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 millipedes, 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, callipodids 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 Callipododa 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.
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Order CALLIPODIDA

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 eral. 8. Last body rings ventral view. 9. End of telopodite.
1.2. Natural History

In contrast to other millipedes callipodidans 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 callipodidans 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 simplicipodicus* and *S. jaegeri*, show troglomorphic adaptions.

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 (Stoev 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)sinuous ly 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 which 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 originate 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:
**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. Hoffmann & 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

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).

- **Cyphocallipus excavatus** Verhoeff, 1909

1971 *Cyphocallipus excavatus* - Jeekel, Monografieen van de Nederlandse Entomologische Vereniging, 5: 973 (note).
1978 *Cyphocallipus excavatus* - Mauriès, Annalen des Naturhistorischen Museums in Wien, 81: 582 (location: Espagne, prov. Cádiz, Sierra Pinar, alt. 1300 m, décembre 1074, coll. L. Daharveng 1♀)

**Dorycallipus** Verhoeff, 1909

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)

- **Dorycallipus arcuum** Verhoeff, 1909

1971 *Dorycallipus arcuum* - Jeekel, Monografieen van de Nederlandse Entomologische Vereniging, 5: 98 (note).

**Lusitanipus** Mauriès, 1978

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.)

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

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).
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6. References

Class: Diplopoda
Order: CALLIPODIDA


