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CLASS DIPLOPODA

Order Callipodida

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1. Brief characterization of the group and main diagnostic characters

1.1. Morphology

The members of the order Callipodida are best recognized by their putative apomorphies: a divided **hypoproct**, divided **anal valves**, long extrusible tubular **vulvae**, and, as in all other helminthomorph millipede orders, a characteristic conformation of the male **gonopods**. As in Polydesmida, only the first leg pair of the 7th body ring is transformed into gonopods, which are retracted inside the body.

Body rings are open ventrally and are not fused with the **sternites**, leaving the **coxae** of the legs free. Legs in the anterior half of the body carry coxal pouches. The small **collum** does not overlap the head. Callipodida are of uniformly cylindrical external appearance. The number of **body rings** is only sometimes fixed in species and usually exceeds 40. There are nine **antennomeres**, as the 2nd antennomere of other Diplopoda is subdivided (= antennomere 2 and 3 in Callipodida). The general structure of the **gnathochilarium** is shared with the Chordeumatida and Polydesmida.

Callipodida are said to be characterised by longitudinal **crests**, which gives the order the common name “crested millipedes”. Although crest are present in most species, some genera (e.g. *Schizopetalum*) lack a crest, while some Spirostreptida (e.g. in Cambalopsidae, ‘Trachystreptini’) and some Julida (e.g. *Cheloiulus*) have similar structures.

Together with the orders Stemmiulida and Chordeumatida, callipodidans are traditionally placed in the superorder Nematophora (e.g. Enghoff, 1984; Blanke & Wesener 2013), due to the presence of spinnerets. Recently Blanke & Wesener (2013) suggested that the Stemmiulida are the the sister group of the Callipodida. However, recent molecular studies indicate that Callipodida are the sister group to the Chordeumatida (Brewer & Bond, 2013). There are several characters of the Callipodida that support one or the other placement. They have divided tarsi, as in Stemmiulida, and an organ of Tömösvary, as in Chordeumatida, but not Stemmiulida. In Callipodida coxal pouches occur on several legs in the anterior half, while they are restricted to the male legs of the 8th body ring in Chordeumatida (see chapter on Chordeumatida) and occur also, but reduced to a porus, on posterior legs in Stemmiulida. A suture dividing the tergite into two connected elements occurs in all Nematophora and not only in Stemmiulida as stated by Blanke & Wesener (2013).

Adult females of Callipodida can be recognized by their enlarged 2nd and 3rd body rings, as figured in Glaubrecht & Spelda (1993) and Hoffman (2009), while in males the 7th ring is usually enlarged.

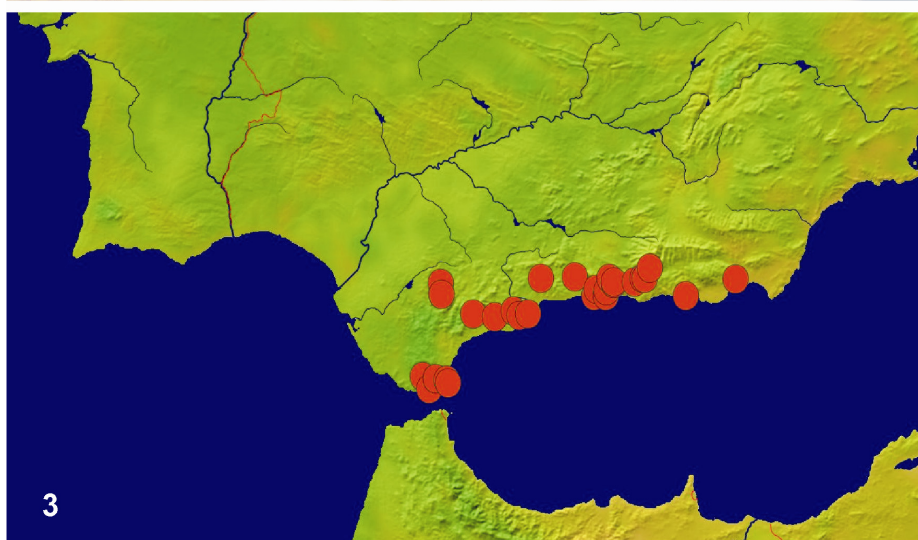
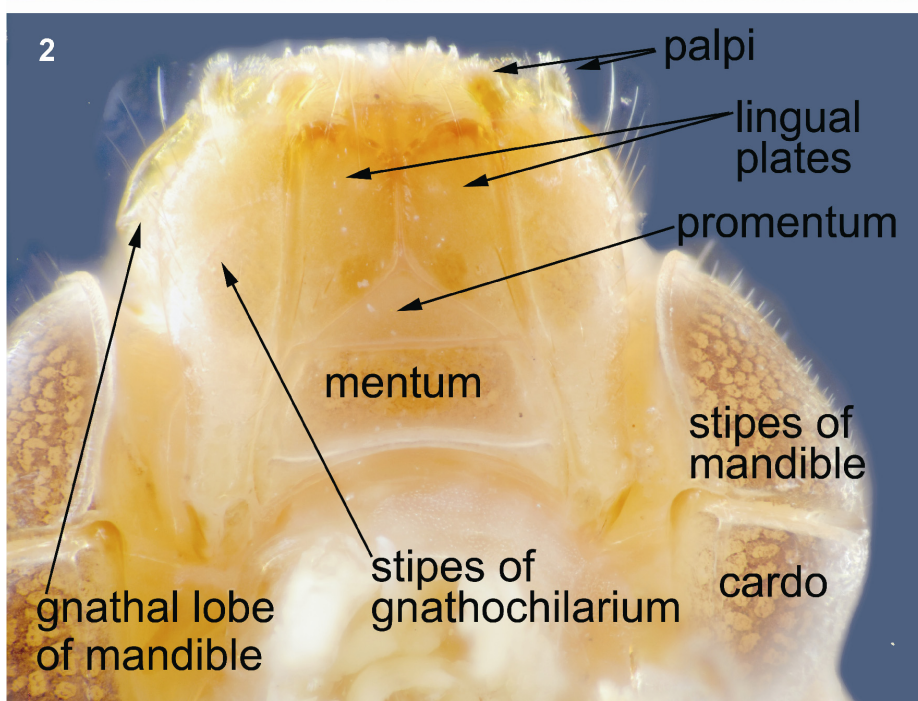
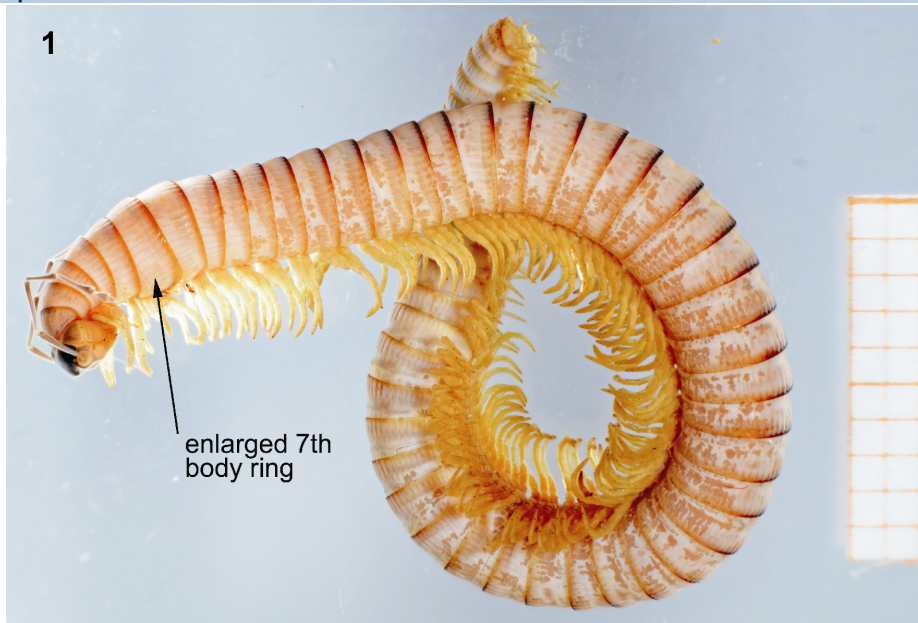


Fig. 1-3. *Cyphocalipus excavatus*: 1. Male habitus. 2. Mandible and gnathochilarium ventral view. 3. Distribution.

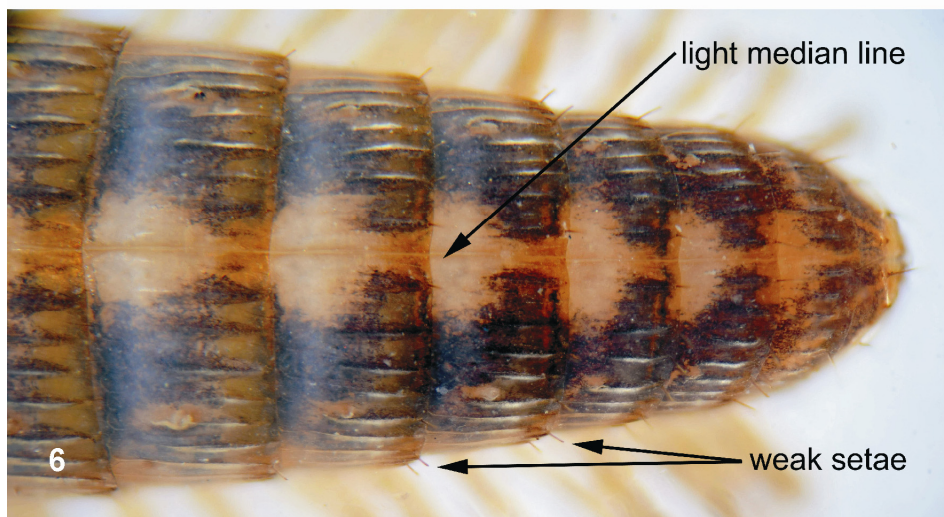
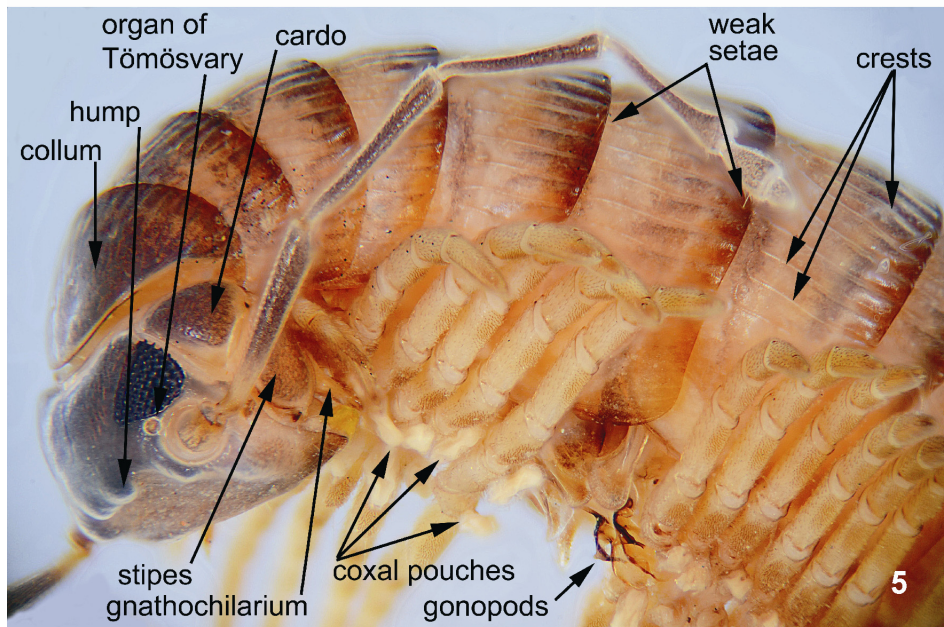
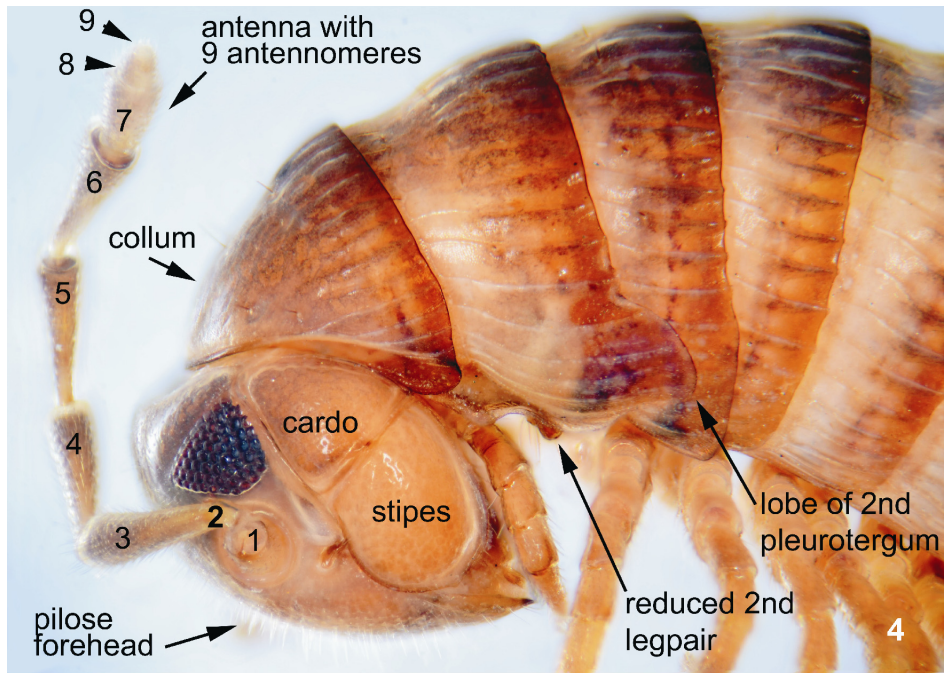


Fig. 4-6. *Cyphocalipus excavatus*: 4. Female anterior part lateral view. 5. Male anterior part ventrolateral view. 6. Last body rings dorsal view.

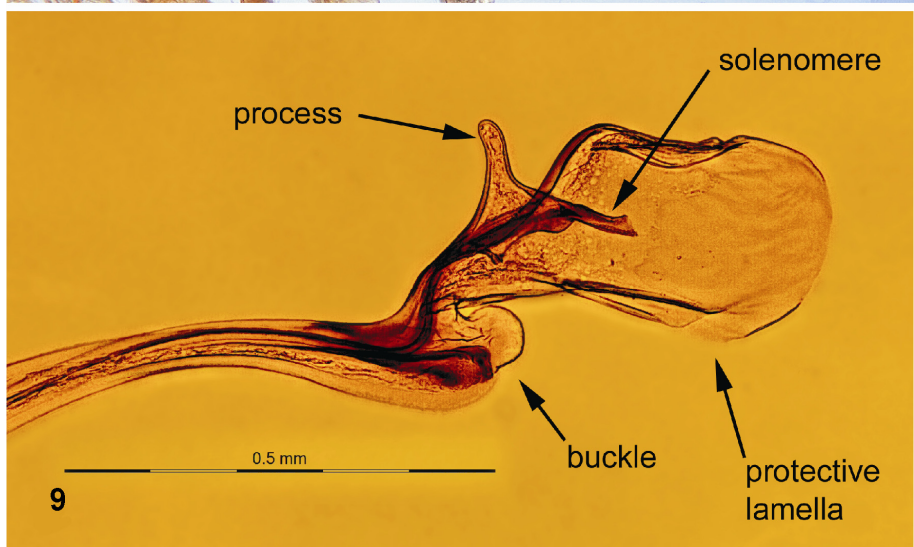
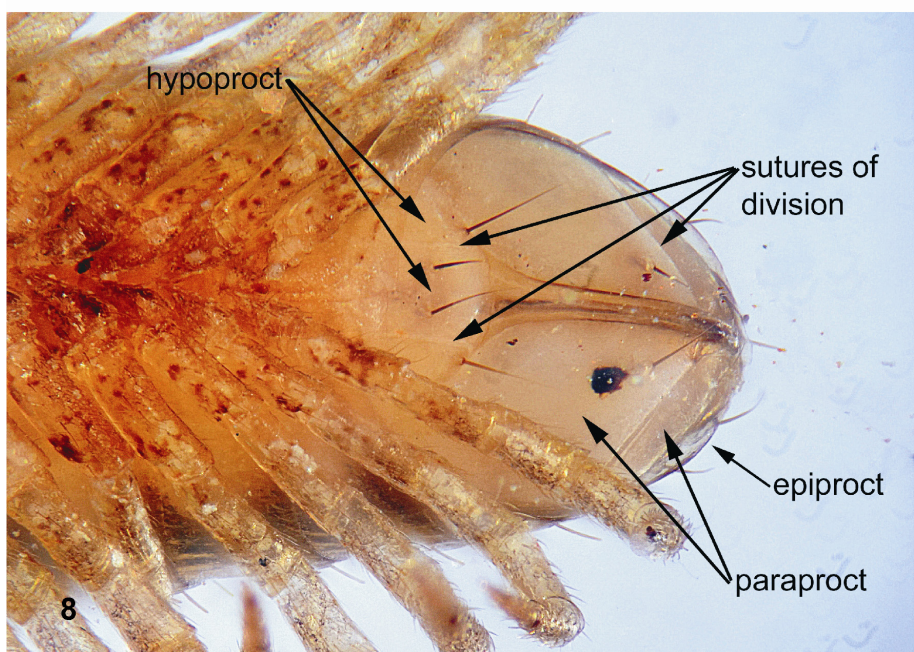
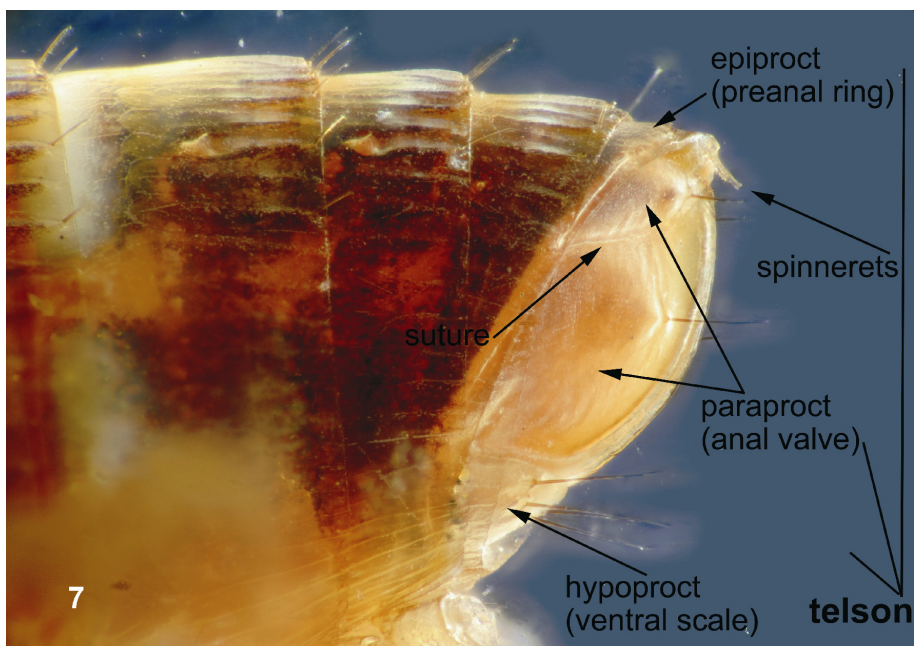


Fig. 7-9. *Cyphocalipus excavatus*: 7. Last body rings lateral view. 8. Last body rings ventral view. 9. End of telopodite.

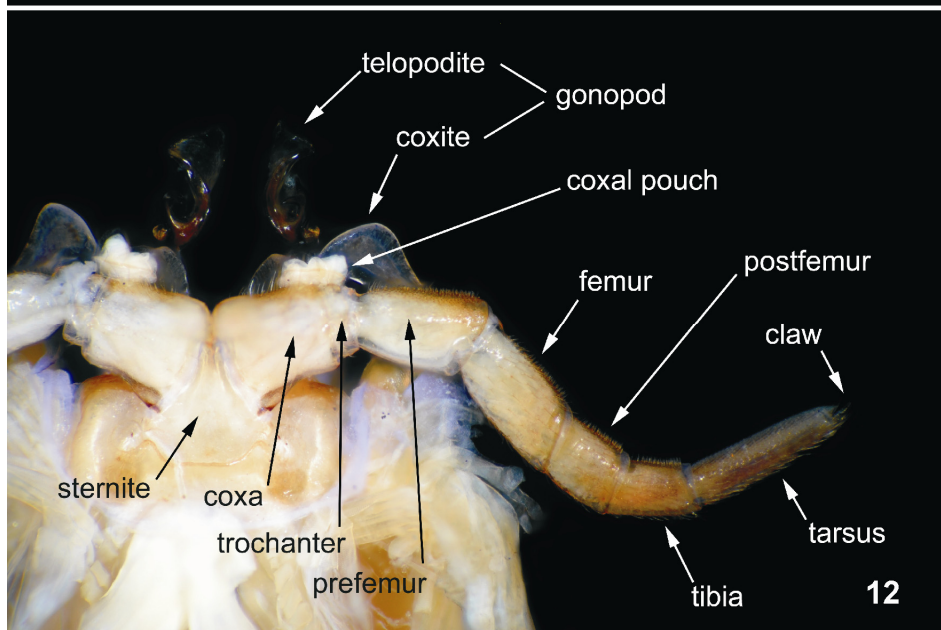
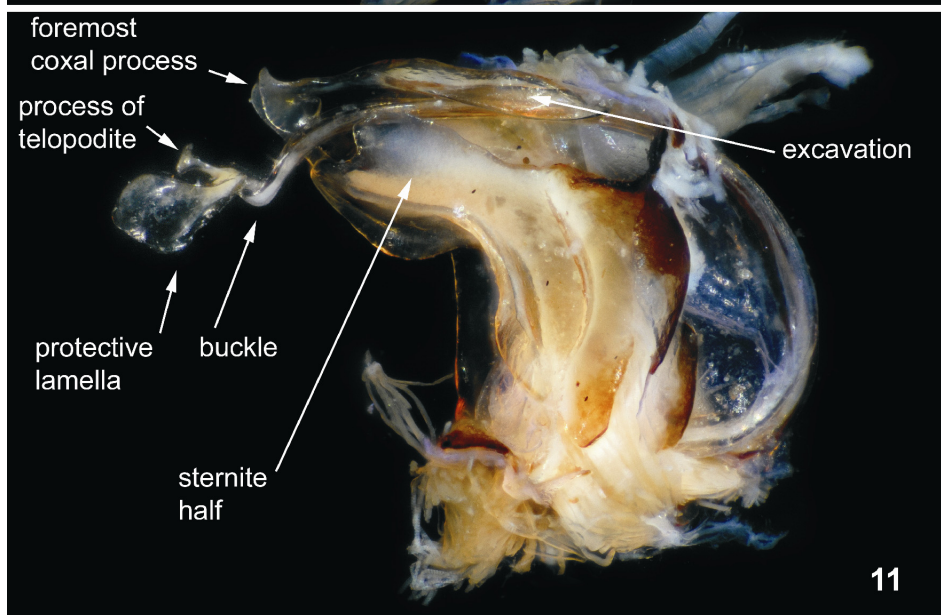
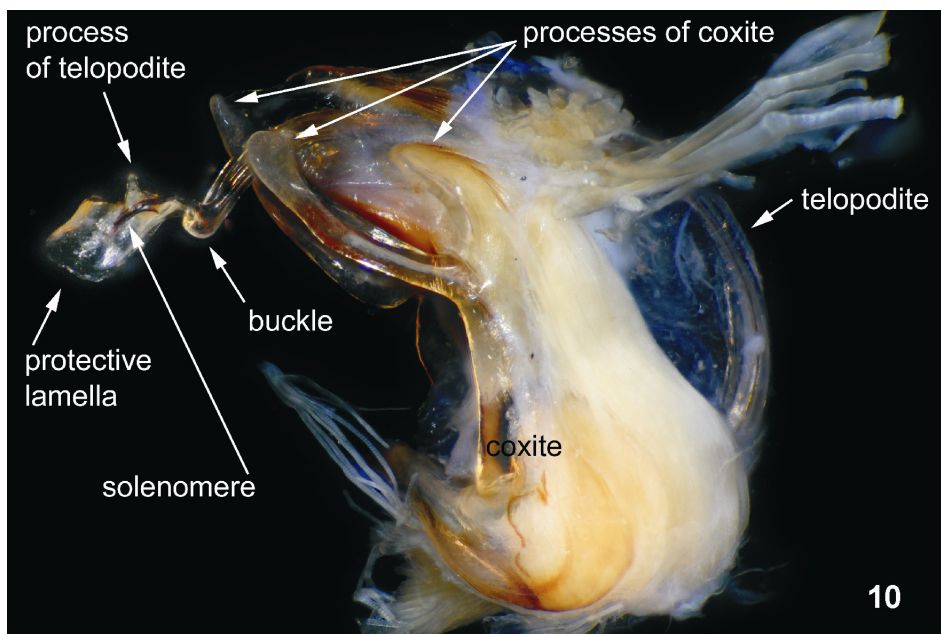


Fig. 10-12. *Cyphocalipus excavatus*: 10. Gonopod external view. 11. Gonopod internal view. 12. Male 7th legpair and gonopod anterior view.

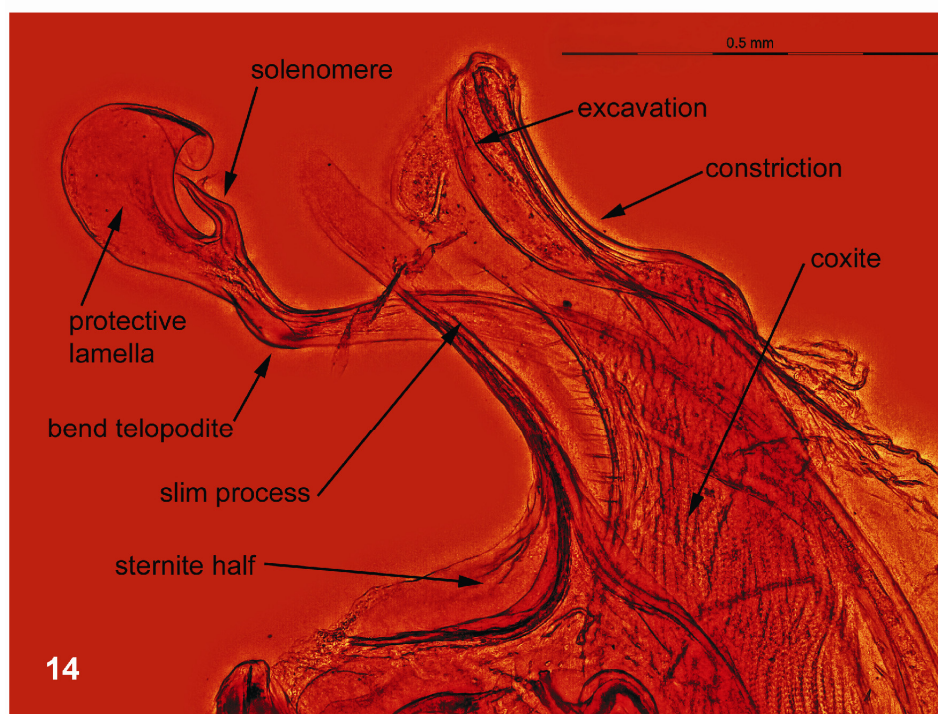
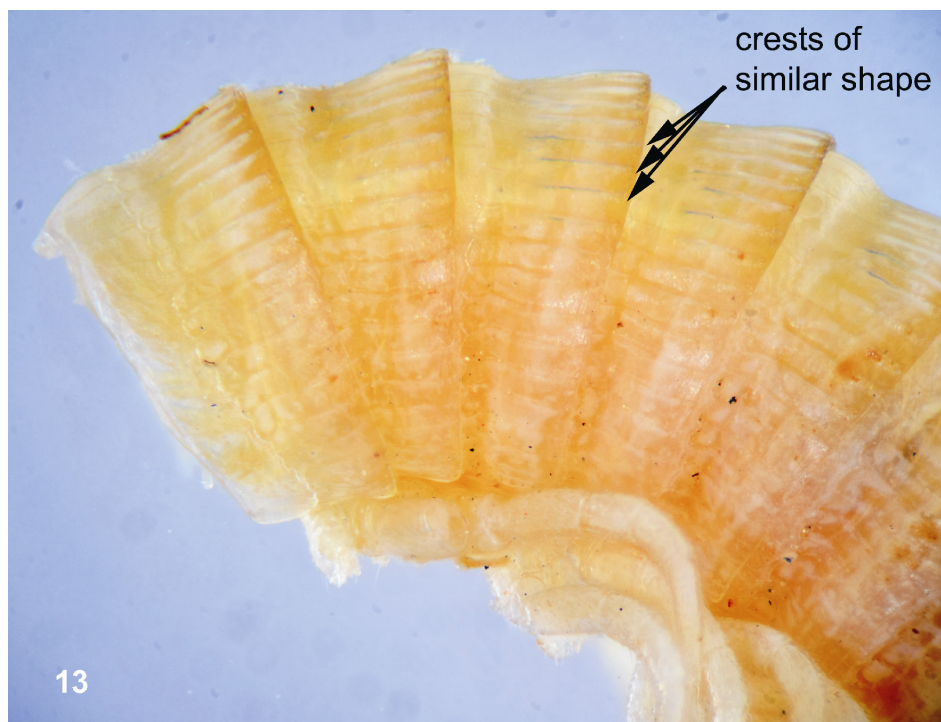


Fig. 13-14. *Dorycallipus arcuum*: 13. Body rings behind ring 7 lateral view. 14. Gonopod internal view.

1.2. Natural History

In contrast to other millipedes callipodids do not only feed on fungi and decomposing plants, but also on dead or living animals (e.g. Verhoeff, 1900; Strasser, 1935). In captivity they can be feed with cheese (personal observation).

If callipodids are irritated, they extrude drops of a white substance on both sides of their bodies from defence glands producing mainly p-cresol (Eisner *et al.*, 1978). They have the smell of wet nappies, something one might never forget. When searching for Callipododa an experienced collector can detect their presence by smell.

The Iberian species *Cyphocallipus excavatus* and *Lusitanipus alternans* are hosts of two species of fungi of the order Laboulbeniales (Santamaria *et al.*, 2014; Reboleira & Enghoff, 2014). One of these fungi, *Diplopodmyces lusitanipodos*, infects mainly the legs, while *D. veneris* infects the genital parts.

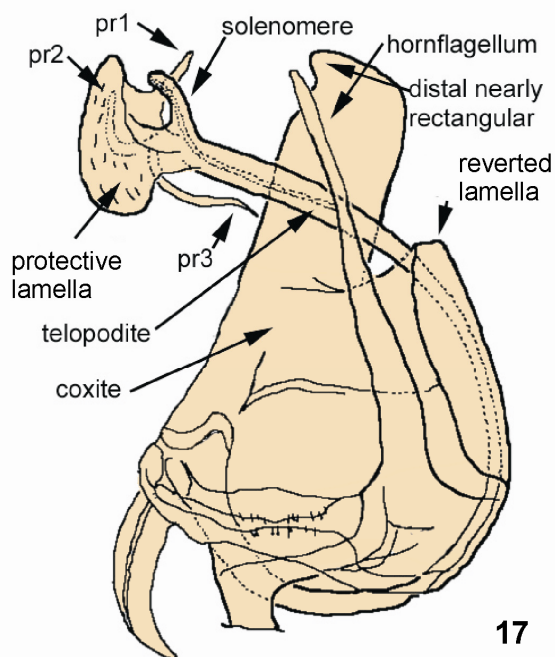
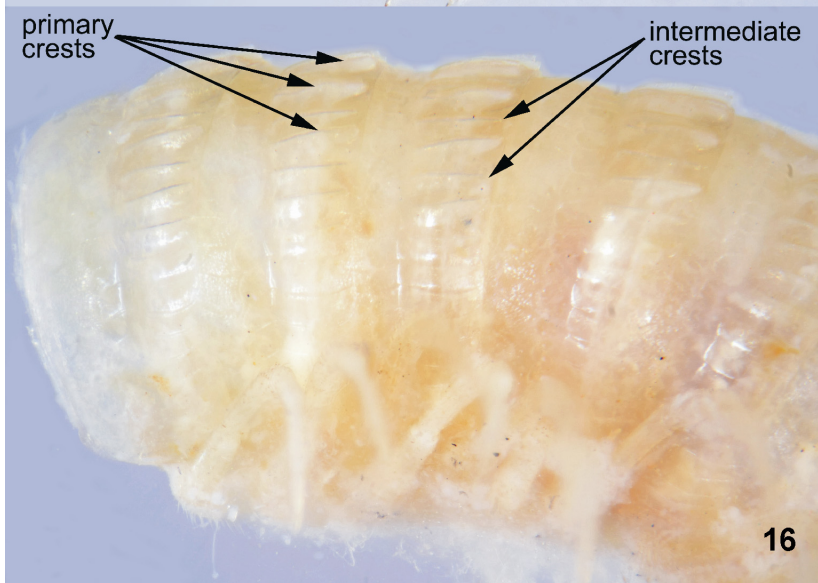
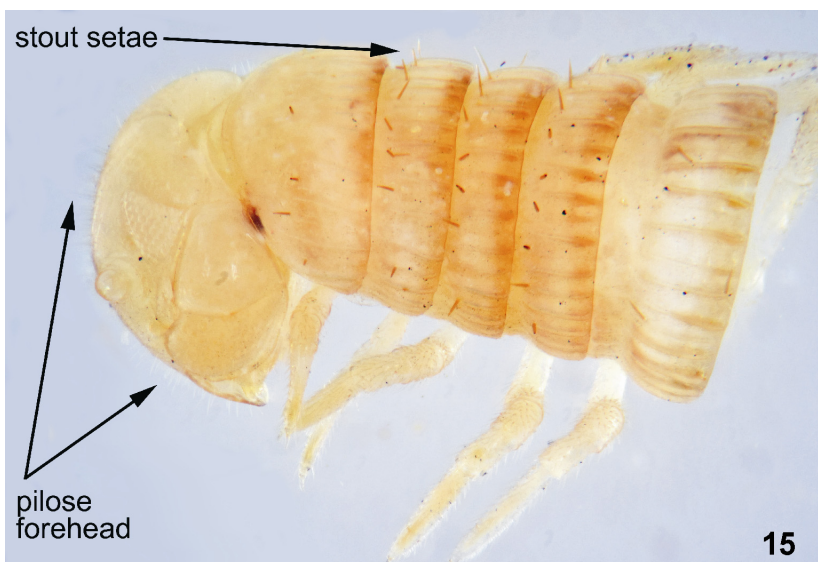


Fig. 15-17. *Lusitanipus alternans*: 15. Male anterior part lateral view. 16. Body rings behind ring 7 lateral view. 17. Gonopod internal view (redrawn from Verhoeff, 1900).

1.3. Distribution

Callipodidans occur mainly in drier subtropical and mediterranean areas, but exclusively in the Northern Hemisphere (Shear *et al.*, 2003). A distribution map can be found in Shelley & Golovatch (2011) and for the European species in Kime & Enghoff (2011). No species have been described from North Africa, although Callipodida have been reported from Algeria by Brolemann (1931, p. 121) and from Libya by Manfredi (1939).

Callipodidans shelter in crevices in rocky biotopes, such as crevices and often invade caves, although true cave species are rather rare. There are no completely blind species and only a few, like *Tetracion jonesi*, *Sinocallipus simplipodicus* and *S. jaegeri*, show troglomorphic adaptations.

1.4. Importance for science and applied research

Callipodida have not attracted much interest from zoologists (other than myriapodologists), but their high degree of endemism makes them good biogeographic indicators, of similar importance to Chordeumatida (Glaubrecht & Spelda, 1993; Spelda, 1996, see also chapter on Chordeumatida). Their distribution patterns suggest that their endemism arises from past restriction to pluvial refugia between desert areas rather than glacial refugia.

1.5. Endangered species

Cyphocallipus excavatus is known from numerous records over a large area and is not endangered. For the two other Iberian species the data is insufficient.

2. Systematic of the group

The order Callipodida is divided in three suborders, the Sinocallipodidea, the Callipodidea and the Schizopetalidea. As with other diplopods the taxonomy is based nearly exclusively on details of the secondary male copulatory organs, the gonopods.

3. Diversity of the group in the Iberian Peninsula and Macaronesia

Callipodida are a comparatively small order of millipedes, currently comprising three suborders (Sinocallipodidea, Callipodidea and Schizopetalidea), seven families, 35 valid genera and subgenera and more than 140 valid species and subspecies (Stoer *et al.*, 2008 and subsequent descriptions). Most species (> 120) are placed in the suborder Schizopetalidea.

Only **Dorypetalidae** (suborder **Schizopetalidea**) occur in the Iberian Peninsula. This family is distinguished by the characteristic long and slender (bi)sinuously circular shape of the curved telopodite of the male gonopods. The Iberian species are regarded as belonging to an endemic subfamily, **Cyphocallipodinae**, characterised by a larger and more complex apical part of the telopodite. Three species have so far been described, but at least one more awaits description.

Of these species *Cyphocallipus excavatus* seems to be the commonest. Numerous samples of this species have been examined by the author, including the type series at the State Collection of Bavaria and material from the locality from wich Mauriès (1978) redescribed the species. Given the high degree of endemism in Callipodida it is a little surprising that there do not seem to be differences between *C. excavatus* specimens across Andalusia. In the author's experience *C. excavatus* is quite common in Andalusia (see map, fig. 3), and the limits of its distribution seem to origin rather from the collecting activity. So it is strange that neither Attems (1952) in his extensive work on myriapods from southern Spain nor Schubart (1959) recorded any member of the order Callipodida. It may be that *C. excavatus* has large population fluctuations, being quite common in one year and very hard to find in another. *C. excavatus* seems to undergo its development over several years, as most specimens examined by the author have been juveniles of different ages. The species seems to be more common in coastal biotopes or in stream valleys, although it also occurs higher in the mountains up to 1300 m. While juveniles can be found at various sites, adult males are usually found in cool, moist places, such as springs on northern slopes.

In contrast, *Dorycallipus arcuum* is only known from the holotype and has not yet been recollected. On the original label only "Südspanien" (southern Spain) is given, making it difficult to define an area for searching. This species is much smaller than *C. excavatus*. The gonopods of the two species are quite similar, and although Verhoeff (1909, 1910, 1926-1932) and Hoffman (1980, 2009) wrote about them, they had not been figured by these authors. *D. arcuum* has even never been figured.

Lusitanipus alternans (Verhoeff, 1893) is currently known from several caves in the surroundings of Coimbra, Portugal, from where it was recently redescribed (Reboleira & Enghoff, 2014).

According to Verhoeff (1926-1932) and the author's investigations the three genera and species can be separated as follows:

	<i>Cyphocallipus excavatus</i>	<i>Dorycallipus arcuum</i>	<i>Lusitanipus alternans</i>
Forehead of male	Distinctly impressed, with a hump above	Slightly impressed, without hump above	Convex
Body rings	54-60, with narrow crests, slightly acuminate posteriorly, separated by intervals	47, with parallel, narrow but strong crests of similar shape, separated by large intervals	44-55, with parallel crests; those with terminal setae distinctly stouter than intermediate
Midbody height of adult males	2 to 3.5 mm	About 1.25 mm	About 2 mm
Collum	With longitudinal furrows and indistinct setae in the posterior half and at the side flaps	At the posterior end with traces of longitudinal crests, at the side flaps with longitudinal furrows	With stout crest, especially in the posterior half; with two transverse rows of stout setae
Hornflagellum	Very long, adjacent to the telopodite	Moderately long, adjacent to the telopodite	Quite straight, not adjacent to the telopodite
Gonocoxite	With three processes, two of them much longer than the 3 rd between them, the foremost with an excavation for the telopodite	With large, constricted process having a spoonlike excavation for the telopodite	With a reverted lamella to accommodate the telopodite and a nearly rectangular process
Sternite halves	With broad, peltate plaques, recessed distally	With very long, slim process, reaching solenomere	Not divided

The adult female of *Cyphocallipus excavatus* is characterised by a reduced 2nd legpair and the 2nd pleurotergum is ventrally prolonged into a lobe (Hoffman 2009). The adult females of the other species are unknown.

4. Current state of knowledge of the group

While France, Italy and the Balkan Peninsula have been surveyed intensively since the early 20th century, with respect to myriapods the Iberian Peninsula is the “terra incognita” of Europe and has been neglected until recently. Only Verhoeff (1897, 1895, 1900, 1926-1932), had Iberian callipodids under the microscope before Mauriès (1978) redescribed *Cyphocallipus excavatus* and Reboleira & Enghoff (2014) *Lusitanipus alternans*. The number of Iberian callipodidan species can be expected to rise as a result of a recent focus on the region by currently active myriapodologists.

5. Main available sources of information

5.1. General sources on taxonomy and identification

Whoever wants to work with Iberian Callipodida has to consult the original papers. For general information on Callipodida one has to consult the broad, but elaborate *handbook for Diplopoda* of Verhoeff (1926-1932) or the smaller one of Attems (1926). All these papers are in German and Verhoeff (1926-1932) is difficult to understand even for a native speaker, while Attems (1926) work is restricted to the most important aspects and thus easier to read and to translate for a non-German. More than half a century later Hopkin & Read (1992) published an English treatment of general aspects of Diplopoda. For France there exists an excellent overview of Callipodida in Brolemann (1935), although the single species occurring there, *Callipus foetidissimus*, belongs to a different suborder. Hoffman & Lohmander (1964) provide another excellent general introduction to the order.

5.2. Keys to the families

There are no published identification keys to the families of Callipodida. For the taxa described in the first quarter of the 20th century the keys in Attems (1926) and Verhoeff (1926-1932) can be used.

5.3. Catalogs

Fortunately, due to the small size of the order and the interest of several myriapodologists in Callipodida there exists a global catalog by Stoev *et al.* (2008).

The following catalog is based on the *SysMyr database*, a part of the *Global Myriapod Information System (GloMyrIS)*, see Spelda, 2006; Melzer *et al.*, 2011) which serves as source for Diplopoda for the Catalog of Life (Spelda, 2007, <http://www.catalogueoflife.org/>). This is a parallel, independent project to *Millibase* of Petra Sierwald, but with cooperation and data exchange. The data of *SysMyr* extend and partly correct the data given in the catalog of Stoev *et al.* (2008). The *SysMyr* catalog gives only data on genera and species, but also includes data on available keys and maps.

Family **Dorypetalidae** Verhoeff 1900

Subfamily **Cyphocallipodinae** Verhoeff 1909

Cyphocallipus Verhoeff, 1909

- 1909 *Cyphocallipus* gen. nov. - Verhoeff, Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, 1909 (4): 210-216 (in key).
1910 *Cyphocallipus* - Verhoeff, Nova Acta. Abhandlungen der Kaiserl. Leop.-Carol. Deutschen Akademie der Naturforscher, 92 (2): 394-401 (in key).
1926 *Cyphocallipus* - Attems, Handbuch der Zoologie. Vol. 4, 1: 180 (in key)
1926-1932 *Cyphocallipus* - Verhoeff, Bronn's Klassen und Ordnungen des Tierreichs, Bd. 5, Abt. 2: 1509 (in key)
1971 *Cyphocallipus* - Jeekel, Monografieen van de Nederlandse Entomologische Vereniging, 5: 97 (note).
1980 (1979) *Cyphocallipus* - Hoffman, Classification of the Diplopoda: 121 (citation).
2009 *Cyphocallipus* - Hoffman, Contributions to Natural History, 12: 644-645 (description).

• **Cyphocallipus excavatus** Verhoeff, 1909

- 1909 *Cyphocallipus excavatus* spec. nov. - Verhoeff, Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, 1909 (4): 211 (original description, type locality: Südspanien, Algeciras).
1910 *Cyphocallipus excavatus* - Verhoeff, Nova Acta. Abhandlungen der Kaiserl. Leop.-Carol. Deutschen Akademie der Naturforscher, 92 (2): 396 (original description, type locality: Südspanien, Algeciras).
1971 *Cyphocallipus excavatus* - Jeekel, Monografieen van de Nederlandse Entomologische Vereniging, 5: 97 (note).
1978 *Cyphocallipus excavatus* - Mauriès, Annalen des Naturhistorischen Museums in Wien, 81: 582 (locality: Espagne, prov. Càdiz, Sierra Pinar, alt. 1300 m, décembre 1074, coll. L. Deharveng 1 ♂).
1978 *Cyphocallipus excavatus* - Mauriès, Annalen des Naturhistorischen Museums in Wien, 81: 582-585, figs. 19-24 (description).
2009 *Cyphocallipus excavatus* - Hoffman, Contributions to Natural History, 12: 645-648, figs. 1-4 (description).

Dorycallipus Verhoeff, 1909

- 1909 *Dorycallipus* gen. nov. - Verhoeff, Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, 1909 (4): 210-216 (in key).
1910 *Dorycallipus* - Verhoeff, Nova Acta. Abhandlungen der Kaiserl. Leop.-Carol. Deutschen Akademie der Naturforscher, 92 (2): 394-401 (in key).
1926 *Dorycallipus* - Attems, Handbuch der Zoologie. Vol. 4, 1: 180 (in key)
1926-1932 *Dorycallipus* - Verhoeff, Bronn's Klassen und Ordnungen des Tierreichs, Bd. 5, Abt. 2: 1509 (in key)
1971 *Dorycallipus* - Jeekel, Monografieen van de Nederlandse Entomologische Vereniging, 5: 98 (note).
1980 (1979) *Dorycallipus* - Hoffman, Classification of the Diplopoda: 121 (citation).

• **Dorycallipus arcuum** Verhoeff, 1909

- 1909 *Dorycallipus arcuum* spec. nov. - Verhoeff, Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, 1909 (4): 211-212 (original description, type locality: Südspanien).
1910 *Dorycallipus arcuum* - Verhoeff, Nova Acta. Abhandlungen der Kaiserl. Leop.-Carol. Deutschen Akademie der Naturforscher, 92 (2): 396 (original description, type locality: Südspanien).
1971 *Dorycallipus arcuum* - Jeekel, Monografieen van de Nederlandse Entomologische Vereniging, 5: 98 (note).
1978 *Dorycallipus arcuum* - Mauriès, Annalen des Naturhistorischen Museums in Wien, 81: 585 (note).

Lusitanipus Mauriès, 1978

- 1900 *Silvestria* - Verhoeff, Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere, 13 (1): 50 (original description).
1909 *Silvestria* - Verhoeff, Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, 1909 (4): 210-216 (in key).
1926 *Silvestria* - Attems, Handbuch der Zoologie. Vol. 4, 1: 180 (in key)
1926-1932 *Silvestria* - Verhoeff, Bronn's Klassen und Ordnungen des Tierreichs, Bd. 5, Abt. 2: 1509 (in key)
1978 *Lusitanipus* - Mauriès, Annalen des Naturhistorischen Museums in Wien, 81: 582 (nom. nov.)
1980 (1979) *Lusitanipus* - Hoffman, Classification of the Diplopoda: 121 (citation).
2000 *Lusitanipus* - Shelley *et al.*, Nomenclator generum et familiarum Diplopodorum II: 58 (note).

• **Lusitanipus alternans** (Verhoeff, 1893)

- 1893 *Lysiopetalum alternans* - Verhoeff, Zoologischer Anzeiger, 16 (418): 167-168 (original description).
1900 *Callipus (Silvestria) alternans* - Verhoeff, Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere, 13 (1): 66, pl. 9, figs. 34-35 (original description).
1909 *Silvestria alternans* - Verhoeff, Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, 1909 (4): 212 (note).
1910 *Silvestria alternans* - Verhoeff, Nova Acta. Abhandlungen der Kaiserl. Leop.-Carol. Deutschen Akademie der Naturforscher, 92 (2): 394-401 (in key).
1960 *Lysiopetalum alternans* - Weidner, Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut, 58: 94 (locality: Portugal 1 ♀ paratipo, note).
2000 *Lysiopetalum alternans* - Shelley *et al.*, Nomenclator generum et familiarum Diplopodorum II: 58 (note).
2014 *Lysiopetalum alternans* - Reboleira & Enghoff, Journal of Cave and Karst Studies, 76 (1): 22 (note).

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