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CLASS DIPLOPODA

Orden Julida

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1. Brief characterization of the group and main diagnostic characters

1.1. Morphology

The order Julida, the snake millipedes, are comparatively uniform in external appearance. They are between 4 and 150 mm long. Together with the orders Spirostreptida and Spirobolida the Julida belong to the superorder Juliformia, characterized by fused body **rings** (but secondarily separated in Nemasomatidae) and are generally of cylindrical shape. The number of body rings is not fixed, even in specimens of the same species, and usually exceeds 30. The three orders can be discriminated best by the form of the mouth plate, the **gnathochilarium**. In Julida the outer sclerites of the gnathochilarium, the gnathochilarial **stipetes**, border each other and the central sclerite (the **promentum**) does not carry setae (Enghoff, 1981). The gnathochilarium of all other millipede orders is of different structure.

Many julidans have two long frontal **setae** between the **eyes** and a posterior row of setae on their body rings. The basal segments of the mandibles ('*cheeks*') are clearly divided in proximal **cardines** and distal **stipetes**. The **collum** is large and partly overlaps the head and the second body ring. Some species lack eyes or have only a single row of ocelli.

In almost all julidans the first legpair of the males is modified to a certain extent. In some julidans, especially blaniulids, the ventral edges of the 'cheeks' are also modified. The last body ring (**telson**) and sometimes also the anal scale vary in a taxon-specific way within the Julida, especially in the family Julidae, often being prolonged or showing an upward or downward directed hook. The pilosity of the telson and the **anal valves** also show taxon-specific differences. The **vulvae** provide helpful characters in discrimination of species or genera as well (Brölemann, 1923; Blower, 1985; Spelda, 1993), but in some tribes (e.g. Julini) they are quite uniform. The male gonopods (see 1.7) are difficult to examine because they are normally retracted inside the body.

1.2. Natural History

Some members of the order Julida show periodomorphosis. This means that adult specimens moult back into a premature stage, allowing them to reach other adult stages in their life (Verhoeff, 1926-1932). While this is not easy to see in females, the so-called intercalary males are easily recognizable by their first legpair, which is neither a hook, as in adult males, nor a leg with regular articulation, but consists of very short podomeres of nearly equal length. Periodomorphosis is especially common in the tribe Ommatiulini, which is well-represented in the Iberian Peninsula.

Periodomorphosis is the exception and only occurs in a few julid and blaniulid lineages. In general Julida develop by euanamorphosis, i.e., new rings are added at every moult.

Julidans usually have a life span of 2-3 years, which can be extended by another 2-4 years through periodomorphosis (Verhoeff, 1926-1932).

As in all other Juliformia the repugnatorial secretions of Julida contain benzoquinones (Eisner *et al.*, 1978). The alcohol surrounding museum samples of Julida becomes dark reddish brown and needs to be refreshed several times.

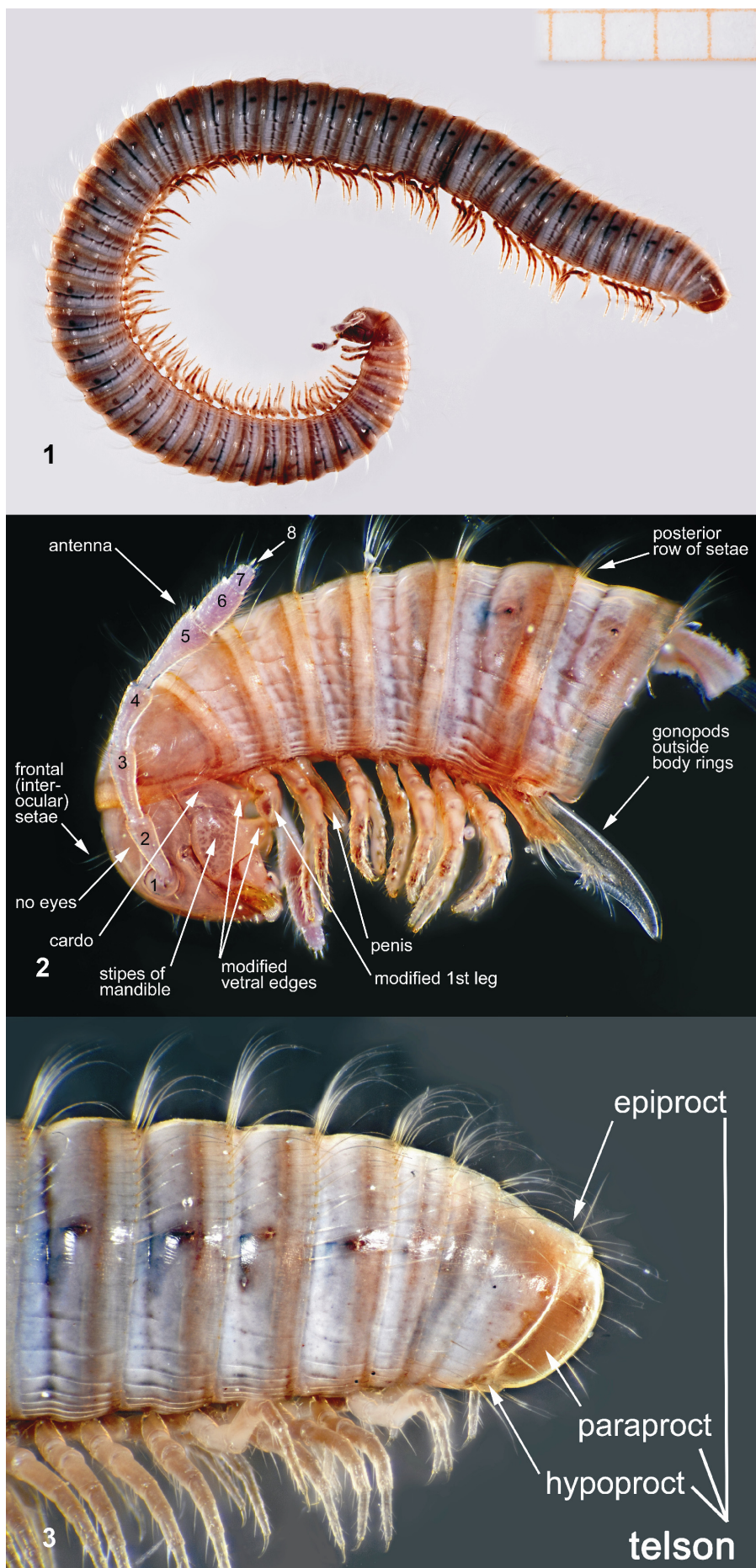
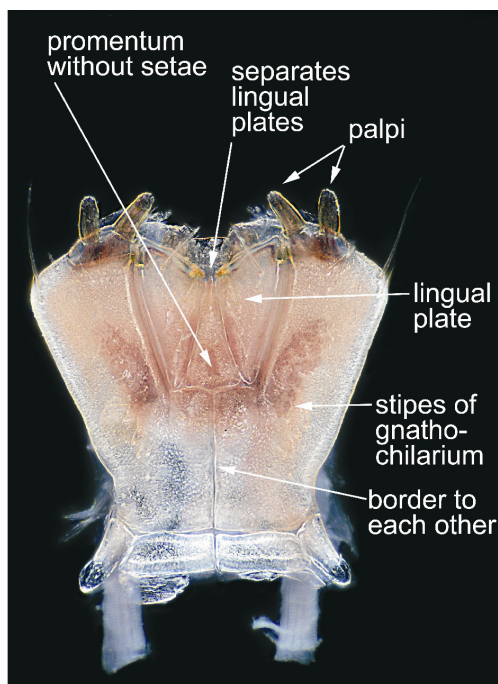
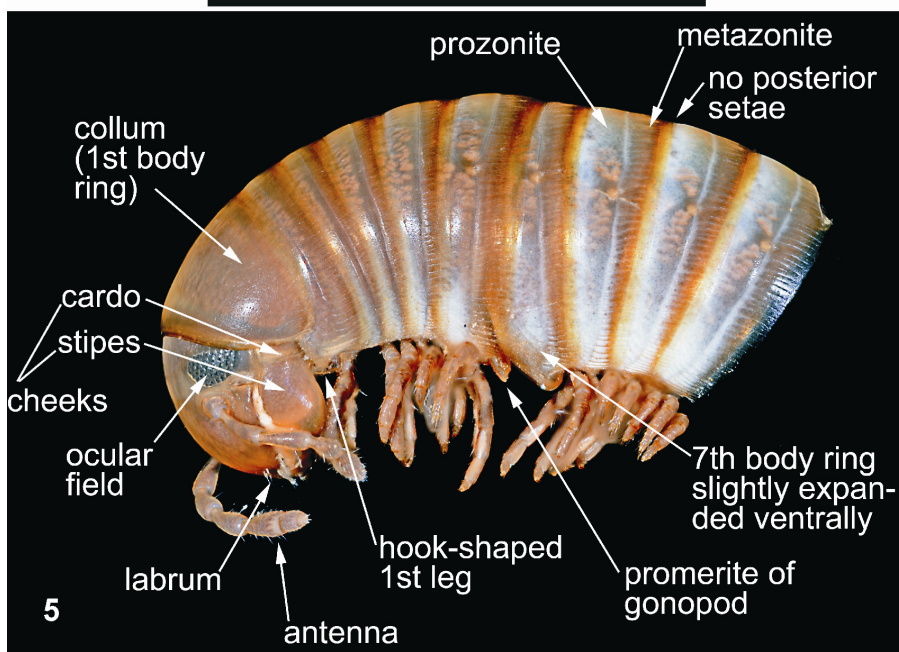


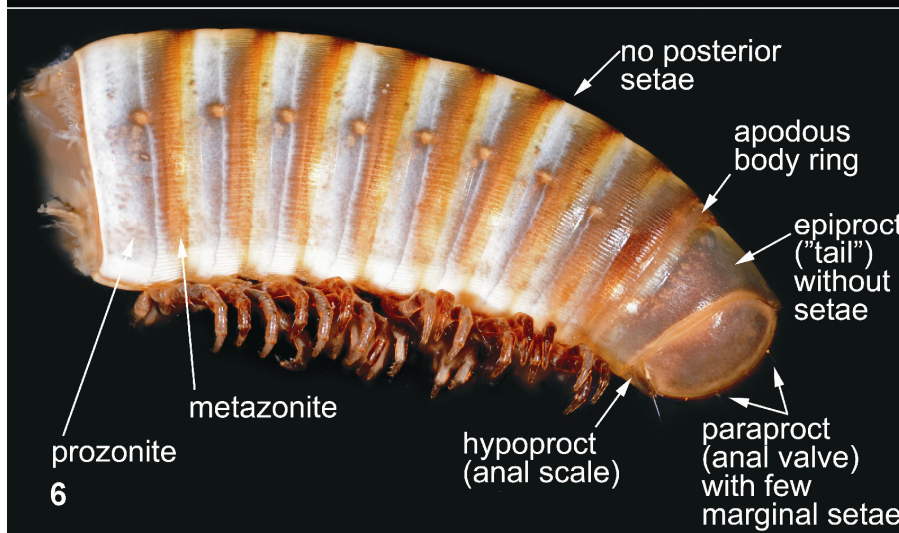
Fig. 1-3. *Blaniulus dollfusi*: 1. Female habitus lateral. 2. Male anterior part lateral. 3. Male posterior part lateral.



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Fig. 4. *Blaniulus dollfusi* male, gnathochilarium, ventral. Fig. 5-6. *Cylindroiulus sanctimichaelis*, macho: 5. Anterior part lateral. 6. Posterior part lateral

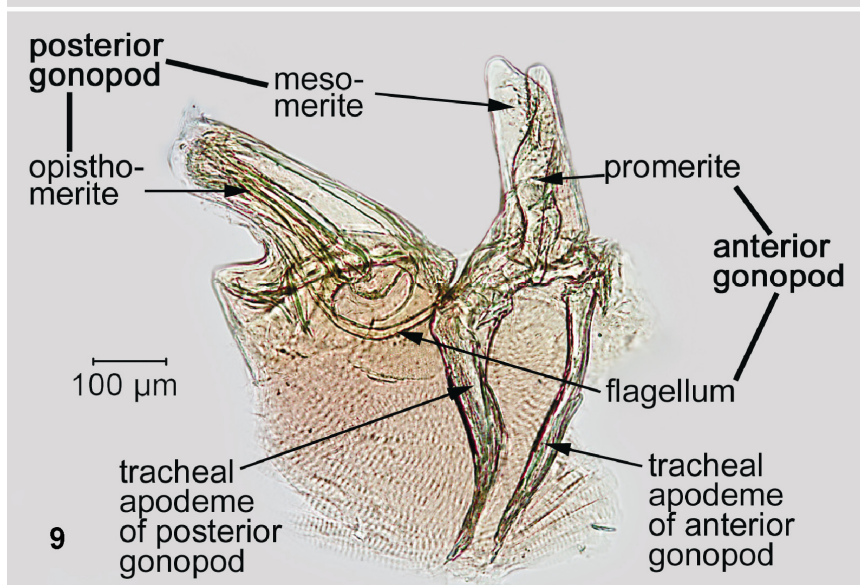
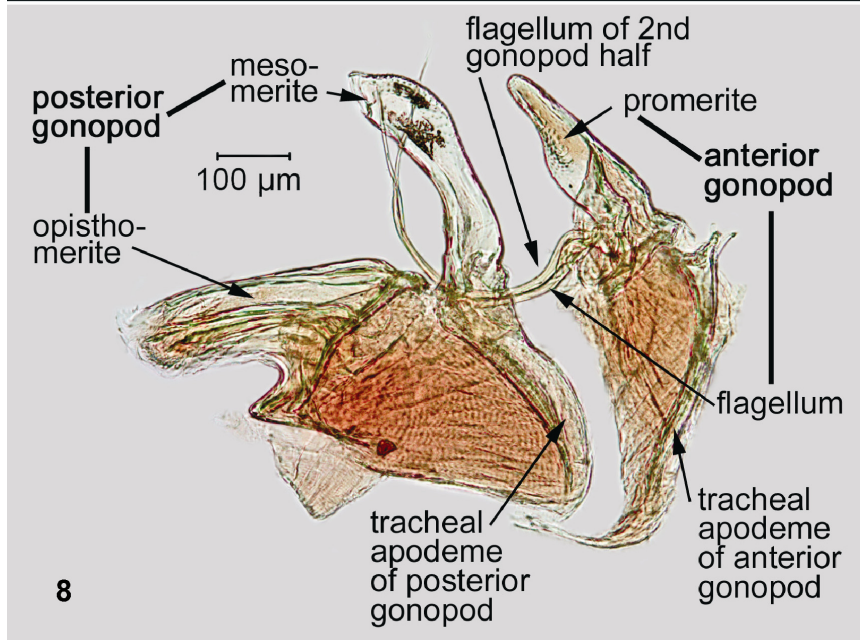
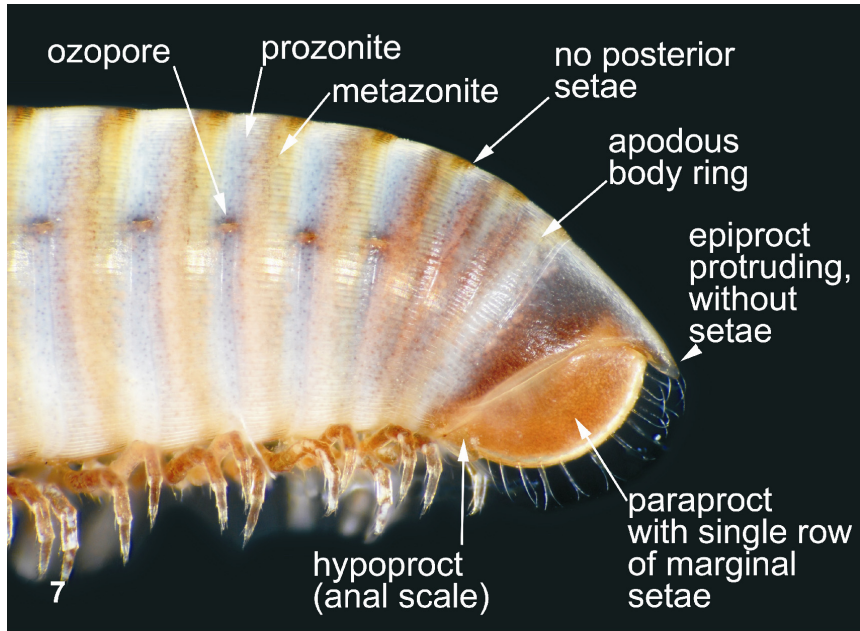


Fig. 7. *Cylindroiulus chalandei* male, posterior part, lateral. Fig. 8-9. *Cylindroiulus franzi*: 8. Gonopod-half dismembered mesal view. 9. Gonopod-half in natural conformation mesal.

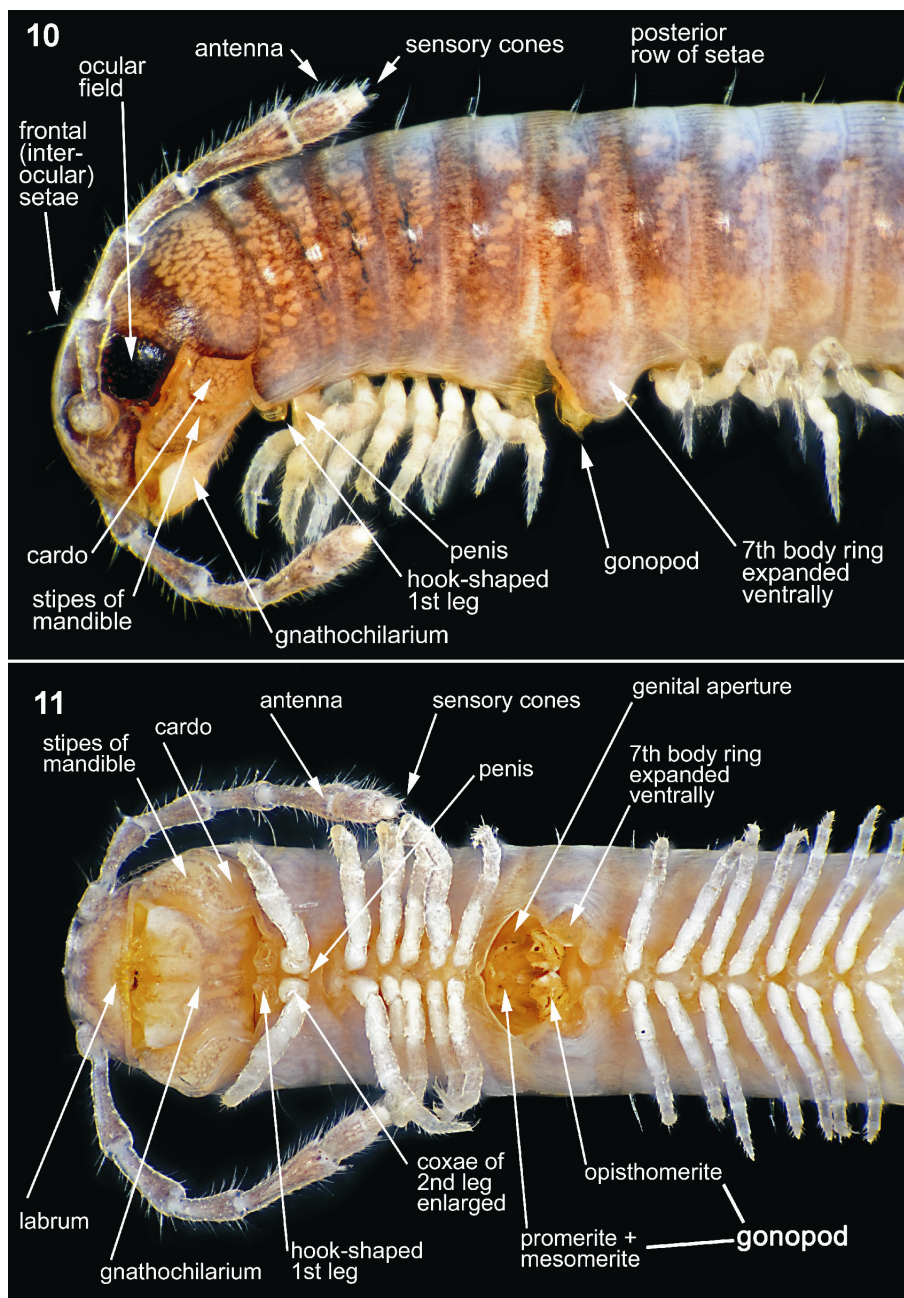


Fig. 10-11. *Leptoiulus* sp. nov. male anterior: 10. Lateral view. 11. Ventral view.

1.3. Distribution

Julida occur naturally only in the Northern Hemisphere (Holarctic distribution), where they are a dominant element of the millipede fauna, reaching south of the Tropic of Cancer only in SE Asia and the Cape Verde Islands (Shelley & Golovatch, 2011). In the Southern Hemisphere they are replaced by the other, Gondwanan members of the superorder Juliformia, the Spirostreptida and Spirobolida.

1.4. importance for science and applied research

Together with the other Juliformia, Julida are important fragmenters of leaf litter. Because they cannot digest the litter efficiently, they eat large amounts, about 5-50% of their weight per day (Dunger, 1983), and produce a huge amount of faeces, which they transport into deeper soil layers. Together with earthworms they are of great importance for soil fecundity. In some sandy soils, poor in nutrients and humidity, julidans completely replace earthworms and are the only humus creators among the macrofauna (Kubienna, 1955).

A few species, such as *Blaniulus guttulatus*, can also become pests in vegetable and fruit horticulture (Hopkin & Read, 1992).

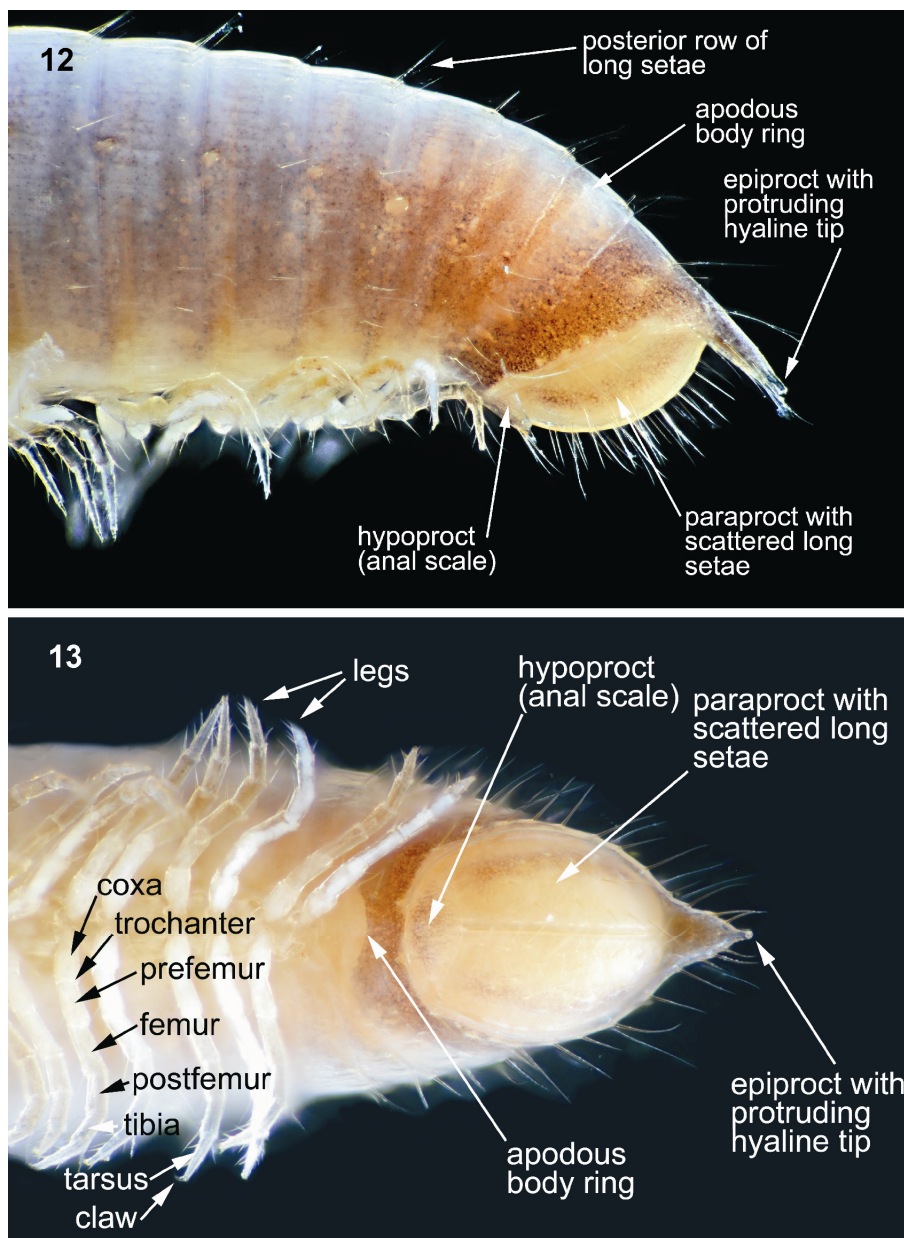


Fig. 12-13. *Leptoiulus* sp. nov. macho, posterior part: 12. Lateral view. 13. Ventral view.

1.5. Endangered species

No endangered Julida are known in the Iberian Peninsula and Macaronesia, but it is likely that some species, especially the endemic species of Macaronesia, are threatened due to the small areas they occupy.

1.6. Invasive species

In recent decades Julida have been introduced to several countries, especially in the Southern Hemisphere where they sometimes become pests, as with the Iberian *Ommatoiulus moreleti* in Australia (Baker, 1978).

1.7. Characters for separating the families

As in other millipede orders the specific structure of the gonopods, the secondary copulatory organs of the males, is one of the main criteria for separating families. In Julida both legpairs of the 7th body ring are transformed to gonopods. The anterior pair (anterior gonopods) usually form protective peltogonopods, while the posterior pair (posterior gonopods) are the organs of sperm transfer. In contrast to other millipede orders, non-gonopodial characters are also important in the higher classification of Julida, namely the structures of the first, second and seventh legpair of males, the penes, the metazonal striation and the structure of the mouthparts (Enghoff, 1991).

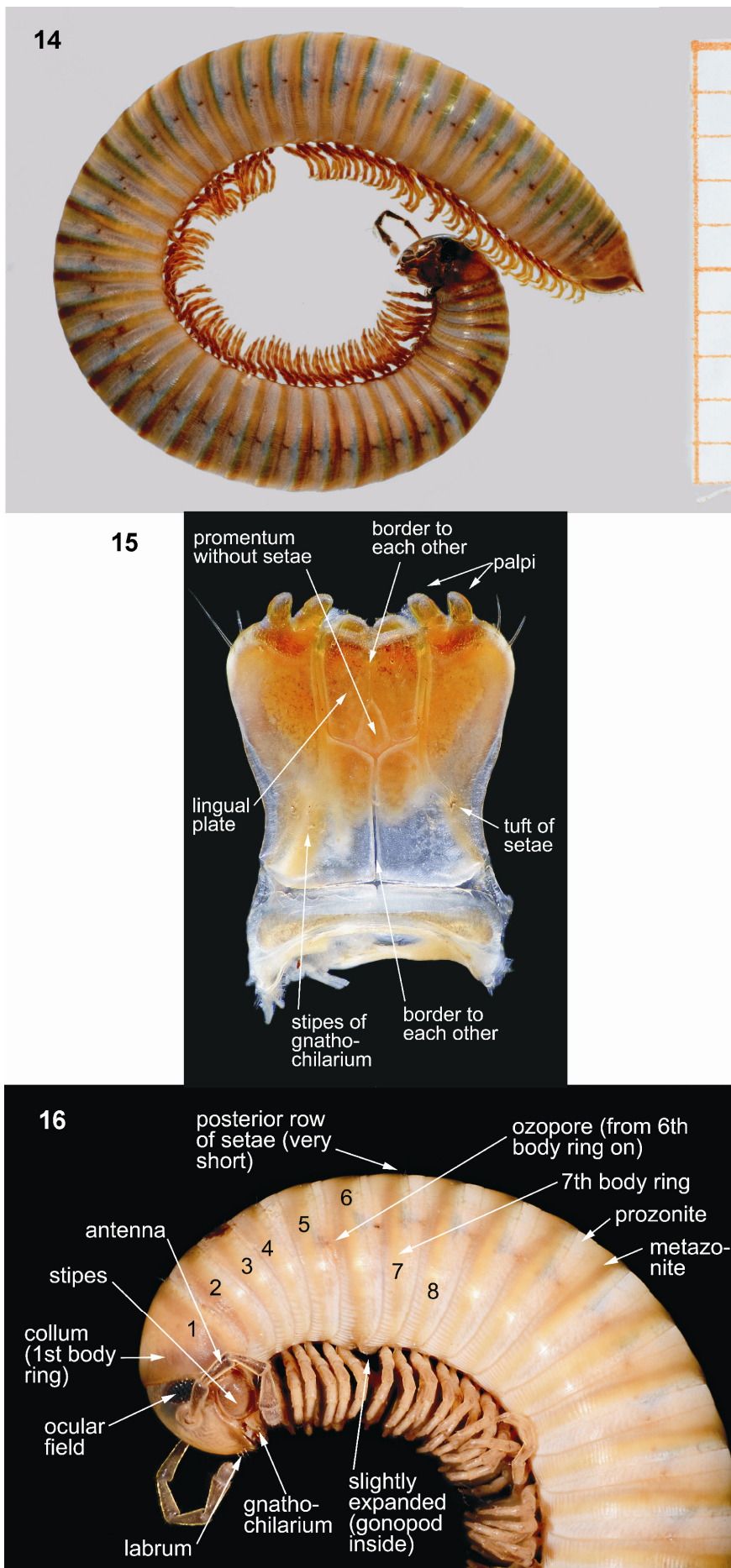


Fig. 14-16. *Ommatoiulus inconspicuus* macho: **14.** Habitus, lateral. **15.** Gnathochilarium, ventral. **16.** Anterior part lateral.

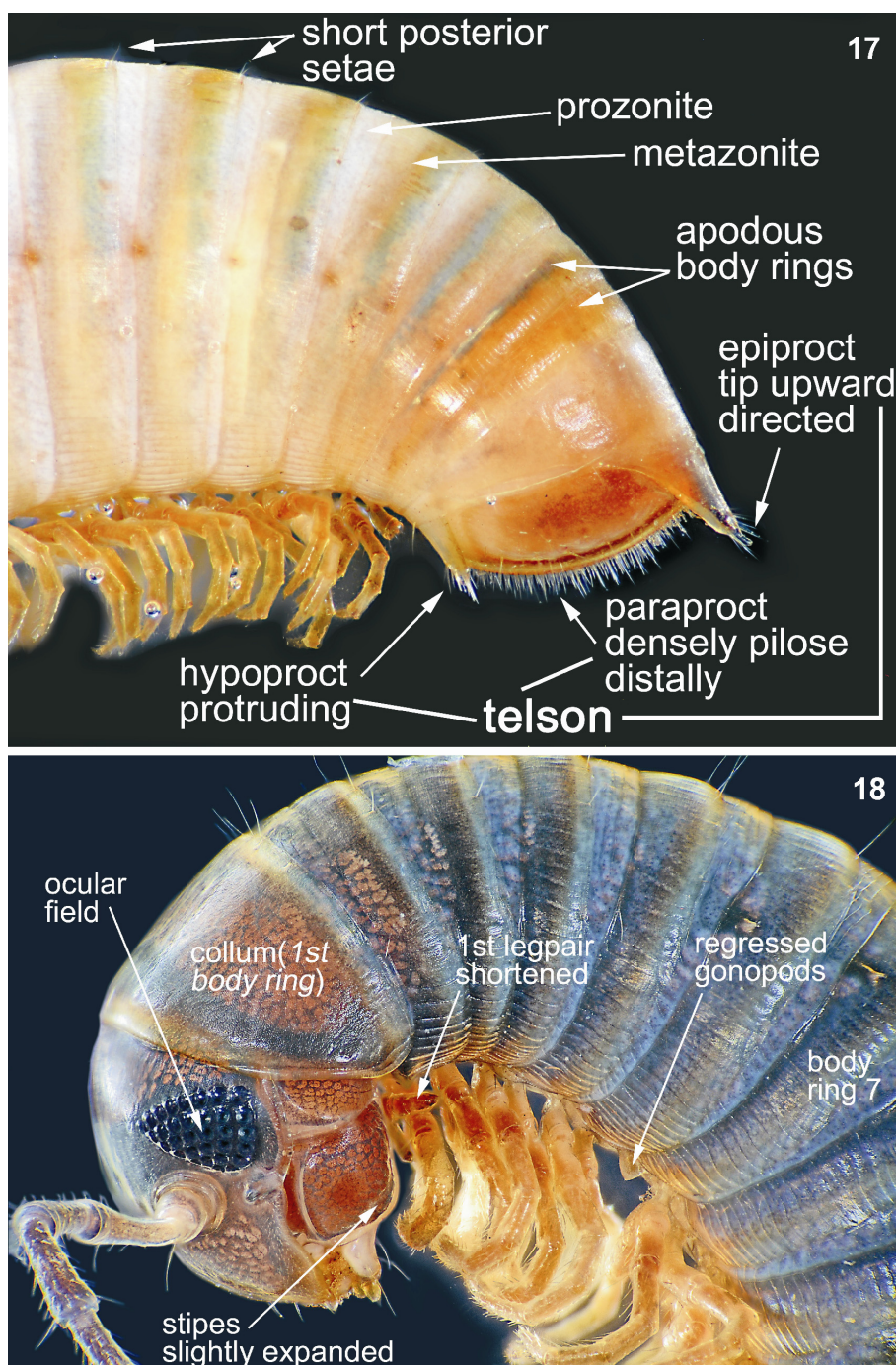


Fig. 17. *Ommatoiulus inconspicuus* male, posterior part, lateral. Fig. 18. *Tachypodoiulus niger* male, anterior part, lateral.

The four families occurring in the Iberian Peninsula can be easily separated by their gonopod confirmation and general shape:

- Members of the family **Blaniulidae** are slender, with a length-width ratio of about 20:1 to 30:1. The gonopods are completely outside the 7th body ring and posteriorly directed. The anterior gonopods laterally have one-segmented rudiments of telopodites, often with distal setae. The posterior gonopods are long and slender.

- The **Julidae** are stockier, with a length-width ratio of about 10:1 to 14:1, although a few species of Blaniulidae and Julidae overlap in body proportions. The anterior part of the body ring, the prozona, is separated from the posterior part, the metazona, by a distinct suture. Longitudinal striae occur all around the ring. In most species the gonopods are completely retracted inside the body, so studying them requires laborious preparation. The indication of their presence is a gap of legs in the 7th body ring combined with a ventral cavity. In immature males the ventral side of ring 7 is closed. Although showing a high variability between species the gonopods are of characteristic construction. The anterior gonopod, called the

promerite, and a part of the posterior gonopod, called the mesomerite, often form a pair of pincers which help the female evert her vulvae during pairing (Haacker & Fuchs, 1970). The remainder of the posterior gonopod is called the opisthomerite. It is the only part directly involved in sperm transfer. A part of the opisthomerite, the solenomerite, carries a sperm canal, which opens apically. Parallel to the sperm canal there is a groove guiding a flagellum, which is of anterior gonopodial origin. In some genera and tribes the flagellum is secondarily missing.

- The **Nemasomatidae** are somewhat intermediate between the above two families. The gonopods hang free as in blaniulids, but have flagellae on the anterior gonopods as in julids. The posterior gonopods are stout and not flagelloid as in blaniulids, but nemasomatids do not build a mesomerite as in julids. The length-width ratio is intermediate. In both Nemasomatidae and Blaniulidae the preanal ring (telson) is never produced into a caudal projection, there is no definite suture between pro- and metazona and longitudinal striae occur only in the ventral half of the body rings below the ozopores.

- The **Trichoblaniulidae** are characterised by an extensive metazonal pilosity all over the metazona and not only in a posterior row.

2. Systematics of the group

According to Enghoff (1981, 1991) the Julida may be split into five superfamilies:

- Parajuloidea, with enlarged and thickened first legpair and enlarged and soft promentum in males.
- Paeromopoidea, with special development of gonopods and first legpair.
- Blaniuloidea, with flattened setae but no adhesive pads in male anterior legs.
- Nemasomatoidea, with sterna secondarily separate from pleurotergites, adhesive pads in male anterior legs and lamellae linguales separated by the promentum (as in Blaniuloidea and Paeromopoidea).
- Juloidea, with the gnathochilarium containing a short promentum that does not separate the lamellae linguales.

Due to this special character of the gnathochilarium, Juloidea can be easily distinguished from all other Julida, which possess a long promentum which separates the lamellae linguales.

Only members of the last three superfamilies are present in the Iberian Peninsula.

Table I: Families and important genera of Julida occurring in the Iberian Peninsula and Macaronesia with species numbers (Azo: Azores, BAL: Balearic Islands, Can: Canary Islands, MIS: Madeira and Selvages, Pen: Iberian Peninsula). Endemic species in brackets. Sources: Canary Islands: Arndt et al (2008)

Family	PEN		BAL		CAN		AZO		MIS	
	Sp.	End	Sp.	End	Sp.	End	Sp.	End	Sp.	End
Blaniulidae excl. <i>Acipes</i>	10	4	2	–	5	–	4	–	4	–
<i>Acipes</i>	4	4	–	–	1	1	–	–	6	6
Nemasomatidae	1	1	1	–	1	1	–	–	–	–
Trichoblaniulidae	1	1	–	–	–	–	–	–	–	–
<i>Cylindroiulus</i>	23	13	–	–	4	1	6	–	35	31
<i>Dolichoiulus</i>	2	2	–	–	51	50	–	–	–	–
<i>Mesoiulus</i>	6	6	–	–	–	–	–	–	–	–
<i>Ommatoiulus</i>	37	30	1	–	1	–	1	–	1	–
Others Julidae	12	3	3	–	2	–	2	–	3	–

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

The Julida are the third largest order of millipedes, currently comprising more than 1.300 described species (Brewer *et al.*, 2012) and 15 families (Enghoff, 1991).

In the Iberian Peninsula members of the families Blaniulidae, Julidae, Nemasomatidae and Trichoblaniulidae can be found. While the Azores are without an indigenous julidan fauna (Enghoff, 2005; after its discovery on the Iberian mainland *Cylindroiulus dahli* can no longer be regarded as being endemic to the Azores), the other biogeographic regions all have a characteristic julidan fauna. It is the genus *Ommatoiulus* which dominates in and has its diversity center in the Iberian Peninsula. While a high number of undescribed species was already expected among diplopod specialists, the diversity exploded for Andalusia after the work of Akkari & Enghoff (2012). The authors recorded 19 species in this part of Spain, of which 10 were new to science. One might expect another wave of species when the other, poorly sampled parts of the Iberian Peninsula are surveyed more intensively. Perhaps less than half of the existing species are described.

It seems remarkable that the Balearic Islands lack an endemic julidan fauna. Mallorca has endemic Amphibia, which suggests there could also be an old, endemic millipede fauna. The large islands of the Tyrrhenian Sea (Corsica, Sardinia, Elba) have endemic millipedes, but for the Balearic Islands the presence of endemic species has only recently been confirmed for Chordeumatida (Mauriès, 2013). Possibly other, endemic faunistic elements have not yet been detected.

While members of other millipede orders are low in species numbers and especially in indigenous species, the millipede inhabitants of the Macaronesian Islands are mainly Julida, with both island groups, Madeira and the Canary Islands, each dominated by one genus that has undergone an adaptive radiation.

In Madeira it is *Cylindroiulus* and in the Canary Islands *Dolichoziulus*. Both genera also have endemic species on the other island group, but it is remarkable that there are only a few species. The genus *Acipes* has six endemic species on Madeira, and recent sampling has revealed that the Iberian mainland harbours an undescribed diversity of *Acipes* species.

Cylindroiulus is also present with several endemic species in the Iberian mainland as well as in northwestern Africa, where the ancestor(s) of the Madeiran fauna probably come from. As with other Iberian millipedes the discovery of most of the endemic species was very recent.

Table II. Checklist of Julida occurring in the Iberian Peninsula and Macaronesia.

AZO: Azores, BAL: Balearic Islands, CAN: Canary Islands, MIS: Madeira and Selvages, PEN: Iberian Peninsula. E = endemic. I = Introduced. ● = present.

Family / sp.	PEN	BAL	CAN	AZO	MIS
Blaniulidae:					
<i>Acipes andalusius</i> Enghoff & Mauriès, 1999	● E				
<i>Acipes atlanticus</i> Attems, 1937					● E
<i>Acipes bifilum</i> Enghoff & Reboleira, 2013	● E				
<i>Acipes continentalis</i> Enghoff, 1986	● E				
<i>Acipes decolor</i> Enghoff, 1983					● E
<i>Acipes lateralis</i> Enghoff, 1983					● E
<i>Acipes machadoi</i> Enghoff & Reboleira, 2013	● E				
<i>Acipes portosantoensis</i> Enghoff, 1983					● E
<i>Acipes serratus</i> Enghoff, 1983					● E
<i>Acipes waldeni</i> Enghoff, 1983					● E
<i>Acipes franzi</i> (Loksa, 1967)			● E		
<i>Blaniulus guttulatus</i> (Fabricius, 1798)			● I	● I	● I
<i>Blaniulus dollfusi</i> Brölemann, 1894	●				
<i>Blaniulus lorifer</i> (Brölemann, 1921)	●				
<i>Blaniulus orientalis</i> Brölemann, 1921	●				
<i>Blaniulus troglodites</i> Brölemann, 1898	●				
<i>Choneiulus palmatus</i> (Nemec, 1895)			● I	● I	● I
<i>Choneiulus subterraneus</i> (Silvestri, 1903)			●		
<i>Iberoiulus cavernicola</i> Ceuca, 1967	● E				
<i>Nopoiulus kochii</i> (Gervais, 1847)	●	●	● I	● I	● I
<i>Orphanoiulus religious</i> (Silvestri, 1903)		●			
<i>Proteroiulus broelemanni</i> Lohmander, 1925	●				
<i>Proteroiulus fuscus</i> (Am Stein, 1857)			● I	● I	● I
<i>Proteroiulus hispanus</i> Schubart, 1959	● E				
<i>Tarracoblaniulus lagari</i> Mauriès & Vicente, 1977	● E				
<i>Tarracoblaniulus phantasmanus</i> Enghoff, Serra & Martínez, 2009	● E				
Nemasomatidae					
<i>Thalassisobates almeriensis</i> Enghoff, 2013	● E				
<i>Thalassisobates emesesensis</i> Enghoff, 2013			● E		
<i>Thalassisobates littoralis</i> (Silvestri, 1903)		●			
Trichoblaniulidae					
<i>Trichoblaniulus tarraconensis</i> Mauriès & Vicente, 1977	● E				
Julidae					
<i>Brachyiulus lusitanus</i> Verhoeff, 1898	●	●	● I	● I	● I
<i>Brachyiulus pusillus</i> (Leach, 1814)	●		● I	● I	● I
<i>Cylindroiulus angliclectus</i> Read, 2007	● E				
<i>Cylindroiulus attenuatus</i> Enghoff, 1982					● E
<i>Cylindroiulus boreoiberius</i> Read, 2007	● E				
<i>Cylindroiulus brachyiuloides</i> Enghoff, 1982					● E
<i>Cylindroiulus britannicus</i> (Verhoeff, 1891)	●		● I	● I	● I
<i>Cylindroiulus caeruleocinctus</i> (Wood, 1864)	●				
<i>Cylindroiulus caramujensis</i> Lohmander, 1955					● E
<i>Cylindroiulus chalandei</i> (Ribaut, 1904)	●				
<i>Cylindroiulus cristagalli</i> Enghoff, 1982					● E
<i>Cylindroiulus dahlia</i> Demange, 1970	●			● I	
<i>Cylindroiulus digitus</i> Enghoff, 1982					● E
<i>Cylindroiulus disjunctus</i> Read, 1989			● E		
<i>Cylindroiulus exiguus</i> Enghoff, 1982					● E
<i>Cylindroiulus fenestratus</i> Read, 1989	● E				
<i>Cylindroiulus fimbriatus</i> Enghoff, 1982					● E
<i>Cylindroiulus finitimus</i> (Ribaut, 1905)	● E				
<i>Cylindroiulus franzi</i> Attems, 1952	● E				
<i>Cylindroiulus gemellus</i> Enghoff, 1982					● E
<i>Cylindroiulus gregoryi</i> Read, 2007	● E				
<i>Cylindroiulus hirticauda</i> Enghoff, 1982					● E

Family / sp.	PEN	BAL	CAN	AZO	MIS
<i>Cylindroiulus hispanicus</i> Ceuca, 1974	• E				
<i>Cylindroiulus ibericus</i> Brölemann, 1913	• E				
<i>Cylindroiulus iluronensis</i> Brölemann, 1912	•				
<i>Cylindroiulus infernalis</i> Lohmander, 1955					• E
<i>Cylindroiulus insolidus</i> Lohmander, 1955					• E
<i>Cylindroiulus julesvernei</i> Reboleira & Enghoff, 2014					• E
<i>Cylindroiulus julipes</i> Enghoff, 1982					• E
<i>Cylindroiulus kappa</i> Enghoff, 1982					• E
<i>Cylindroiulus latestriatus</i> (Curtis, 1845)	•		•	•	•
<i>Cylindroiulus laurisilvae</i> Enghoff, 1982					• E
<i>Cylindroiulus londinensis</i> (Leach, 1814)	•				
<i>Cylindroiulus lundbladi</i> Lohmander, 1955					• E
<i>Cylindroiulus madeirae</i> Attems, 1937				•	• E
<i>Cylindroiulus numerosus</i> Enghoff, 1982					• E
<i>Cylindroiulus obscurior</i> Enghoff, 1982					• E
<i>Cylindroiulus oromii</i> Reboleira & Enghoff, 2014					• E
<i>Cylindroiulus pallidior</i> Enghoff, 1982					• E
<i>Cylindroiulus perforatus</i> Verhoeff, 1905	• E			•	
<i>Cylindroiulus propinquus</i> (Porat, 1870)	• E			•	•
<i>Cylindroiulus punctatus</i> (Leach, 1815)	•				
<i>Cylindroiulus quadratistipes</i> Enghoff, 1982					• E
<i>Cylindroiulus rabacalensis</i> Lohmander, 1955					• E
<i>Cylindroiulus sagittarius</i> (Brölemann, 1897)	•				
<i>Cylindroiulus sanctimichaelis</i> Attems, 1927	• E				
<i>Cylindroiulus simplex</i> Ceuca, 1974	• E				
<i>Cylindroiulus speluncaris</i> Lohmander, 1955					• E
<i>Cylindroiulus transmarinus</i> Enghoff, 1982					• E
<i>Cylindroiulus truncorum</i> (Sivestri, 1896)	•		•		•
<i>Cylindroiulus uroxiphos</i> Enghoff, 1982					• E
<i>Cylindroiulus velatus</i> Enghoff, 1982					• E
<i>Cylindroiulus ventaneana</i> Read, 2007	• E				
<i>Cylindroiulus waldeni</i> Read, 1988					• E
<i>Cylindroiulus xynon</i> Read, 1988					• E
<i>Cylindroiulus ynnox</i> Read, 1988					• E
<i>Cylindroiulus zarcoi</i> Read, 1988					• E
<i>Dolichoïulus alluaudi</i> (Brölemann, 1901)			• E		
<i>Dolichoïulus altitenerife</i> Enghoff, 1992			• E		
<i>Dolichoïulus aquasilvae</i> Enghoff, 1992			• E		
<i>Dolichoïulus architheca</i> Enghoff, 1992			• E		
<i>Dolichoïulus axeli</i> Enghoff, 1992			• E		
<i>Dolichoïulus baezi</i> Enghoff, 1992			• E		
<i>Dolichoïulus blancatypa</i> (Enghoff, 1992)			• E		
<i>Dolichoïulus canariensis</i> (Pocock, 1893)			• E		
<i>Dolichoïulus carolineae</i> Enghoff, 1992			• E		
<i>Dolichoïulus chioensis</i> Enghoff, 1992			• E		
<i>Dolichoïulus dendromystax</i> Enghoff, 1992			• E		
<i>Dolichoïulus dubiosus</i> Enghoff, 1992			• E		
<i>Dolichoïulus eumadeirae</i> Enghoff, 1992					• E
<i>Dolichoïulus fjellbergi</i> Enghoff, 1992			• E		
<i>Dolichoïulus fuerteventurae</i> Enghoff, 1992			• E		
<i>Dolichoïulus gara</i> Enghoff, 1992			• E		
<i>Dolichoïulus heliophilus</i> Enghoff, 1992			• E		
<i>Dolichoïulus hercules</i> (Schubart, 1960)	•				
<i>Dolichoïulus hyaena</i> Enghoff, 1992			• E		
<i>Dolichoïulus ingeare</i> Enghoff, 1992			• E		
<i>Dolichoïulus insularis</i> (Brölemann, 1901)			• E		
<i>Dolichoïulus jandiensis</i> Enghoff, 1992			• E		
<i>Dolichoïulus jonay</i> Enghoff, 1992			• E		
<i>Dolichoïulus kraepelinorum</i> (Latzel, 1895)			• E		
<i>Dolichoïulus labradae</i> Enghoff, 1992			• E		
<i>Dolichoïulus lasiurus</i> Enghoff, 1992			• E		
<i>Dolichoïulus longunguis</i> Enghoff, 2012			• E		
<i>Dolichoïulus martini</i> Enghoff, 1992			• E		
<i>Dolichoïulus mystax</i> (Brölemann, 1901)			• E		
<i>Dolichoïulus nemasoma</i> Enghoff, 1992			• E		
<i>Dolichoïulus madeiranus</i> (Mauriès, 1970)					• E

Family / sp.	PEN	BAL	CAN	AZO	MIS
<i>Dolichoïulus oromi</i> Enghoff, 2012			• E		
<i>Dolichoïulus oskari</i> Enghoff, 1992			• E		
<i>Dolichoïulus parcestriatus</i> Enghoff, 1992			• E		
<i>Dolichoïulus praesenilis</i> Enghoff, 1992			• E		
<i>Dolichoïulus quasimystax</i> Enghoff, 1992			• E		
<i>Dolichoïulus rectangulus</i> Enghoff, 1992			• E		
<i>Dolichoïulus salvagicus</i> (Latzel, 1895)					• E
<i>Dolichoïulus sansebastianus</i> (Attems, 1911)			• E		
<i>Dolichoïulus senilis</i> Attems, 1911			• E		
<i>Dolichoïulus silvahierro</i> Enghoff, 1992			• E		
<i>Dolichoïulus silvapalma</i> Enghoff, 1992			• E		
<i>Dolichoïulus tiendaris</i> (Attems, 1911)			• E		
<i>Dolichoïulus typhlocanaria</i> Enghoff, 2012			• E		
<i>Dolichoïulus troglöhierro</i> Enghoff, 1992			• E		
<i>Dolichoïulus typhlops</i> Ceuca, 1973	• E		• I		
<i>Dolichoïulus ultimus</i> Enghoff, 1992			• E		
<i>Dolichoïulus variabilis</i> Enghoff, 1992			• E		
<i>Dolichoïulus vosseleri</i> (Verhoeff, 1901)			• E		
<i>Dolichoïulus wunderlichi</i> Enghoff, 1992			• E		
<i>Dolichoïulus xerohierro</i> Enghoff, 1992			• E		
<i>Dolichoïulus xeropalma</i> Enghoff, 1992			• E		
<i>Dolichoïulus xylomystax</i> Enghoff, 1992			• E		
<i>Dolichoïulus ypsilon</i> Enghoff, 1992			• E		
<i>Dolichoïulus zygodon</i> Enghoff, 1992			• E		
<i>Haplopodoïulus spathifer</i> (Brölemann, 1897)	•				
<i>Leptoiulus belgicus</i> (Latzel, 1884)	•				
<i>Leptoiulus demangei</i> Schubart, 1962	•				
<i>Leptoiulus piceus</i> (Risso, 1826)					• I
<i>Leptoiulus remyi</i> Schubart, 1962	•				
<i>Leptoiulus umbratilis</i> (Ribaut, 1905)	•				
<i>Leptoiulus vieirae</i> (Verhoeff, 1901)	• E				
<i>Mesoiulus cavernarum</i> (Verhoeff, 1938)	• E				
<i>Mesoiulus derouteae</i> Mauriès, 1971	• E				
<i>Mesoiulus drescoi</i> Mauriès, 1971	• E				
<i>Mesoiulus henroti</i> Mauriès, 1971	• E				
<i>Mesoiulus rusticanus</i> Mauriès & Vicente, 1977	• E				
<i>Mesoiulus stammeri</i> (Verhoeff, 1938)	• E				
<i>Ommatoiulus albolineatus</i> (Lucas, 1845)	•				
<i>Ommatoiulus andalusius</i> (Attems, 1927)	• E				
<i>Ommatoiulus armatus</i> (Verhoeff, 1910)	• E				
<i>Ommatoiulus bavayi</i> (Brölemann, 1897)	• E				
<i>Ommatoiulus bailey</i> Akkari & Enghoff, 2012	• E				
<i>Ommatoiulus bipartitus</i> (Verhoeff, 1910)	• E				
<i>Ommatoiulus cervinus</i> (Verhoeff, 1910)	• E				
<i>Ommatoiulus cingulatus</i> (Attems, 1927)	• E				
<i>Ommatoiulus clavigerus</i> (Verhoeff, 1921)	• E				
<i>Ommatoiulus cornigerus</i> (Verhoeff, 1921)	• E				
<i>Ommatoiulus corunnensis</i> (Verhoeff, 1910)	• E				
<i>Ommatoiulus demangei</i> Vicente & Rodriguez, 1992	• E				
<i>Ommatoiulus diplurus</i> (Attems, 1903)	• E				
<i>Ommatoiulus dorsovittatus</i> (Verhoeff, 1893)	• E				
<i>Ommatoiulus fuentei</i> (Brölemann, 1920)	• E				
<i>Ommatoiulus haackeri</i> Mauriès, 1969	•				
<i>Ommatoiulus hoffmani</i> Akkari & Enghoff, 2012	• E				
<i>Ommatoiulus ibericus</i> Ceuca, 1974	• E				
<i>Ommatoiulus ilicis</i> (Brölemann, 1896)	•				
<i>Ommatoiulus inconspicuus</i> (L. Koch, 1881)	•	•			
<i>Ommatoiulus jaenensis</i> Akkari & Enghoff, 2012	• E				
<i>Ommatoiulus kimei</i> Akkari & Enghoff, 2012	• E				
<i>Ommatoiulus lusitanus</i> (Verhoeff, 1895)	• E				
<i>Ommatoiulus martensi</i> Mauriès, 1969	• E				
<i>Ommatoiulus moreletii</i> (Lucas, 1860)	•		• I	• I	• I
<i>Ommatoiulus navasi</i> (Brölemann, 1918)	• E				
<i>Ommatoiulus niger</i> (Attems, 1952)	• E				
<i>Ommatoiulus oliveirae</i> (Verhoeff, 1893)	• E				
<i>Ommatoiulus porathi</i> (Verhoeff, 1893)	• E				

Family / sp.	PEN	BAL	CAN	AZO	MIS
<i>Ommatoiulus pseudoflagellatus</i> Akkari & Enghoff, 2012	• E				
<i>Ommatoiulus recueroi</i> Akkari & Enghoff, 2012	• E				
<i>Ommatoiulus reipi</i> Akkari & Enghoff, 2012	• E				
<i>Ommatoiulus robustus</i> Ceuca, 1974	• E				
<i>Ommatoiulus rutilans</i> (C. L. Koch, 1847)	•				
<i>Ommatoiulus sabinarensis</i> Akkari, Mauriès & Enghoff, 2012	• E				
<i>Ommatoiulus sabulosus</i> (Linnaeus, 1758)	•				
<i>Ommatoiulus schubarti</i> Akkari & Enghoff, 2012	• E				
<i>Ommatoiulus terulensis</i> Ceuca, 1974	• E				
<i>Ommatoiulus tridentifer</i> Ceuca, 1974	• E				
<i>Ophiulus germanicus</i> (Verhoeff, 1896)	•				
<i>Ophiulus targionii</i> Silvestri, 1898		•			
<i>Pachyiulus flavipes</i> (C.L. Koch, 1847)		•			
<i>Syniulus bolivari</i> (Ceuca, 1973)	• E				
<i>Syniulus lagari</i> (Ceuca, 1973)	• E				
<i>Tachypodoiulus niger</i> (Leach, 1814)	•				

4. Current state of knowledge of the group

As with other millipede orders the Julida are an understudied group within most of their range. While the faunas of western, central and northern Europe, namely the British Isles (Blower, 1985), France (Demange, 1981), Germany (Schubart, 1934), Poland (Stojalowska, 1961) and Scandinavia (Andersson *et al.*, 2005) are well known, there are no handbooks for any country in southern Europe or North America, not to mention other parts of the world, e.g. northern Asia. Estimates are difficult to give. Hoffman (1980) stated about 80.000 millipede species globally, meaning that with more than 12.000 described species (Brewer *et al.*, 2012) only 15% of the world fauna is already known. Brewer *et al.* (2012) disbelieve this high estimate but propose a value between 13.000 and 21.000 based on estimation factors given in this work. Nevertheless it seems more likely that the number of undescribed species exceeds the described, as the sum of described species until a given year has not yet reached a plateau.

Although there are no complete treatments of the Julidan fauna of the Iberian Peninsula, knowledge of the group expanded in the 19th century when Lucas (1860), Koch (1882), Verhoeff (1892, 1893a, 1893b, 1893c, 1895, 1898), Brölemann (1896, 1897a) and Pocock (1893) began their studies. In the first half of the 20th century Verhoeff (1901, 1905, 1910, 1921, 1936, 1938) Attems (1903, 1927, 1952), Brölemann (1901, 1918, 1920, 1923) and Machado (1946, 1953) extended our knowledge of Julidan millipedes. Progress continued in the second half of the 20th century through the treatments of Ceuca (1967, 1973, 1974), Schubart (1959), Demange (1961) and Mauriès (1969, 1971). With Maria Christina Vicente, Spain got its first local specialist, who published several studies (Mauriès & Vicente, 1976, 1977a, 1977b; Vicente, 1985; Vicente & Ascaso, 1990; Vicente & Rodríguez, 1992; Vicente & Serra, 1992) before her early death.

After some other treatments in recent decades (Enghoff, 1986; Enghoff & Mauriès, 1999; Read, 1989b) another wave of studies started in the new millennium (Enghoff, 2013; Enghoff *et al.*, 2009; Enghoff & Reboleira, 2013; Read, 2007) culminating in the explosion of species described by Akkari & Enghoff (2012).

The huge endemic Julidan faunas of the Macaronesian Islands were incompletely known up to the last quarter of the 20th century (Porat, 1870; Latzel, 1895; Verhoeff, 1900; Brölemann, 1897b, 1901; Attems, 1911, 1937; Lohmander, 1955; Loksa, 1967; Mauriès, 1970; Demange, 1970), when Enghoff (1982) started his extensive studies in them with the genus *Cylindroiulus* on Madeira, followed by treatments of the genera *Acipes* (Enghoff, 1983a) and *Dolichoulus* (Enghoff, 1992a), all the size of small books. Since these publications, followed by further descriptions (Read, 1989a; Enghoff, 2012; Reboleira & Enghoff, 2014), papers on general aspects of adaptive radiation (Enghoff, 1983b; Enghoff & Baez, 1993; Read, 1988; Vicente & Enghoff, 1999) as well as a key to the Macaronesian millipede fauna (Arndt *et al.*, 2008), the Julida of Macaronesia can be regarded as comparatively well-known.

As the Azores are distant oceanic islands it seems very probable, that they do not contain an indigenous millipede fauna. Nevertheless there might be the possibility, that the indigenous fauna was not yet detected, as it often happens, that introduced species replace indigenous island faunas. Only in remote, undisturbed areas the relict fauna is able to survive.

This might be the case in the Balearic Islands, in which an indigenous millipede fauna was overlooked until Mauriès (2013) discovered two *Ceratosphys* species, while earlier studies (Koch, 1882; Verhoeff, 1924; Demange, 1961; Mauriès & Vicente, 1976, see also Frederiksen *et al.*, 2012 for the identity of the *Pachyiulus* species) recorded only widespread or introduced species. There have been no systematic myriapodological surveys in the Balearic Islands, especially in the mountain karsts, where additional indigenous species might be expected. *Megaphyllum unilineatum* has been removed from the species list of the Balearic Islands because this eastern European species is not present in recent collections and has probably not established.

5. Main available sources of information

5.1. General sources on taxonomy and identification

During the first quarter of the 20th century specialists tried to summarise all available knowledge about Diplopoda. This started with Verhoeff's unfinished book on German Diplopoda (1911-1914), treating many aspects beside systematics. The summarizing effort was continued by Attems (1926) and Verhoeff (1926-1932). More than half a century later Hopkin & Read (1992) published an English treatment of general aspects of Diplopoda. Special treatments of the order Julida alone have never been produced. Diplopoda in general show a high degree of endemism. This has the advantage that only local or global taxonomic papers have to be checked, while treatments of local faunas even of nearby countries are not very helpful.

5.2. Keys to the families

A current key to the families of Julida is given by Enghoff (1991) which updates Enghoff (1981). Beside the keys in the old books of Attems (1926) and Verhoeff (1926-1932) the later treatment of Attems (1940) is noteworthy for the characterisation of subfamilies and tribes of the family Julidae.

5.3. Catalogs

Neither global nor local catalogs of Julida are available which cover the Iberian Peninsula and Macaronesia. A catalog exists only for the Nearctic fauna (Hoffman, 1999). There are two cooperating ongoing database projects by Petra Sierwald (*Millibase*) and Jörg Spelda (*SysMyr*, Spelda, 2006; Melzer *et al.*, 2011) with the aim for a global catalog but although providing information for the *Catalog of Life* (Spelda, 2007, <http://www.catalogueoflife.org/>) they have not yet reached a final state for the order Julida. The same can be said about Fauna Europaea (<http://www.faunaeur.org/>) which provides online information on European species.

6. Acknowledgement

I would like to thank Hans Reip (Jena, Germany) and Henrik Enghoff (Copenhagen, Denmark) for valuable comments on the manuscript. Both also provided important literature. Robert Mesibov (West Ulverstone, Tasmania, Australia) thankfully corrected the English of the manuscript and gave other valuable comments. Axel Schönhofer (Mainz, Germany) provided material of Iberian Julida. Ignacio Ribera (Spain) organized the translation of the manuscript into Spanish. My wife Ute accompanied me during the fieldwork and supported me in many ways.

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