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Revisão sistemática do gênero *Eucynortula*
Roewer, 1912 (Opiliones: Cosmetidae) e notas
sistemáticas sobre algumas espécies
relacionadas

Systematic review of the genus *Eucynortula*
Roewer, 1912 (Opiliones: Cosmetidae) and
systematic notes on some related species

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Resumo

O gênero *Eucynortula* Roewer, 1912 é revisado pela primeira vez com base na morfologia externa e da genitália masculina. Um enfoque conservativo foi utilizado para selecionar o grupo externo, considerando a correspondência morfológica e geográfica. A análise foi baseada numa matriz de 94 caracteres e 30 terminais pertencentes a duas famílias, Metasarcidae (uma espécie) e Cosmetidae (29 espécies, 10 gêneros). Os resultados mostraram *Eucynortula* parafiletico, sendo excluídas todas as espécies do gênero do clado, exceto a espécie tipo, *E. albipunctata*. Três gêneros foram sinonimizados com *Eucynortula*: *Cynortula* Roewer, 1912; *Cynortoperna* Roewer, 1947 and *Cynortetta* Roewer, 1947. As seguintes espécies foram transferidas para *Eucynortula* com base na diagnose proposta no presente trabalho: *E. albornata* **comb. nov.**, *E. annulata* **comb. nov.**, *E. albipustulata* **comb. nov.**, *E. analis* **comb. nov.** e *E. areolata* **comb. nov.**, *E. leucopyga* **comb. nov.**, *E. longipes* **comb. nov.**, *E. punctatolineata* **comb. nov.**, *E. punctitergum* **comb. nov.**; *E. pictipes* **comb. nov.** e *E. rugosa* **comb. nov.** As espécies *Cynortula cingulata* e *Cynortula brevipes* foram consideradas sinônimos júnior de *E. albipunctata*. A espécie *Eucynortula alboirrorata* foi mantida dentro do gênero por apresentar os caracteres diagnósticos. As demais espécies do gênero, *E. auropicta*, *E. metatarsalis*, *E. pentapunctata*, *E. bituberculata*, *E. lata*, *E. maculata*, *E. nannocornuta*, *E. puer*, *E. rugipes* e *E. ypsilon*, que não apresentaram os caracteres diagnósticos propostos, foram considerados *Incertae sedis* devido a que a evidencia revisada não permitiu estabelecer a sua identidade genérica. Além disso, a espécie *Eucynortula sexpunctata*, atualmente valida como sinônimo júnior de *E. nannocornuta*, foi revalidada e considerada *Incertae sedis*. As

espécies de *Cynortula* cuja identidade não foi resolvida, foram consideradas ***Incertae sedis***.

A espécie tipo de *Eucynorta*, *E. quadrimaculata* foi descrita e nova informação inédita sobre caracteres dimórficos foi incluída com o fim de aumentar o conhecimento sobre sua variação morfológica. *Cynorta liturata* foi encontrada sinônimo júnior de *E. quadripustulata* e *Eucynortula multilineata* foi transferida para *Eucynorta* com base na morfologia externa e dos genitais.

Finalmente, é proposta uma nova classificação para o gênero *Eucynortula* representado por treze espécies distribuídas em Norte de America do Sul e Central e é considerado como pertencente a subfamília Cynortinae.

Abstract

The genus *Eucynortula* Roewer, 1912 is reviewed for the first time based on a set of morphological characters considering external and genital morphology of males. A conservative approach was employed to select the outgroup, considering geographic and morphologic correspondence. The analysis was based on a matrix of 94 characters and 30 terminals from two families, Metasarcidae (one species) and Cosmetidae (29 species in 10 genera). Results showed a paraphyletic *Eucynortula* by the exclusion of all terminals of *Eucynortula* from the clade except the type species, *E. albipunctata*. Three genera were herein proposed as junior synonyms of *Eucynortula*: *Cynortula* Roewer, 1912; *Cynortoperna* Roewer, 1947 and *Cynortetta* Roewer, 1947. In addition, the following species were transferred to *Eucynortula* based on the diagnosis herein proposed: *E. albornata* **comb. nov.**, *E. annulata* **comb. nov.**, *E. albipustulata* **comb. nov.**, *E. analis* **comb. nov.** e *E. areolata* **comb. nov.**, *E. leucopyga* **comb. nov.**, *E. longipes* **comb. nov.**, *E. punctatolineata* **comb. nov.**, *E. punctitergum* **comb. nov.**; *E. pictipes* **comb. nov.** e *E. rugosa* **comb. nov.** The species *Cynortula cingulata* and *Cynortula brevipes* were considered junior synonyms of *E. albipunctata*. The species *E. alboirrorata* previously valid as *Eucynortula* presents the diagnostic characters, thus it was maintained. The remaining species of *Eucynortula*, *E. auropicta*, *E. metatarsalis*, *E. pentapunctata*, *E. bituberculata*, *E. lata*, *E. maculata*, *E. nannocornuta*, *E. puer*, *E. rugipes* and *E. ypsilon*, which do not present diagnostic characters of the genus were considered *Incertae sedis* because of evidence reviewed was inconclusive to determine their generic identity. Furthermore, the species *Eucynortula sexpunctata*, currently valid as a junior synonym of *E. nannocornuta*, was revalidated and considered *Incertae sedis*. The species of *Cynortula* whose identity was not clarified were considered *Incertae sedis*.

The type species of *Eucynorta*, *E. quadrimaculata* was described and new information about dimorphic characters was given in order to expand the knowledge about its morphology and variation. *Cynorta liturata* was considered a junior synonym of *E. quadripustulata* and *Eucynortula multilineata* was transferred to *Eucynorta* based on genital and external morphology.

Finally, a new classification is proposed for the genus *Eucynortula* being represented by 13 species distributed in North of South America and Central America and is considered as belonging to the subfamily Cynortinae.

Introduction

Opiliones belong to the class Arachnida and represent the third most diverse order among arachnids (Giribet & Kury, 2007). Currently, the order is divided into five suborders: the extinct Tetrophthalmi Garwood *et al.*, 2014, and the remaining Cyphophthalmi Simon, 1879, Dyspnoi Hansen & Sørensen, 1904, Eupnoi Hansen & Sørensen, 1904 and Laniatores Thorell, 1876, extant today and widespread on all continents except Antarctica (Machado *et al.*, 2007).

Laniatores is the most diverse suborder among Opiliones (Kury, 2013), with most of its diversity concentrated in two Neotropical families: Cosmetidae (> 700 spp) and Gonyleptidae (> 800 spp) (Benavides *et al.*, 2020). The former is well represented from the south of North America to almost all of South America, including the Antilles (Kury & Pinto-da-Rocha, 2007), with a diversity peak in Central America, northern South America, and the Caribbean (Townsend *et al.*, 2010; Damron *et al.*, 2018).

Cosmetids can be morphologically recognized by the shape of the pedipalps, where the femur is laterally compressed and the tibia is dorso-ventrally flattened and spoon-like shaped covering chelicerae (Pinto-da-Rocha & Hara, 2011). Furthermore, pedipalps are not well armed with spines or long setae as other families of Laniatores sharing raptorial pedipalps (i.e., Cranidae, Gonyleptidae, Nomoclastidae).

The family Cosmetidae has been divided into two subfamilies: Cosmetinae C. L. Koch, 1839 and Discosomaticinae Roewer, 1923. This division was traditionally based on the presence (Discosomaticinae) or absence (Cosmetinae) of pectination on the claws of leg IV. However, some authors have widely criticized these taxonomic arrangements (Ringuelet, 1959; Ferreira & Kury, 2010). Furthermore, in recent systematic analyses of some genera of cosmetids, it has been demonstrated that the pectination of claws

of leg IV has emerged several times within Cosmetidae and consequently, the primary homology hypothesis for Discosomaticinae has lost support (Coronato-Ribeiro & Pinto-da-Rocha, 2017; Medrano & Kury, 2018; Damron, 2020; Medrano *et al.*, 2021).

The subfamily Discosomaticinae was the object of a recent phylogenetic analysis using morphological evidence (Medrano *et al.*, 2021), which represents the first published analysis focused on a suprageneric taxon of Cosmetidae. The analysis rejected the monophyly of Discosomaticinae (*sensu* Roewer, 1923) and eight subfamilies were recognized, five new and three reestablished under a different configuration and diagnosis: Cynortinae Mello-Leitão, 1933; Cosmetinae C.L. Koch, 1839; Discosomaticinae Roewer, 1923; Ferkeriinae Medrano, Kury & Mendes, 2021; Flirteinae Medrano, Kury & Mendes, 2021; Metergininae Medrano, Kury & Mendes, 2021 and Taitoinae Medrano, Kury & Mendes, 2021. Discosomaticinae was divided into two tribes, Discosomaticini Roewer 1923 and Roquetteini Medrano, Kury & Mendes, 2021.

Also, Medrano *et al.* (2021) provided data on the geographic distribution of each subfamily and used this information to suggest a limited number of species included in large genera (i.e., *Paecilaema*, *Cosmetus*) which in the traditional taxonomic sense could not represent natural clades (Kury & Medrano, 2018; Medrano *et al.*, 2021).

Medrano *et al.* (2021) brought light to the general suprageneric interpretation of Cosmetidae. Nevertheless, most of the genera analyzed by Medrano and collaborators remain poorly described and are often just known from old descriptions without any modern redescription. Furthermore, the suprageneric classification provided by Medrano *et al.* (2021) did not sort most cosmetid genera within the subfamilies proposed, instead just a few genera included in the analysis were classified. Therefore, it is necessary to examine the morphology of each cosmetid genus to give an accurate

taxonomic position, understand its diversity, and assess the new subfamilial classification under additional sources of evidence.

The taxonomy of Cosmetidae and other families of Laniatores have been complex and their phylogenetic relationships obscured due to the use of doubtful morphological characters in some taxonomic works (Benavides *et al.*, 2020). One of the first classifications was proposed by Carl Friedrich Roewer and was called the “Roewerian system”. It was based on an invariable combination of somatic characters such as the number of spines/tubercles on dorsal scutum, the number of tarsal segments, and coloration of dorsal scutum (i.e., Roewer, 1912; 1923). The main problem with the Roewerian system is that it leads to an increased number of species and monotypic genera. This is due to the inability to recognize intraspecific variation and in consequence, overestimates morphological differences (Pinto-da-Rocha & Yamaguti, 2013). Since strong intraspecific variation in tarsal segments has been recorded, Roewer’s classification resulted in an artificial grouping that concealed evolutionary relationships.

In opposition to the Roewerian system, a new approach was proposed by Goodnight and Goodnight (i.e., 1953a) for use in the genera classification of Central America cosmetids. They widely discussed the superficiality of features commonly used in the Roewerian system (Goodnight & Goodnight, 1953b), and made a significant number of taxonomic changes in several species and genera, considering a wider range of intraspecific variation (Goodnight & Goodnight, 1953a).

Both approaches, from Roewer and Goodnight & Goodnight, expressed extremes in the interpretation of morphological variation, and lead to erected taxonomic entities that deserve major studies to identify their real boundaries (Kury, 2003).

More recently, a new resource of taxonomic information was proposed and widely expanded into opilological research, this began with the exploration of genital morphology in the 1970s (Martens, 1976; 1986; 1988). Nowadays, penial morphology has great relevance in the description of taxa at genus and species level and homologies have been recently proposed for some suprafamilial clades (i.e., Gonyleptoidea in Kury & Villarreal, 2015; Kury, 2016)

Among Laniatores, Cosmetidae has recently received great taxonomic attention. The first attempt to review the whole family was carried out (Damron, 2020); the subfamily Discosomaticinae was reviewed in detail (Medrano et al., 2021) and some South American genera have been reviewed and new diagnoses proposed (i.e. *Cynorta* C. L. Koch, 1839 by Kury et al., 2007; *Flirtea* C. L. Koch, 1839 by Kury & García, 2016; *Metalibitia* Roewer, 1912 by Coronato-Ribeiro & Pinto-da-Rocha, 2017; *Rhaucus* (Simon, 1879) by García & Kury, 2017; *Eulibitia* Roewer, 1912 by Medrano & Kury, 2017; *Paecilaema* C. L. Koch, 1839 by Kury & Medrano, 2018; *Roquettea* Mello-Leitão, 1931 by Medrano & Kury, 2018; *Neocynorta* Roewer, 1915 by Medrano et al., 2019). These revisions allowed the recognition of new morphological characters, such as ornamentation of legs (Kury & Barros, 2014; Garcia & Kury, 2017), the shape of dorsal scutum (DS) (Kury & Medrano, 2016), color pattern on DS (Kury & Medrano, 2018; Medrano et al., 2021) and relevant information on genital morphology which has been studied in Cosmetidae. The inclusion of new morphological data provides major support in the recognition of monophyletic groups within the family and helps to better define genera and species, with further studies being able to clarify the internal relationships of several taxa.

Recent revisions of some Cosmetidae genera have highlighted that the use of the geographical distributions of genera and species, may allow the definition of taxonomic boundaries (Medrano & Kury, 2017; Garcia & Kury,

2018). Taking into account the high homoplasy of morphological characters found in recent phylogenetic analysis (Coronato-Ribeiro & Pinto-da-Rocha, 2017; Medrano & Kury, 2018; Damron, 2020). So, these distributional patterns, largely ignored before, can now be used to interpret the morphology, and to be used as a criterion for delimiting taxa, as phylogenetic studies have shown the results to be informative (Damron, 2020; Medrano *et al.*, 2021).

The genus *Eucynortula*, for instance, has not been reviewed or even included in any cladistic hypothesis before this work. This genus includes species distributed from Mexico to Northern Brazil, occupying a considerably wide geographic range and containing species described using non-informative characters common in the classic systems of delimitation of species discussed above.

This work will review the genus *Eucynortula* based on morphological features including new informative characters proposed in recent works (Kury & Villareal, 2015; Coronato-Ribeiro & Pinto-da-Rocha, 2017; Medrano & Kury, 2017; Medrano & Kury, 2018; Damron, 2020 and Medrano *et al.*, 2021) and will test its monophyly employing a cladistic analysis.

1.1. Systematic background of genus *Eucynortula* Roewer, 1912

The genus *Eucynortula* Roewer, 1912 was diagnosed by Roewer the following character combination: All areas of dorsal scutum unarmed, except area III with a medial pair of low but outstanding tubercles; males with cheliceral bulla well developed; Leg IV of males could be unarmed or armed with strong denticles and Tarsus I with 6 segments, III and IV always bearing more than 7 segments. Roewer (1912) transferred to the genus the following species: *Cynorta mexicana* Banks, 1898 (without type locality data, except for the title of the publication “Some Mexican phalangida”); *Cynorta*

albipunctata Pickard-Cambridge, 1905 (proposed as the type species of *Eucynortula* by Roewer) from Costa Rica; *Cynorta bituberculata* Pickard-Cambridge, 1905 from Guatemala, San Juan Chamelco, Petet, Cahabon (Pickard-Cambridge, 1905) and *Cynorta lata* Banks, 1909 from Santo Domingo, San Mateo, Costa Rica. In the same work, Roewer described *Eucynortula metatarsalis*, recognizing three subspecies: *E. metatarsalis metatarsalis* Roewer, 1912; *E. metatarsalis separata* Roewer, 1912 and *E. metatarsalis medialis* Roewer, 1912 from Mexico, Sierra de Nayarit, and Puebla; these subspecies were differentiated based on differences in the color pattern of dorsal scutum. Afterward, *Cynorta nannocornuta* Chamberlin (1925), was described from Barro Colorado Island, based on only females, Chamberlin (1925) suggested that the new species could belong to the genus *Flirtea* C. L. Koch, 1839 but decided not to transfer it due to the absence of males (Chamberlin, 1925). Shortly after it, Roewer (1925) described *Eucynortula ypsilon* Roewer, 1925 from Colombia, Darien "Punta di Sabana".

Subsequently, Goodnight & Goodnight (1942a) described *Eucynortula maculosa* Goodnight & Goodnight, 1942 whose holotype is a female and the male was not described but, established as a paratype in the same work; they identified this species as similar to *E. albipunctata* but exhibiting a different color pattern on the dorsal scutum.

In the same year, *Eucynortula dorsata* Goodnight & Goodnight, 1942 and *Eucynortula sexpunctata* Goodnight & Goodnight 1942 both from Barro Colorado Island, Canal Zone were described. Both species were differentiated from the remaining species of *Eucynortula* just by the color patterns on the dorsal scutum, and it was suggested to be a close relationship between *E. dorsata* and *E. ypsilon* solely based on their distinct color patterns. In addition, they described a male of *C. nannocornuta* (Goodnight & Goodnight, 1942b). Furthermore, Mello-Leitão (1943) described and

illustrated *Eucynortula puer* Mello-Leitão, 1943 from Ecuador, El Oro, Rio Colorado; Goodnight & Goodnight (1946) transferred *Eucynortula mexicana* (Banks, 1898) to *Poala* Goodnight & Goodnight, 1942 leaving the genus *Eucynortula* with 10 species.

Later, Goodnight & Goodnight (1947a) transferred *Cynorta nannocornuta* to *Eucynortula* without any justification and synonymized *E. dorsata* and *E. sexpunctata* under *Eucynortula nannocornuta* (Chamberlin, 1925). This new arrangement was supported by the examination of a large series of specimens that allowed them to infer that both species constitute extreme cases of intraspecific morphological variation. Also, the same authors described *Eucynortula multilineata* Goodnight & Goodnight, 1947 from Silkgrass, British Honduras, based on a female; they related this species to *E. bituberculata*, but as usual in their previous works with other species, the only different feature they found was the color pattern (Goodnight & Goodnight, 1947a).

Afterward, Roewer (1947) described *Eucynortula pentapunctata* Roewer, 1947 from Manaus, Brazil; *E. rugipes* Roewer, 1947 from San José, Costa Rica; *E. auropicta* Roewer, 1947 from Costa Rica, Tilarán and *E. puncticulosa* Roewer, 1947 from Maracay, Venezuela; the latter two with a female holotype. Additionally, the species *Cynorta centralis* Sørensen in Henriksen, 1932 was transferred by Roewer (1947) to *Eucynortula* without justification. *Cynorta centralis* was described by Sørensen (in Henriksen, 1932 *opus postumum*) from Mexico as the type locality, without any further details. Originally the species was named by the original author as “*Cynorta mexicana*”, but the specific epithet was changed because it was preoccupied by Banks (1898).

After that, Caporiacco (1951) described *Eucynortula alboirrorata* from Cerro El Copey, Isla Margarita, Venezuela with only a female. Subsequently, Gonzalez-Sponga (1992) designated a male neotype for *E. alboirrorata* from

the same type locality, and in the same work, the author considered *E. puncticulosa* as a junior synonym of *Flirtea clypeata* (Sørensen, 1932).

A great number of synonyms were proposed by Goodnight & Goodnight (1953b), where 64 genera of Cosmetidae were synonymized under only three genera: *Cynorta* Koch, 1839, *Paecilaema* Koch, 1839 and *Vonones* Simon, 1879. Considering morphological variation, the authors stated “*it has been thought best to consider the mexican cosmetids as belonging in three genera which differ from one another in the number of tarsal segments in the first tarsus*” [italics added]. Nevertheless, the synonymic lists provided by them included genera with species not occurring in Mexico. This was the case for *Eucynortula*, which was considered a junior synonym of *Cynorta*, with just *E. metatarsalis* recorded from that country. Furthermore, the authors did not explain to support all the taxonomic changes proposed.

More recently, the genus *Eucynortula* was revalidated by Kury (2003) and all synonymies resulting from Goodnight & Goodnight (1953) were ignored and all genera revalidated, nevertheless, it was suggested by Kury (2003) that detailed studies are necessary to propose some nomenclature arrangements. Likewise, Kury (2003) synonymized the subspecies *E. metatarsalis metatarsalis*, *E. m. separata* and *E. m. medialis* considering differences in marks on the dorsal scutum highly variable to separate sympatric morphotypes.

On the other hand, Kury (2003) referred to *Eucynortula maculosa* as two different species as “*Eucynorta maculosa* (Goodnight & Goodnight, 1942) and *Eucynortula maculosa* Goodnight & Goodnight, 1942”. Kury (2003) did not make a nomenclatural change for *Eucynortula maculosa*, which is the original species described by Goodnight and Goodnight (1942) and he quoted the same reference, page, and figure for both species, probably a mistake made by the author. In his recent catalog, *Eucynorta maculosa* is not considered as a valid species (Kury *et al.*, 2021).

Nowadays, the genus *Eucynortula* includes 13 species distributed in Central America and South America.

Conclusions

1. *Eucynortula* is a monophyletic clade supported on two non-homoplastic synapomorphies, including thirteen species from Guatemala, Costa Rica and Venezuela.
2. Morphology of *Eucynortula*, as was proposed in the present work, is highly homogeneous among its species in characters such as color patterns, body shape, armature of DS and dimorphic ornamentation of Fe IV of males.
3. Subfamilies of Cosmetidae as currently proposed do not allow to fit several Centro American and South American genera, consequently, morphologic features supporting those groups must be reviewed and/or new subfamilies should be proposed under further information.

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