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Taxonomic revision of *Mecynorhina* Hope, 1837 and allied African genera with simple or bifurcate horns (Coleoptera, Scarabaeidae, Cetoniinae, Goliathini)

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Summary. We conducted morphological and DNA barcoding analyses of representative taxa in the *Mecynorhina* Hope, 1837 species-complex (type species: *Scarabaeus polyphemus* Fabricius, 1781), which had been split into five subgenera by DE PALMA & FRANTZ (2010). Subgenus *Mecynorrhinella* Marais and Holm, 1992 (type species: *Mecynorhina oberthuri* Fairmaire, 1903), comprising taxa with a simple, saber-shaped horn, is here raised to genus level (**stat. rev.**) to receive four species: *Mecynorrhinella torquata* (Drury, 1782), *Mecynorrhinella immaculicollis* (Kraatz, 1890) **stat rev.**, *Mecynorrhinella poggei* (Kraatz, 1890) **stat. rev.** (=*ugandensis* Moser, 1907 **syn. nov.**), and *Mecynorrhinella oberthuri*. *Mecynorhina* is found to involve two distinct species with bifurcate horn: *Mecynorhina polyphemus* from West Africa and *Mecynorhina confluens* Kraatz, 1890 **stat. rev.** from Central Africa. *Chelorhinella* De Palma & Frantz, 2010 (type species: *Mecynorhina savagei* Harris, 1844) is raised to genus level (**stat. rev.**) to accommodate *Chelorhinella kraatzi* (Moser, 1905) and three highly similar members in the *savagei* species-group. In addition, *Amaurodes* Westwood, 1843 (type species: *Ceratorhina* (*Amaurodes*) *passerinii* Westwood, 1843) is raised to genus level (**stat. rev.**) and *Megalorhina* Westwood, 1847 (type species: *Ceratorhina* (*Megalorhina*) *harrisii* Westwood, 1847) is ranked subgenerically under it (**comb. nov.**). The resulting four genera display markedly different aedeagal types, strongly supporting their generic status. Finally, *Ceratorhinella* De Palma, Takano, Léonard & Bouyer, 2021 (type species: *Eudicella cupreosuturalis* Bourgoin, 1913), which was previously ranked subgenerically under *Eudicella* White, 1839 (type species: *Cetoninus* (*Goliathus*) *smithii* MacLeay, 1838), is now raised to genus level (**stat. rev.**). Interestingly, *Mecynorhina*, *Chelorhinella, Amaurodes*, *Ceratorhinella* and *Eudicella* – all Goliathini with bifurcate horns – form a separate clade that is sister to *Mecynorrhinella*. These findings, while limited to the analysis of a single mitochondrial gene, suggest that the simple horn of *Mecynorrhinella*, which is unique among the African Goliathini, has evolved from a precursor near to *Mecynorhina* before, or in parallel to, the radiation and diversification of allied Goliathini with bifurcate horns.

Résumé. Nous avons effectué des analyses morphologiques et génétiques par barcoding des taxa représentatifs appartenant au complexe d'espèces *Mecynorhina* Hope, 1837 (espèce type : *Scarabaeus polyphemus* Fabricius, 1781) qui a été précédemment divisé en cinq sous-genres (DE PALMA & FRANTZ, 2010). Le sous-genre *Mecynorrhinella* Marais et Holm, 1992 (espèce type : *Mecynorhina oberthuri* Fairmaire, 1903), qui comprend des taxa dotés d'une corne simple en forme de sabre, est ici élevé au statut générique (**stat. rev.**). Le genre comprend quatre espèces : *Mecynorrhinella torquata*

(Drury, 1782), *Mecynorrhinella immaculicollis* (Kraatz, 1890) **stat. rev.**, *Mecynorrhinella poggei* (Kraatz, 1890) **stat. rev.** (= *ugandensis* Moser, 1907 **syn. nov.**), et *Mecynorrhinella oberthuri*. *Mecynorhina* comprend deux espèces distinctes à corne bifurquée : *Mecynorhina polyphemus* d'Afrique de l'Ouest et *Mecynorhina confluens* (Kraatz, 1890) **stat. rev.** d'Afrique centrale. *Chelorhinella* De Palma & Frantz, 2010 (espèce type : *Mecynorhina savagei* Harris, 1844) est élevée au niveau du genre (**stat. rev.**) pour accueillir *Chelorhinella kraatzi* (Moser, 1905) et trois membres très voisins du groupe d'espèces *savagei*. *Amaurodes* Westwood, 1843 (espèce type : *Ceratorhina* (*Amaurodes*) *passerinii* Westwood, 1843) est élevée au niveau du genre (**stat. rev.**) et *Megalorhina* Westwood, 1847 (espèce type : *Ceratorhina* (*Megalorhina*) *harrisii* Westwood, 1847) est classée comme sous-genre de ce dernier (**comb. nov.**). Les quatre genres résultants présentent des types d'édéage nettement différents confirmant leur statut générique. Enfin, *Ceratorhinella* De Palma, Takano, Léonard & Bouyer, 2021 (espèce type : *Eudicella cupreosuturalis* Bourgoin, 1913), qui était auparavant classé comme sous-genre d'*Eudicella* White, 1839 (espèce type : *Cetoninus* (*Goliathus*) *smithii* MacLeay, 1838), est désormais élevé au niveau de genre (**stat. rev.**). Il est intéressant de noter que *Mecynorhina*, *Chelorhinella*, *Amaurodes*, *Ceratorhinella* et *Eudicella* – tous des Goliathini aux cornes bifurquées – forment un clade distinct de *Mecynorrhinella*. Ces découvertes, bien que limitées à l'analyse d'un seul gène mitochondrial, pourraient suggérer que la corne simple de *Mecynorrhinella* – unique parmi les Goliathini africains – a évolué à partir d'un précurseur proche de *Mecynorhina* avant, ou en parallèle, le rayonnement et la diversification des Goliathini aux cornes bifurquées.

Keywords. Coleoptera, Cetoniinae, Goliathini, *Mecynorrhinella*, *Mecynorhina*, *Chelorhinella*, *Amaurodes*, *Ceratorhinella*, DNA barcoding, phylogeny, clypeal horn, aedeagus, stat. rev., Africa.

Introduction

DE PALMA & FRANTZ (2010) split *Mecynorhina* Hope, 1837 into five subgenera: *Mecynorhina s. str.* (type species: *Scarabaeus polyphemus* Fabricius, 1781), *Mecynorrhinella* Marais & Holm, 1992 (type species: *Mecynorhina oberthuri* Fairmaire, 1903), *Chelorhinella* De Palma & Frantz, 2010 (type species: *Mecynorhina savagei* Harris, 1844), *Amaurodes* Westwood, 1843 (type species: *Ceratorhina* (*Amaurodes*) *passerinii* Westwood, 1843), and *Megalorhina* Westwood, 1847 (type species: *Ceratorhina* (*Megalorhina*) *harrisii* Westwood, 1847). All members of *Mecynorhina s. lat.* appear superficially similar being characterized in the male by a velutinous body surface, hypertrophic and internally serrated protibiae, and a well-developed clypeal horn. The armature of the male head includes the following structures: (i) a median clypeal horn, which can be either simple or bifurcate; (ii) two lateral horns projecting from in front of the eyes and with variable shape (elongate or short, arched or straight, subconical or flattened dorso-ventrally); (iii) two basofrontal horns, only present in *Amaurodes*. The basal margins of the clypeus can be either attenuated or strongly angular, and are visible from above only in those taxa with reduced development of the lateral horns (i.e. *Amaurodes* and *Megalorhina*).

Mecynorhina s. lat., as defined by DE PALMA & FRANTZ (2010), appears phylogenetically related to the *Eudicella* White, 1839 species-complex (DE PALMA et al., 2021), as initially proposed by HOLM (1993). In their recent revision of *Eudicella s. lat*., DE PALMA et al. (2021) identified five subgenera: *Eudicella s. str.* (type species: *Cetoninus* (*Goliathus*) *smithii* MacLeay, 1838), *Coelorrhina* Burmeister, 1842 (type species: *Cetonia quadrimaculata* Fabricius, 1781), *Coelorrhinella* De Palma, Takano, Léonard & Bouyer, 2021 (type species: *Goliathus* (*Eudicellus*) *auratus* Westwood, 1841), *Aneurhina* De Palma, Takano, Léonard & Bouyer, 2021 (type species: *Coelorrhina mutica* Janson, 1915), and *Ceratorhinella* De Palma, Takano, Léonard & Bouyer, 2021 (type species: *Eudicella cupreosuturalis* Bourgoin, 1913). *Mecynorhina s. lat.* and *Eudicella s. lat.* share the general structure of the male's head armature (with clypeal and lateral horns), the shape of the mesometasternal process, and the internally serrated male protibia (HOLM, 1993). However, the aedeagal parameres display striking variability. Here, we reassess the status of the taxa previously assigned to *Mecynorhina s. lat.* and *Eudicella s. lat.* in light of relevant morphological characters, such as the structure of the male's head armature and aedeagal parameres, and the sequencing of cytochrome c oxidase subunit I (COI-5P).

DNA barcoding analysis

Muscle tissue or eggs were removed from 111 individuals belonging to 25 putative ingroup taxa and submitted to the Biodiversity Institute of Ontario in Guelph, Canada for DNA extraction, amplification, and sequencing of COI-5P. *Goliathus goliatus* Linnaeus, 1771 was selected as outgroup taxon.

Sequences were aligned using MUSCLE in MEGA version X (KUMAR et al., 2018) and phylogenetic tree searches were performed using Bayesian Inference (BI) in MrBayes version 3.2.7a (RONQUIST et al., 2012). Briefly, Metropolis-coupled Markov chain Monte Carlo (MCMC) analyses were run with four chains (one cold and three heated) for 10,000,000 generations sampling every 100 generations, discarding the first 25% as burn-in. The two runs converged with the standard deviation of split frequencies of 0.008. Support for clades was evaluated for BI using posterior probabilities. The resulting tree was visualized and annotated in FigTree version 1.4.4.

The tree resulting from the BI analysis is shown in **Fig. 1**. Two major clades were identified: one involving *Mecynorrhinella*, with two well separated species-groups (*torquata* and *oberthuri*), and another involving the remainder of *Mecynorhina* and *Eudicella* subgenera. ***Mecynorrhinella*** is here raised to generic status (**stat. rev.**) due to its significant genetic distance from the other species-groups and the very distinctive apomorphy represented by

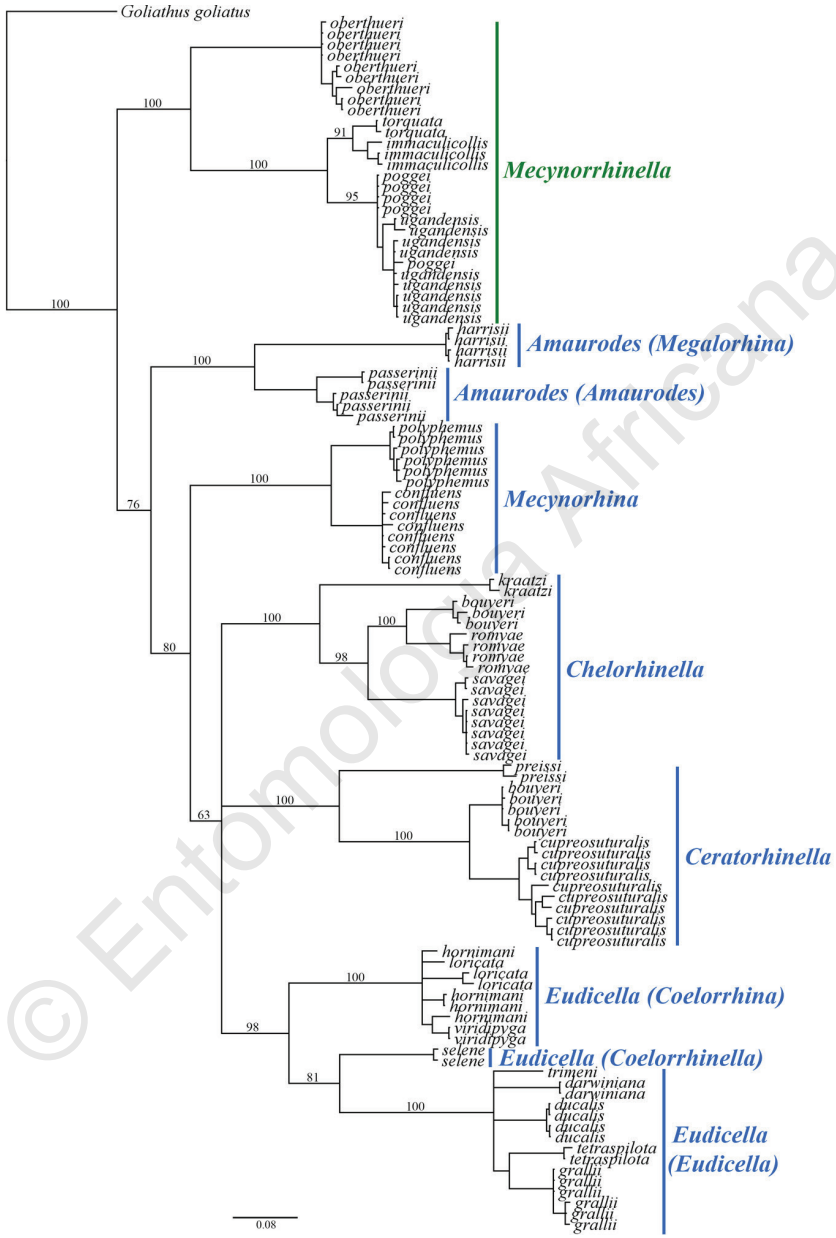


Figure 1. BI tree of *Mecynorhina s. lat.* and *Eudicella s. lat.* taxa with *Goliathus goliatus* as outgroup taxon. Numbers above branches indicate posterior probabilities. Scale bar indicates substitution rate per site.

the simple, saber-shaped clypeal horn of the male. ***Chelorhinella*** is recognized as a separate genus (**stat. rev.**) due to the highly derived aedeagal parameres and the other male-specific characters described below. As expected (HOLM, 1993), *Amaurodes* was found to cluster with *Megalorhina*; we here propose to raise ***Amaurodes*** to genus level (**stat. rev.**), with ***Megalorhina*** ranked subgenerically under *Amaurodes* (**comb. nov.**). In addition, ***Ceratorhinella***, previously ranked subgenerically under *Eudicella*, is raised to genus level (**stat. rev.**) in light of its significant genetic separation from the outstanding *Eudicella* taxa. As a result, the former genus *Mecynorhina s. lat.* (DE PALMA & FRANTZ, 2010) is here resolved into four genera (*Mecynorhina*, *Chelorhinella*, *Amaurodes*, and *Mecynorrhinella*) and one subgenus (*Amaurodes* (*Megalorhina*)), whereas the former genus *Eudicella s. lat.* (DE PALMA et al., 2021) is resolved into two genera (*Eudicella* and *Ceratorhinella*), with *Eudicella s. lat.* containing four subgenera: *Eudicella s. str.*, *Coelorrhina*, *Coelorrhinella*, and *Aneurhina*. Inter-generic pairwise distances (PWD) ranged from 16.7–26.6%, strongly supporting the generic status of the aforementioned taxa. The PWD between the ingroup and the outgroup taxon *Goliathus goliatus* was 18.3–26.1%.

The main characters in support of the changes proposed above for the *Mecynorhina* genus-group are discussed in the sections below. In addition, certain taxa in the *Mecynorhina* and *Mecynorrhinella* genera were found to require revision.

Mecynorhina Hope, 1837 (Figs 2-11)

Type species: *Scarabaeus polyphemus* Fabricius, 1781

Main characters: Male: Median clypeal horn terminally bifurcate; Lateral horns much developed and blade-shaped, with irregularly denticulate margins; Basal clypeal margins attenuated; Basofrontal horns absent; Profemur with dense setal brush on anterior margin; Protibia hypertrophic and armed with spines on both interior and outer margins, with basal inner hook present; Integument of dorsal side of the body velutinous; Elytra with white cretaceous marks; Ventral areas largely covered with cretaceous integument, except for the central area of metasternum, mesometasternal process, and abdominal sternites; Mesometasternal process with apex subtriangular, with sides of the apex gently rounded; Femora partly invaded with cretaceous integument; Abdominal sternites deeply depressed; Parameres with free, enlarged, spoon-shaped apices, not fused ventrally. Female: Clypeus with angular antero-lateral margins; Dorsum completely or partially velutinous; Elytra with white cretaceous marks; Ventral side of the body largely without cretaceous integument; Mesometasternal process with apex subtriangular, with rounded margins.

Fig. 2: ♂, Tokonou, Republic of Guinea.

aedeagus, lateral view.

aedeagus, frontal view.

Fig. 3: ♂, Man Prov. Côte d'Ivoire.

Fig. 4: ♀, Tokonou, Republic of Guinea.

Fig. 5: ♀, Tiassalé, Côte d'Ivoire.

Figures 2-5. ***Mecynorhina polyphemus***.

Fig. 6: ♂, Kraatz's syntype.

Fig. 7: ♂, "Shaba" Prov. DRC.

aedeagus, lateral view.

aedeagus, frontal view.

Fig. 8: ♂, Goma, Nord Kivu Prov., DRC.

Fig. 9: ♂, Kolwezi, Lualaba Prov., DRC.

Fig. 10: ♀, Goma, Nord Kivu Prov., DRC.

Fig. 11: ♀, "Shaba" Prov. DRC.

Figures 6-11. ***Mecynorhina confluens***.

Taxonomic notes: KRAATZ (1890) described the variety *confluens* for "*Chelorrhina polyphemus*" based on a specimen (**Fig. 6**), now housed in the Senckenberg Deutsches Entomologisches Institut (SDEI), which was collected in the vicinity of "Kimbundu" in south-western Democratic Republic of the Congo (DRC). The variety *confluens* Kraatz, 1890 was established based on the distinctive feature of white cretaceous marks on the elytral margins, presenting a confluent distribution, which contrasts with the more evenly spaced distribution observed in typical *polyphemus* specimens from West Africa. The name *confluens* is available and subspecific according to the International Commission on Zoological Nomenclature (ICZN; article 45.6.4). *Mecynorhina confluens* has been treated by various authors as the *polyphemus* subspecies from central Africa (ALLARD, 1985; SAKAI & NAGAI, 1998). We here raise *Mecynorhina confluens* to species level (**stat. rev.**) based on the following characters: (i) its significant genetic separation from *Mecynorhina polyphemus* (PWD of 7.8–9.6%); (ii) the lack of velutinous tomentum on the basal part of the elytra in the female; (iii) the somewhat broader protibia in the male (without traces of white tomentum on the dorsal side, often present in *polyphemus*); (iv) the confluent and variably reduced elytral maculation in both sexes. The genus contains two species.

***Mecynorhina polyphemus* (Fabricius, 1781)** (West Africa: Sierra Leone, Liberia, Republic of Guinea, Côte d'Ivoire, Ghana, Togo, Benin?).

***Mecynorhina confluens* (Kraatz, 1890) stat. rev.** (Broadly in Central Africa: Nigeria, Cameroon, Central African Republic, DRC, Uganda, Republic of the Congo, Gabon, Angola, Zambia).

Mecynorrhinella Marais & Holm, 1992, stat. rev. (Figs 12-32)

Type species: *Mecynorhina oberthuri* Fairmaire, 1903

Main characters: Male: Median clypeal horn simple, saber-shaped, apically pointed; Lateral clypeal horns subtriangular, flattened dorso-ventrally and projecting externally (*torquata* group) or subconical and projecting anteriorly (*oberthuri*); Basal clypeal margins attenuated; Basofrontal horns absent; Profemur with dense setal brush on anterior margin; Protibia hypertrophic and armed with spines on both interior and outer margins, with basal inner hook present; Integument of dorsal side of the body velutinous; Elytra with (*torquata*) or without/with reduced (*oberthuri*) white cretaceous marks; Ventral areas largely devoid of cretaceous integument, except for parts of pro- and meso-sternum; Mesometasternal process with sides of the apex medially constricted and forming an acute angle (arrowhead-shaped in the *torquata* group), or gently rounded (subtriangular in *oberthuri*); Femora not invaded with cretaceous integument; Abdominal sternites deeply depressed; Parameres cup-shaped, with apices truncated or slightly elongated and forming a relatively narrow orifice. Female: Clypeus with angular antero-

lateral margins; Dorsum velutinous; Elytra with (*torquata* group) or without/with reduced (*oberthuri*) white cretaceous marks; Ventral side of the body largely without velutinous integument.

Taxonomic notes: Since ALLARD (1985), two or three species have been recognized in this genus: *Mecynorrhinella torquata* (Drury, 1782), with two subspecies (*immaculicollis* Kraatz, 1890, and *poggei* Kraatz, 1890); *Mecynorrhinella ugandensis* (Moser, 1907), often treated as a subspecies of *torquata* (HOLM, 1993; SAKAI & NAGAI, 1998; DE PALMA & FRANTZ, 2010); and *Mecynorrhinella oberthuri* (Fairmaire, 1903). However, the analysis of the aedeagal parameres and other characters of the aforementioned taxa has shown unexpected results.

KRAATZ (1890) described the variety *immaculicollis* based on four specimens communicated by Dr. PLASON from "West Africa" (the specimens likely originated from Gabon or the coastal areas of Cameroon). He compared his specimens with typical *torquata* specimens from Sierra Leone. One syntype has been located at SDEI (**Fig. 16**) that is fully consistent with the original description, differing from *torquata* by the reduced white markings on the pronotum and the more intense dark green color. It has emerged that *torquata* and *immaculicollis* present very different aedeagal parameres, which are apically elongated in the former but horizontally truncated in the latter. The name *immaculicollis* is available and subspecific according to the ICZN (article 45.6.4), thus we raise *Mecynorrhinella immaculicollis* to species level (**stat. rev.**). An additional character distinguishing *immaculicollis* from *torquata* are the cretaceous markings of the elytra, which are, at least partly, of a brownish color in *immaculicollis* (**Fig. 18**) and invariably white in *torquata* (**Fig. 12**). *Mecynorrhinella torquata* and *immaculicollis* are tropical forest species. The Dahomey Gap (a relatively dry forest-savannah ecoregion in eastern Ghana), which separates the Upper Guinean forests west of the gap from the Lower Guinean forests east of the gap, represents the natural boundary between the two species.

In the same article, KRAATZ (1890) described the variety *poggei* from "Mukenge", approximately in today's Kasaï provinces of the DRC. The description ("…*the form Poggei mihi, in which the two lines are transformed into more or less wide bands and the side bands of the pronotum are also wider than usual"*) and the precise collection localities of the four syntypes in southern DRC ("*The Berlin Museum has 4 examples of this form, the largest of which was collected by Pogge in November 1881 in Mukenge, and the others also coming from the interior, between the Mukenge area and the Lualaba*") (KRAATZ, 1890; English translation) leave no doubts about the identity of *poggei*.

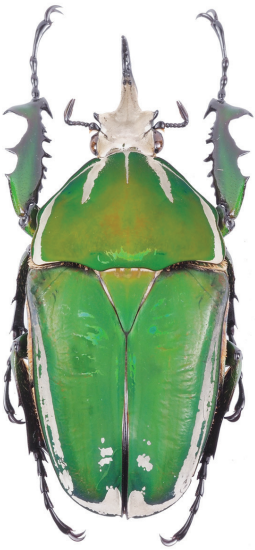
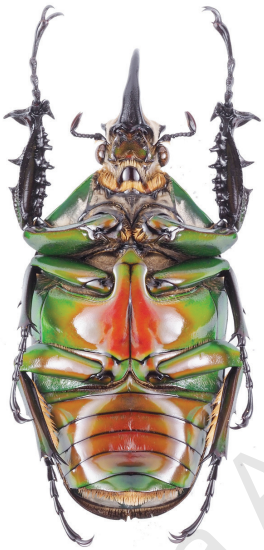


Fig. 12: ♂, Mt. Tonkoui, Man Prov., Côte d'Ivoire.



aedeagus, lateral view.

aedeagus, frontal view.

Fig. 13: ♂, Mt. Tonkoui, Man Prov., Côte d'Ivoire.

Fig. 14: ♂, ditto.

Fig. 15: ♀, Diécké, Republic of Guinea.

Figures 12-15. ***Mecynorrhinella torquata***.

Fig. 16: ♂, Kraatz's syntype.

Fig. 17: ♂, SW Prov., Cameroon.

aedeagus, lateral view

aedeagus, frontal view.

Fig. 18: ♂, Lékana, Republic of Congo.

Figures 16-18. ***Mecynorrhinella immaculicollis*.**

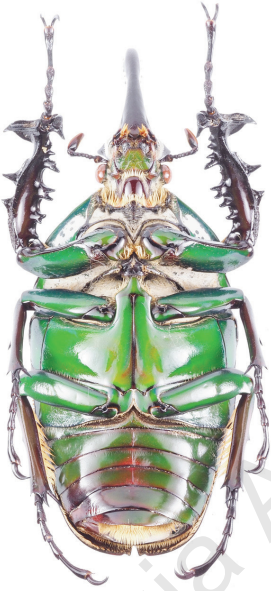


Fig. 19: ♂, Marungu, Tanganyika Prov., DRC.

aedeagus, lateral view.

aedeagus, frontal view.

Fig. 20: ♂, Dekese, Kasai Prov., DRC.

Fig. 21: ♂, ditto. Fig. 22: ♀, Likasi, Haut-Katanga Prov., DRC.

Figures 19-22. ***Mecynorrhinella poggei***.

Fig. 23: ♂, Buhoma, Uganda.

aedeagus, lateral view.

aedeagus, frontal view.

Fig. 24: ♂, ditto.

Fig. 25: ♂, Goma, Nord Kivu Prov., DRC.

Fig. 26: ♂, ditto.

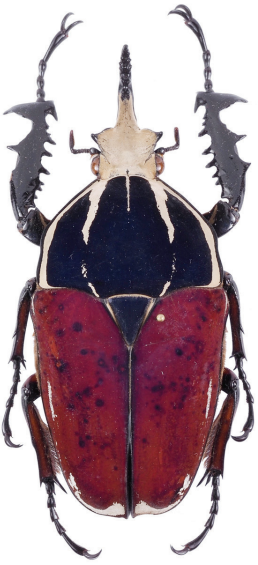


Fig. 27: ♂, Nord Lac Kivu, Rwanda.

Figures 23-27. ***Mecynorrhinella poggei*** **(form "*ugandensis*").**

Fig. 28: ♂, Kondoa, Dodoma Prov., Tanzania.

Fig. 29: ♂, Uluguru Mts., Morogoro Prov., Tanzania.

Fig. 30: ♂, ditto.

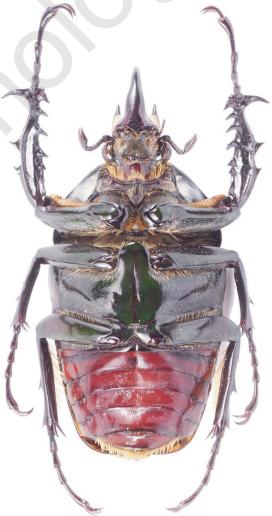


Fig. 31: ♂, Usambara Mts., Tanga Prov., Tanzania.

aedeagus, lateral view.

aedeagus, frontal view.

Fig. 32: ♂, ditto.

Figures 28-32. ***Mecynorrhinella oberthuri***.

Examination of the aedeagal parameres of several *poggei* specimens collected in southern and northwestern DRC revealed a structure that differs from both *torquata* and *immaculicollis*, being somewhat intermediate between the two (i.e., with apices slightly stretched ventrally and not horizontally truncated). The name *poggei* is available and subspecific according to the ICZN (article 45.6.4), thus we raise *Mecynorrhinella poggei* to species level (**stat. rev.**). The taxon *poggei* frequently displays fully developed white cretaceous bands on the disc of the pronotum, which distinguishes it from both *torquata* and *immaculicollis*. Of note, our records indicate that *M. immaculicollis* and *poggei* may be sympatric (or parapatric) in northern DRC. Two *poggei* specimens in the collections of the African Natural History Research Trust were collected in Dongo-Kuma (Sud-Ubangi Province, northwestern DRC), an area also inhabited by *immacullicollis*. Additional specimens examined by us confirm that the distribution of *Mecynorrhinella poggei* is more extensive than commonly believed, likely encompassing a significant portion of the DRC and certain areas in central-southern Republic of the Congo. Interestingly, the taxon *ugandensis* (from the Ituri and North Kivu Provinces of eastern DRC and neighboring areas of Uganda and Rwanda) clustered in our BI tree together with *poggei*, with which it shares the shape of the aedeagal parameres, the acute apex of the mesometasternal process, and the robust body structure. Although *ugandensis* displays remarkable polychromatism (**Figs 23-27**), neither DNA barcoding nor morphological characters can support its separation from *poggei*. In light of these observations, *ugandensis* is hereby synonymized with *poggei* (**syn. nov.**) and considered a polychromatic population of *poggei* localized in the easternmost geographic range of the latter. As reassessed here, the genus contains four species.

***Mecynorrhinella oberthuri* (Fairmaire, 1903)** (Tanzania, with one subspecies).

***Mecynorrhinella torquata* (Drury, 1782)** (West Africa: Sierra Leone, Liberia, Republic of Guinea, Côte d'Ivoire, western Ghana).

***Mecynorrhinella poggei* (Kraatz, 1890) stat. rev.** (Broadly in Eastern-Central Africa: DRC, central-southern Republic of the Congo?, northeastern Angola?, Uganda, Rwanda, Burundi?, northwestern Tanzania?)

Mecynorrhinella ugandensis (Moser, 1907) **syn. nov.**

***Mecynorrhinella immaculicollis* (Kraatz, 1890) stat. rev.** (Broadly in Western-Central Africa: eastern Nigeria, Cameroon, Central African Republic, northwestern DRC, Gabon, Equatorial Guinea, central-northern Republic of the Congo, Angola?).

Chelorhinella De Palma & Frantz, 2010, stat. rev. (Figs 33-38)

Type species: *Mecynorhina savagei* Harris, 1844

Main characters: Male: Median clypeal horn terminally bifurcate; Lateral clypeal horns either long and arched (*savagei* group) or short and projecting externally (*kraatzi*); Basal clypeal margins attenuated; Basofrontal

horns absent; Profemur with dense setal brush on anterior margin; Protibia hypertrophic and armed on both interior and outer margin, without basal inner hook; Integument of dorsal side of the body velutinous; Elytra without white cretaceous marks; Ventral areas largely covered with cretaceous integument, with dense and long setae (*kraatzi* only), except for the central area of metasternum, mesometasternal process, and abdominal sternites; Mesometasternal process with apex subtriangular, with sides of the apex gently rounded; Anterior and middle femora partly invaded with cretaceous integument; Abdominal sternites deeply depressed; Parameres cup-shaped, with apices in the shape of subparallel laminas, ventrally fused and forming a wide orifice visible from above. Female: Clypeus with angulate antero-lateral margins; Dorsum velutinous; Elytra without white cretaceous spots. Ventral side of the body largely without cretaceous integument; Mesometasternal process with apex subtriangular, with rounded margins.

Fig. 33: ♂, Mt. Tonkoui, Man Prov., Côte d'Ivoire.

aedeagus, lateral view.

aedeagus, frontal view.

Fig. 34: ♂, Ziama Ft., Republic of Guinea.

Figures 33-34. ***Chelorhinella savagei***.

Taxonomic notes: *Chelorhinella savagei* has been recently resolved into three species, based on their genetic divergence and differences in the aedeagal parameres (LÉONARD & BEINHUNDNER, 2014; LÉONARD, BEINHUNDNER & BOUYER, 2017). The genus contains four species.

***Chelorhinella savagei* (Harris, 1844)** (West Africa: Sierra Leone, Liberia, Republic of Guinea, Côte d'Ivoire, Ghana, Togo). Note: the name "*savagei*" is an emendation in prevailing usage of *savagii* Harris, which is the original author's spelling (article 33.2.3.1 of the ICZN).

***Chelorhinella romyae* (Léonard & Beinhundner, 2014)** (Broadly in Western-Central Africa: Cameroon, Central African Republic, northwestern DRC, Gabon, Republic of the Congo?, Angola?).

***Chelorhinella bouyeri* (Léonard & Beinhundner, 2014)** (Eastern and Southern Central Africa: eastern and southern DRC, Rwanda, Uganda).

***Chelorhinella kraatzi* (Moser, 1905)** (Cameroon).

Fig. 35: ♂, Mt. Cameroun, SW Prov., Cameroon.

aedeagus, lateral view.

b: aedeagus, frontal view.

Fig. 36: ♂, ditto.

Fig. 37: ♀, ditto.

Fig. 38: ♂, Rumpi Hills, SW Prov., Cameroon.

Figures 35-38. ***Chelorhinella kraatzi***.

Amaurodes Westwood, 1843 stat. rev. (Figs 39-44)

Type species: *Ceratorhina* (*Amaurodes*) *passerinii* Westwood, 1843

Main characters: Male: Median clypeal horn terminally bifurcate; Lateral clypeal horns small, pointed, sometimes vestigial, basally retracted; Basal clypeal margins strongly angular; Basofrontal horns either present (*Amaurodes s. str.*) or absent (*Amaurodes* (*Megalorhina*)); Profemur with dense setal brush on anterior margin; Protibia armed with spines on interior margin, without basal inner hook; Integument of dorsal side of the body velutinous; Elytra without white cretaceous marks; Ventral areas devoid of cretaceous integument; Mesometasternal process with apex subtriangular, with sides of the apex gently rounded; Femora without cretaceous integument; Abdominal sternites deeply depressed; Parameres elongate, with tapering free apices not fused ventrally, forming a narrow orifice visible from above. Female: Clypeus with relatively rounded antero-lateral margins, with widened lateral declivity; Dorsum velutinous; Elytra without white cretaceous spots; Ventral side of the body largely without velutinous integument.

Fig. 39: ♂, Gombe Masito Ugalla Ft., Tanzania.

Fig. 40: ♀, Zilo, Lualaba Prov., DRC.

aedeagus, lateral view.

aedeagus, frontal view

Fig. 41: ♂, Uluguru Mts., Tanzania.

Figures 39-41. ***Amaurodes* (*Amaurodes*) *passerinii***.

Taxonomic notes: *Amaurodes* and *Megalorhina* are highly related. In the male, they share the general structure of the aedeagal parameres, the angular profile of the clypeal margins, the structure of the protibia, and the lack of cretaceous tomentum on the ventral side of the body. However, *Megalorhina* is here retained as a subgenus of *Amaurodes* (comb. nov.) because of the genetic distance between the two taxa and the development of

basofrontal horns (an autapomorphic character) in *Amaurodes s. str.*, among other characters of lesser importance (e.g., the more broadly rounded clypeal margins in the females of *Amaurodes s. str.*). The genus, as redefined here, contains four species and several subspecies.

***Amaurodes* (*Amaurodes*) *passerinii* (Westwood, 1843)** (Broadly in central and southern Africa, with several subspecies).

***Amaurodes* (*Megalorhina*) *harrisii* (Westwood, 1847) comb. nov.** (Broadly in sub-Saharan Africa, with several subspecies).

***Amaurodes* (*Megalorhina*) *mukengiana* (Kolbe, 1884) comb. nov.** (Eastern and southern DRC, Uganda, Rwanda, Burundi, Kenya, Tanzania).

***Amaurodes* (*Megalorhina*) *taverniersi* (Allard, 1990) comb. nov.** (Tanzania).

Fig. 42: ♂, *A.* (*M.*) *harrisii*. Ziama Ft., Republic of Guinea.

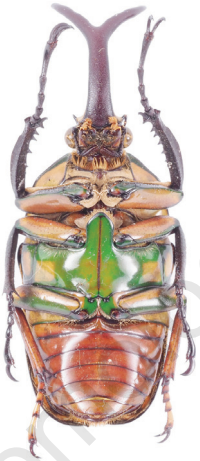


Fig. 43: ♀, *A.* (*M.*) *harrisii*. Banco Ft., Côte d'Ivoire.

aedeagus, lateral view.

aedeagus, frontal view

Fig. 44: ♂, *A.* (*M.*) *mukengiana*. Sefula Ft., Zambia.

Figures 42-44. ***Amaurodes* (*Megalorhina*)**

Key to genera and subgenera (♂)

1 - Median clypeal horn simple, saber-shaped. ***Mecynorrhinella* Marais and Holm**
- Median clypeal horn bifurcate 2

2 - Basal clypeal margins obsolete or strongly attenuated 3
- Basal clypeal margins strongly angular 4

3 - Protibia with basal inner hook. Parameres with apices enlarged, spoon-shaped, not fused ventrally. ***Mecynorhina* Hope**
- Protibia without basal inner hook. Parameres cup-shaped, with apices subparallel and laminate, fused ventrally. ***Chelorhinella* De Palma & Frantz**

4 - Basofrontal horns present. ***Amaurodes* (*Amaurodes*) Westwood**
- Basofrontal horns absent. ***Amaurodes* (*Megalorhina*) Westwood**

Discussion

In this study, DNA barcoding of taxa in the *Mecynorhina s. lat.* group, as defined previously by DE PALMA & FRANTZ (2010), has helped to clarify relationships among species-groups with potentially confounding structural hypertrophies in the male sex. It has emerged that the species characterized by a simple, saber-shaped horn (e.g., *torquata*) constitute a distinct clade sister to the genus-group comprising both the outstanding *Mecynorhina s. lat.* species-groups and the *Eudicella s. lat.* species-groups, all of which display bifurcate horns. On the one hand, these findings support the monophyly of the *Mecynorhina-Eudicella* genus-group, as proposed previously by HOLM (1993). On the other, they suggest that the simple horn of *Mecynorrhinella* stat. rev. may have evolved independently from a precursor that is sister to the remaining *Mecynorhina-Eudicella* genus-group. An immediate implication of the above findings is that the two-genera arrangement of *Mecynorhina s. lat.* and *Eudicella s. lat.*, as defined by DE PALMA & FRANTZ (2010) and DE PALMA et al. (2021), becomes untenable. Accordingly, we have elevated *Mecynorrhinella*, *Chelorhinella* and *Amaurodes* to genus level. This course is, in our view, well supported by the phylogenetic tree illustrated above and a number of important characters, such as the shape of the clypeal horn (differentiating *Mecynorrhinella* from the other genera), the lack of cretaceous tomentum on the metasternum in *Mecynorrhinella* and *Amaurodes*, and, most importantly, the markedly different aedeagal types in the four genera (**Figs. 45-48**). Although the species respectively placed in *Mecynorhina* and *Chelorhinella*, which BURMEISTER (1842) combined in his genus "*Chelorrhina*" (a synonym of *Mecynorhina*), appear superficially similar, the very different structure of the parameres reveals distant relationships. Of note, hypertrophic protibiae have evolved independently in several Goliathini lineages, such as *Compsocephalus* White, 1845.

One consequence of the dissolution of the *Mecynorhina sensu* DE PALMA & FRANTZ (2010) is the necessity to elevate subgenus *Eudicella* (*Ceratorhinella*) to genus level. This resolution is consistent with the earlier interpretation of this species-group made by ALLARD (1985), who improperly resurrected the genus "*Ceratorhina*" Westwood (a synonym of *Dicronorhina* Hope, 1837; DE PALMA & TAKANO, 2021) to receive *Eudicella cupreosuturalis* Bourgoin, 1913 and *Coelorrhina preissi* Moser, 1912. The genetic separation between *Ceratorhinella* and the other species-groups in the *Eudicella* complex supports the notion that two genera are involved. The characters that identify *Ceratorhinella* have been described previously by DE PALMA et al. (2021). The lack of dorsal velutinous integument in *Ceratorhinella* and *Eudicella s. lat.* is here interpreted as a derived

(apomorphic) character with limited phylogenetic significance. Also, several oddities have appeared in this homogenous group of African Goliathini, such as the deep punctuation of the pronotum in *Ceratorhinella preissi* (Moser, 1912), the lack of head armature in the male of *Eudicella* (*Aneurhina*) *mutica* (Janson, 1915), and the presence of basofrontal horns in *Amaurodes* (*Amaurodes*) *passerinii*, all of which are here regarded as autapomorphies.

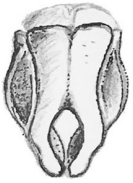


Fig. 45
Mecynorrhinella torquata

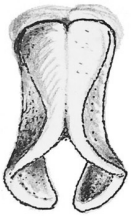


Fig. 46
Mecynorhina confluens

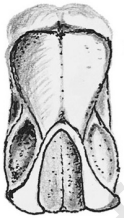


Fig. 47
Chelorhinella savagei

Fig. 48
Amaurodes (*Amaurodes*) *passerinii*

Figures 45-48. Schematic rendering of the aedeagal parameres, viewed from above.

In this study we have reassessed the status of several taxa in the genera *Mecynorhina* and *Mecynorrhinella*. In addition to erecting *Mecynorrhinella immaculicollis* and *poggei* to species level, we have synonymized *Mecynorrhinella ugandensis* with *poggei*. The latter action is supported by the negligible genetic separation and the lack of objective phenotypic characters distinguishing the two taxa. We appreciate that the magnificent polychromatism of "*ugandensis*" makes it one of the most popular Cetoniine beetle among amateur collectors, so we propose that this insect be referred to as *Mecynorrhinella poggei* "form *ugandensis*" if deemed necessary. However, it should be noted that names used to denote forms or varieties have no nomenclatural standing before the ICZN. The same provisions apply to the dramatic color forms of *Goliathus goliatus* that are localized in south-west Cameroon and neighboring areas (DE PALMA et al., 2020).

While we believe that the taxonomic revisions put forward in this study are sufficiently corroborated (especially in light of the identification of major aedeagal types), we acknowledge that defining genera, let alone subgenera, in this group of Cetoniinae with hypertrophic males and poorly differentiated females remains a tentative endeavor. Further studies incorporating nuclear gene regions may be necessary to achieve a more conclusive resolution of the proposed classification.

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