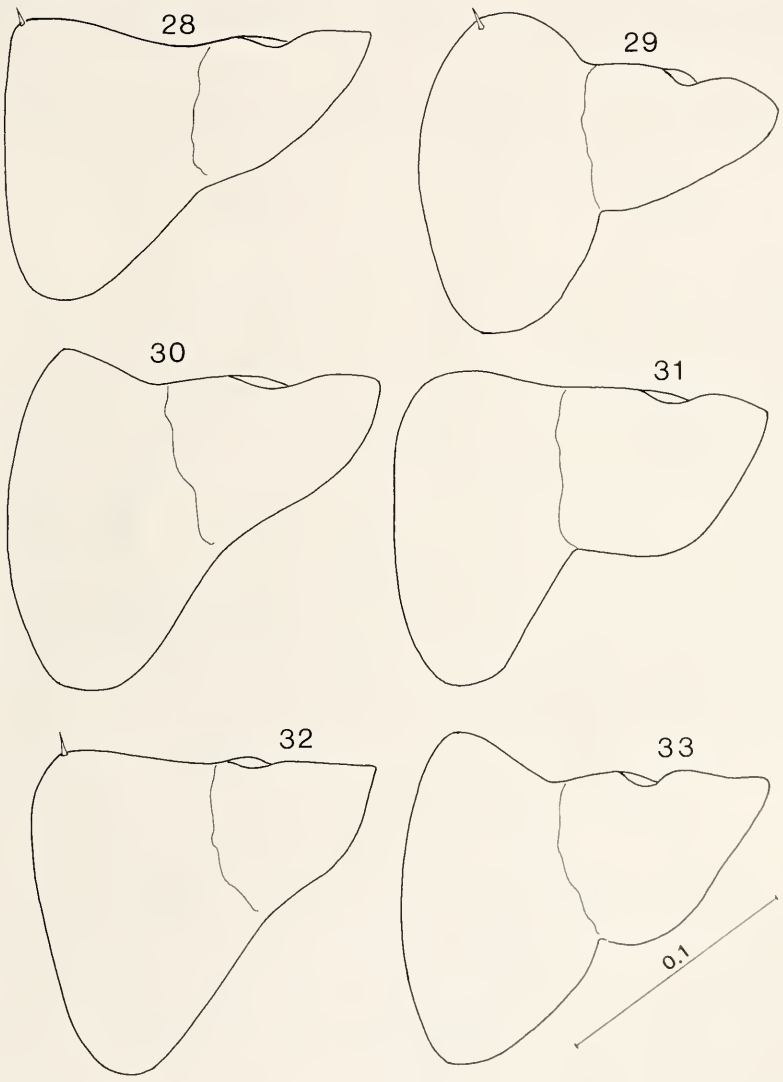


Figs. 25–27. *Echinarmadillidium cycladicum* n. sp.; ♂ from Serifos (SMNS T314). – 25. Pereiopod VII; – 26.–27. Ischium VII from both sides.

The single female seems to be adult. No marsupium is present, so the time of capture (April) does not seem to be inside the main reproduction period.

1.3. *Echinarmadillidium* sp. from Crete

Dr. S. ANDREEV (Sofia) has sent us specimens of *Echinarmadillidium* from Knossos on Crete, which may belong to *E. cycladicum* n. sp., or they are representatives of a third Aegaean species of that genus. The material will be published by Dr. ANDREEV.



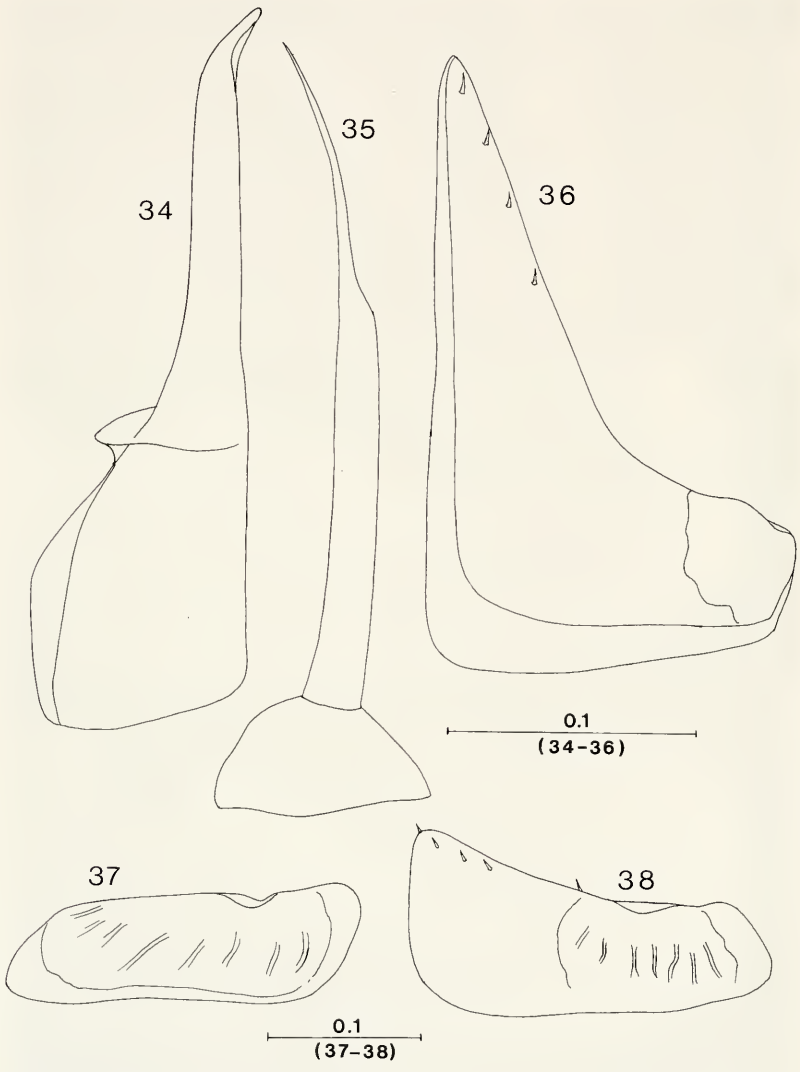
Figs. 28–33. *Echinarmadillidium cycladicum* n. sp.; pleopod-exopodites 1 from different islands. – 28. ♂ from Anafi, 2.5 mm long; – 29. ♂ from Eastern Ftena, 3 mm long; – 30. ♂ from Levitha, 3 mm long; – 31. ♂ from Antiparos, 3 mm long; – 32. ♂ from Serifos, 3 mm long; – 33. ♂ from Sifnos, 3 mm long. – Scale in [mm].

2. The genus *Paxodillidium* Schmalfuss, 1985

Type-species: *Paxodillidium schawalleri* Schmalfuss, 1985 by monotypy.

Diagnostic characters:

1. Head morphology of the *Eluma*-type: Linea post-scutellaris, which very probably corresponds to the linea frontalis of other Oniscidea, reduced, linea antennalis (forming the upper margin of the frontal triangle) continued laterally to the eyes.



Figs. 34–38. *Echinarmadillidium cycladicum* n. sp. – 34. ♂ from Serifos, 3 mm long, pleopod-endopodite I; – 35. Dito, pleopod-endopodite II; – 36. Dito, pleopod-exopodite II. – 37. ♀ from Serifos, 4.5 mm long, pleopod-exopodite I; – 38. Dito, exopodite II. – Scales in [mm].

2. Epimera of pereion-tergite I without schisma and groove.
3. Four giant tubercles on the posterior margin of the head and on each pereion-tergite.
4. Oblique lateral ridge ventrally on protopodite of uropod (figs. 42–43) (not mentioned in the original description).

Phylogenetically *Paxodillidium* is probably closely related to the genus *Cyphodillidium* Verhoeff, 1939. If the oblique ridge on the uropod-protopodite in *Trichodillidium* Schmalfuss, 1989 (Schmalfuss 1989: 211, fig. 13) is homologous with this character in *Paxodillidium*, *Trichodillidium* should be one of the closest relatives of *Paxodillidium*.

At present only one species of *Paxodillidium* is known from the Greek Ionian islands.

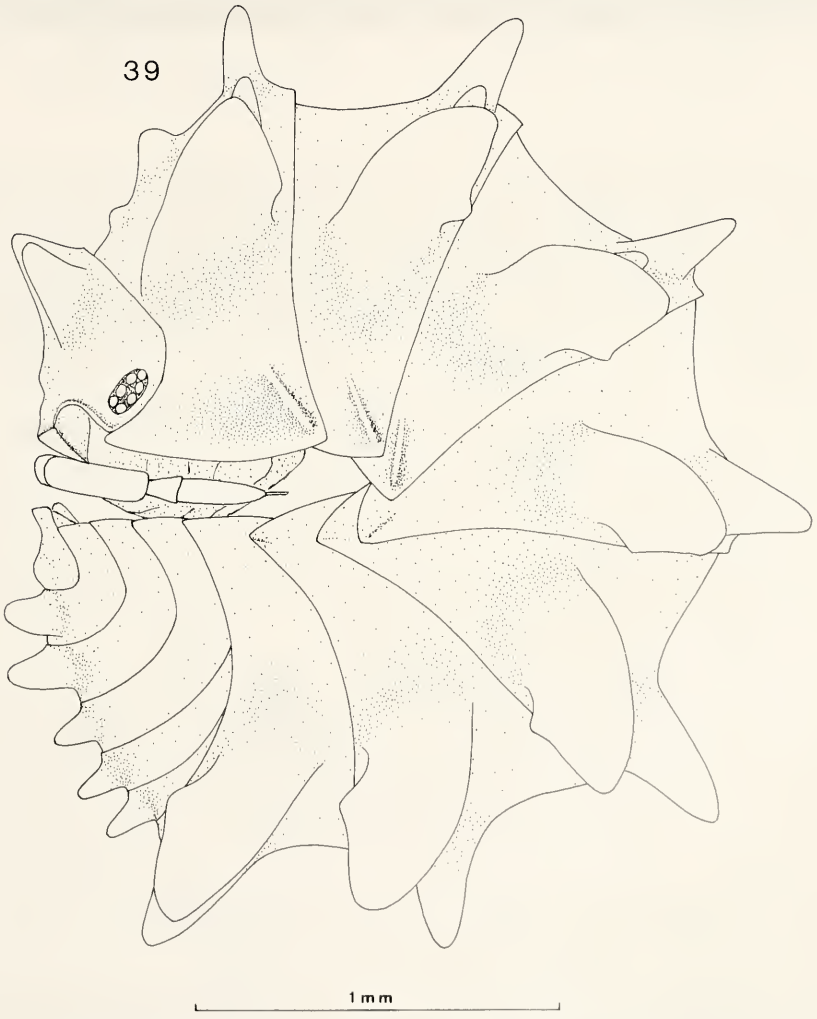


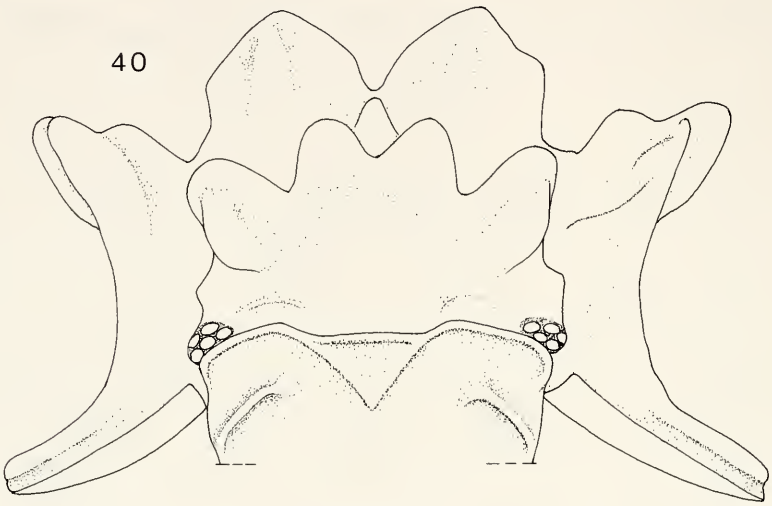
Fig. 39. *Paxodillidium schawalleri*; paratype ♀ from island Paxí, lateral view of rolled-up animal (from Schmalfuss 1985).

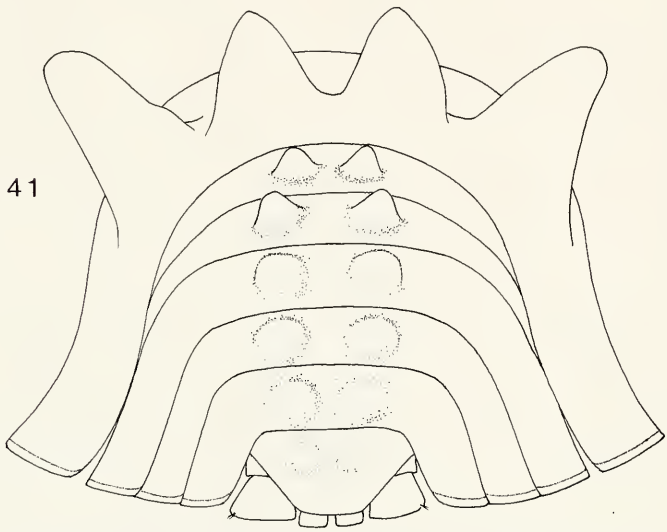
2.1. *Paxodillidium schawalleri* Schmalfuss, 1985

Paxodillidium schawalleri: Schmalfuss 1985: 5, figs. 7–13.

Location of types

♂ holotype and 1 ♂ and 1 ♀ paratypes from island Paxí in SMNS, 1 ♂ paratype from island Paxí in the Zoological Museum of the University of Florence/Italy, 1 ♂ and 1 ♀ paratypes from island Kerkira in the Natural History Museum of Leiden/Holland.





Figs. 40–41. *Paxodillidium schawalleri*; holotype ♂ from island Paxí (from Schmalfuss 1985). – 40. Head and pereion-tergite I in frontal view; – 41. Pereion-tergite VII and pleon in caudal view.

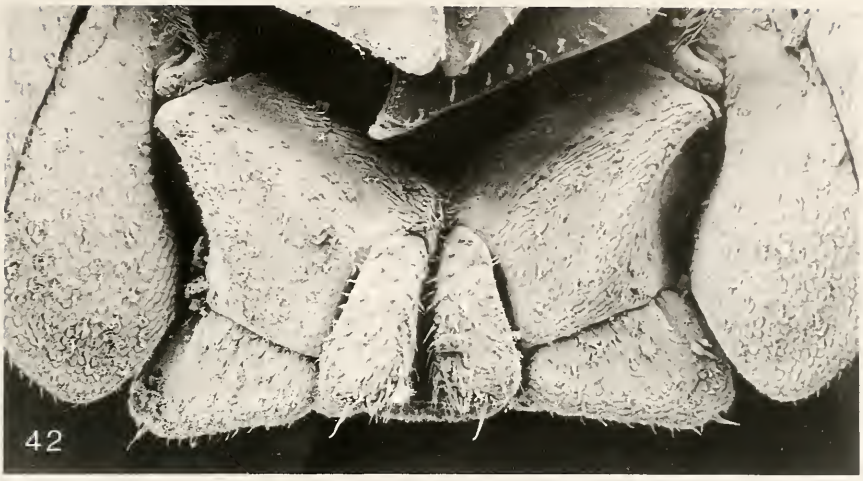


Fig. 42. *Paxodillidium schawalleri*; ♂ from island Ithaki (SMNS 2175), uropods in situ, ventral view.

New records

3 specimens, islet Mogonisi on the southern tip of the island Paxí, leg. SCHAWALLER & SCHEUERN 19. IV. 1981 (SMNS 1391). – 4 specimens, island Ithaki, Yerakhori, *Quercus-ilex*-wood, leg. MAHNERT 20. IV. 1972 (SMNS 2175: 1 ♂, MHNG: 3 specimens). – 2 specimens, island Kefallinia, Livadhi, leg. HAUSER 1. IV. 1971 (MHNG). – 1 specimen, island Kefallinia, Sami, phrygana, leg. HAUSER & LÖBL 31. III. 1971 (MHNG). – 1 specimen, island Zakinthos, Skopos Mt., leg. MAHNERT 22. IV. 1972 (MHNG). – 1 ♂, Strofadhes islands S Zakinthos, island Stamfani, leg. SFENTHOURAKIS 6. XII. 1991 (ZMUA).

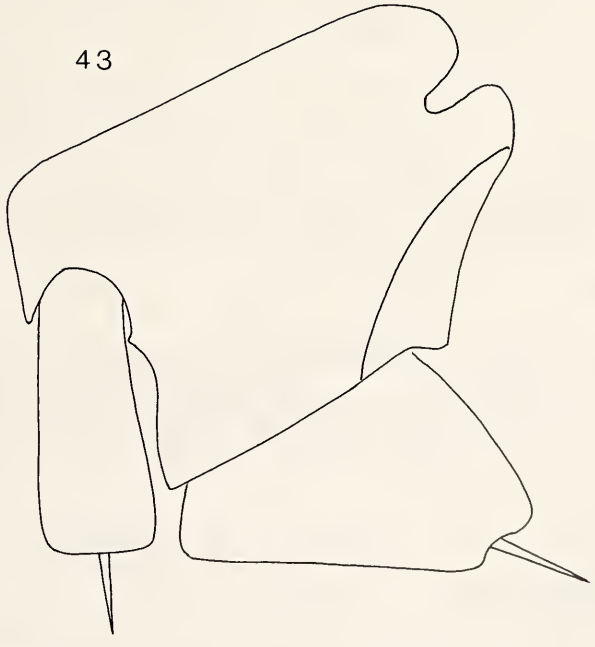


Fig. 43. *Paxodillidium schawalleri*; paratype ♂ from island Paxí, detached uropod in ventral view.

Further records

Ionian islands Kerkira and Paxí S Kerkira (SCHMALFUSS 1985).

Distribution

Presently known from the Greek Ionian islands, but no records from the adjacent mainland.

Description

Maximum dimensions: 6.0 x 3.0 mm (♂ from island Ithaki).

Coloration: White, without pigmentation.

Tergal cuticular structures: Four huge tubercles on posterior part of head and on each pereion-tergite (figs. 39–40). The function of these gigantic tubercles might be the same as the one ascribed to corresponding structures of the African genus *Stegosauroniscus* (SCHMALFUSS 1975): The tubercles increase the diameter of the rolled-up animal considerably, so the species might escape the prey-size spectrum of certain predators (lizards, geckos). Additionally the tubercles of *Paxodillidium* may cause injuries in the mouth cavity and the esophagus of these vertrebrate predators. Pleon and telson with two small tubercles each along the mid-line (fig. 41).

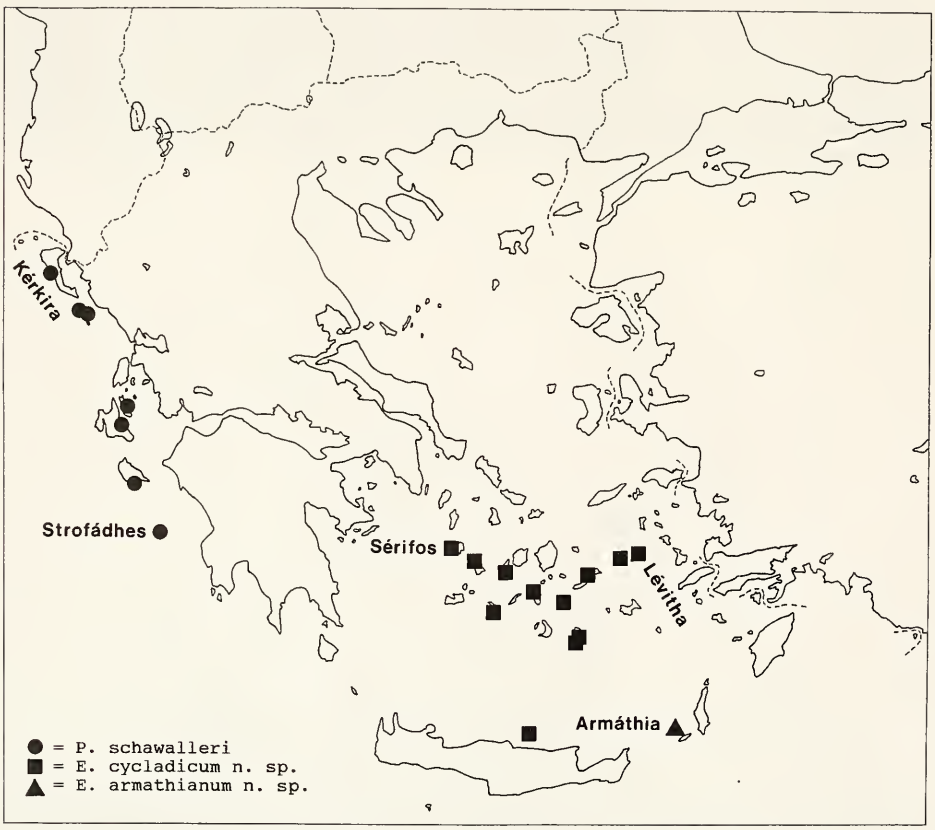


Fig. 44. Records of *Paxodillidium schawalleri*, *Echinarmadillidium cycladicum* n. sp. and *E. armathianum* n. sp.

The species is unmistakable by the enormous individualized tuberculation of the tergites. Uropods and telson see figs. 41–43. Additional figures of ventral morphology of pereion-epimera I and II, ischium VII ♂ and pleopods I ♂ are given in the original description (SCHMALFUSS 1985).

3. Abbreviations and acknowledgments

MHNG = Muséum d'Histoire naturelle de Genève,
SMNS = Staatliches Museum für Naturkunde Stuttgart,
ZMUA = Zoological Museum of the University of Athens.

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