UNIVERSIDADE FEDERAL DE PERNAMBUCO
CENTRO DE BIOCIÊNCIAS
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JOÃO CARLOS DA SILVEIRA REGUEIRA

REVISÃO TAXONÔMICA E ANÁLISE MORFOMÉTRICA DE *Blepharotoma* BLANCHARD, 1850 (COLEOPTERA: SCARABAEIDAE: SERICOIDINAE)

Recife, 2025

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Tese apresentada ao Programa de Pós-Graduação em Biologia Animal da Universidade Federal de Pernambuco, como requisito parcial para obtenção do título de doutor em Biologia Animal. Área de concentração: Taxonomia de grupos recentes.

Orientadora: Luciana Iannuzzi

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“*That's how a diamond grows,*

Give yourself the right chance over time

Don't believe them if they try to sell you something quicker,

That's how a diamond grows,

Reach as far as you can, then hold tight

Don't believe them if they try to tell you something different.”

(Jim Adkins, 2019)

RESUMO

Blepharotoma Blanchard, 1850 é um gênero de besouros fitófagos. Atualmente pertence à tribo Sericoidini (Scarabaeidae, Sericoidinae), tendo sido classificado em outras tribos ao longo dos anos. O táxon, originalmente monotípico, atualmente é composto por 20 espécies com registros na Argentina, Bolívia, Brasil, Paraguai e Peru. Desde a sua descrição, *Blepharotoma* sofreu diversos atos taxonômicos, tendo um total de nove novas espécies descritas dentro do gênero após a sua definição, e dez transferências, sendo a mais recente a espécie *Blepharotoma nitida* (Mannerheim, 1829), transferida de *Omaloplia* Schönherr, 1817. Tais mudanças, levam a questionar os limites internos do gênero devido a caracteres genéricos/superficiais. Para solucionar este tipo de problema, a revisão taxonômica do gênero tem sido indicada por diferentes autores. Além deste, dois métodos são importantes para a melhor definição do posicionamento de *Blepharotoma* e suas espécies, sendo eles as análises filogenéticas morfológicas e morfométrica. Portanto, a fim definir os limites e propor uma hipótese de relacionamento entre as espécies do gênero e de seu posicionamento tribal, realizamos neste trabalho a revisão taxonômica, análise filogenética a partir de caracteres morfológicos e análise morfométrica de *Blepharotoma*. Com isso, foi possível propor uma hipótese de posicionamento tribal, bem como os limites internos do gênero e das espécies que o compõem. A morfometria geométrica permitiu verificar variações no padrão de forma, entre os gêneros de Sericoidini, que os diferencia entre si. Da mesma forma, os resultados das espécies de *Blepharotoma*, mostram-se eficazes na diferenciação apenas para a determinadas espécies quando comparadas par-a-par. Quanto à proposta filogenética, recuperamos a monofilia de *Blepharotoma*, corroborando os resultados da morfometria em relação aos outros Sericoidini. Por fim, a revisão taxonômica resultou na redescrição de 19 espécies do gênero incluindo novos caracteres, além de uma expansão nos dados de distribuição geográfica.

Palavras-chave: Região neotropical; besouro; taxonomia integrativa; filogenia, forma.

ABSTRACT

Blepharotoma Blanchard, 1850 is a phytophagous beetle genus described. Currently belong to the tribe Sericoidini (Scarabaeidae, Sericoidinae), having been classified in several others over the years. This taxon, originally monotypic, is currently composed of 20 species distributed in Argentina, Bolivia, Brazil, Paraguay and Peru. Since its description, *Blepharotoma* passed through several taxonomic acts, having in total nine new species described in the genus and ten transfers, being the most recent the species *Blepharotoma nitida* (Mannerheim, 1829), transferred from *Omaloplia* Schönherr, 1817. Such changes lead to questioning the internal limits of the genre claiming on generic/superficial characters. To solve this kind of problem, a taxonomic revision has been recommended for some authors as necessary for the group. Besides, two methods are important to provide a better definition about the positioning of *Blepharotoma* and its species, the phylogenetic and morphometric analysis. Therefore, this work proposes taxonomic review, phylogenetic analysis based on morphological characters and morphometric analysis of the genus *Blepharotoma*. Therefore, to define the limits and propose a phylogenetic relationship hypothesis among species from this genus a its tribal positioning, in this work we carried out a taxonomic review, phylogenetic analysis based on morphological characters and morphometric analysis of *Blepharotoma*. Thus, it was possible to propose a hypothesis of tribal positioning, as the internal limits of the genus and its species. The geometric morphometrics analysis allowed us to verify that each genus of Sericoidini has a well-defined shape that differentiates them from each other. Still, the species results seem to be useful to differentiate some of them in peer-to-peer comparison. Regarding phylogeny, the analysis recovered the monophyly of *Blepharotoma*, corroborating with the results of morphometrics related to other Sericoidini. Finally, the taxonomic review resulted in the redescription of 19 genus' species including new characters, also extending the data from distribution for this species.

Key words: Neotropical; beetle; integrative taxonomy; phylogenetics; shape.

LISTA DE FIGURAS

PHYLOGENETIC ANALYSIS OF *BLEPHAROTOMA* (BLANCHARD, 1850) (SCARABAEIDAE; SERICOIDINAE; SERICOIDINI) BASED ON MORPHOLOGICAL CHARACTERS

TAXONOMIC REVIEW OF *BLEPHAROTOMA* (BLANCHARD, 1850) (COLEOPTERA: SCARABAEIDAE, SERICOIDINAE)

SUMÁRIO

1 INTRODUÇÃO GERAL

Scarabaeoidea Latreille, 1802 é a superfamília de Coleoptera onde estão incluídas as espécies de besouros comumente conhecidas como escaravelhos, e atualmente agrupa um total de 31 mil espécies (RATCLIFFE, 2014). Em termos taxonômicos os limites internos deste táxon têm um histórico bastante controverso. Originalmente chamado de Lamellicornia por Janssens (1949), agrupava as famílias Lucanidae, Passalidae e Scarabaeidae, esta última dividida em duas linhagens, Pleurosticti e Laparosticti (JANSSENS, 1949; KOHLMANN e MORÓN, 2003). Os Pleurosticti são caracterizados pela posição dos espiráculos no ápice dos esternitos e hábito alimentar fitófago ou fitosaprófago, enquanto os Laparosticti, possuem os espiráculos na membrana pleural e hábito alimentar coprófago ou saprófago (BALTHASAR, 1963). Devido a sua grande diversidade, começaram a ocorrer discordâncias entre as escolas em relação à classificação taxonômica dos grupos dentro de Scarabaeoidea. Na escola Europeia, por exemplo, Balthasar (1963) e Paulian (1988) adotaram a nomenclatura de Melolonthidae para os Pleurosticti, elevando-os ao nível de família. Enquanto isso, Endrödi (1966), na escola latino-americana, abandonou as séries Laparosticti e Pleurosticti e dividiu os membros internos de Scarabaeoidea nas famílias Lucanidae, Passalidae, Trogidae, Scarabaeidae e Melolonthidae. Já a escola norte-americana, baseada nos trabalhos de Browne e Scholtz (1995, 1999) e Lawrence e Newton (1995), passam a considerar 13 famílias dentro de Scarabaeoidea, sendo Melolonthinae uma subfamília de Scarabaeidae. Sendo assim, Scarabaeiodea poderia ser classificada de duas formas: (1) *sensu* Endrödi (1966) com cinco famílias, sendo Melolonthidae uma delas (latino-americanos e europeus); (2) *sensu* Lawrence e Newton (1995) com 13 famílias, sendo Melolonthinae uma subfamília de Scarabaeidae (norte-americanos).

Cerca de 20 anos depois dessas classificações, a família Melolonthidae é recuperada por Cherman e Morón (2014) baseados em análises filogenéticas utilizando dados morfológicos e moleculares, como um clado monofilético dentro da superfamília, retomando a discussão da classificação interna do grupo. Cherman e Morón (2014) questionaram o uso de Melolonthidae, uma vez que pela lei da prioridade, Cetoniidae deveria ser o nome utilizado. Mas determinaram como Melolonthidae a família em detrimento de Cetoniidae, justificando a decisão do nome devido ao fato de que Melolonthidae era mais utilizado até então. Mais recentemente, McKenna et al. (2019) em uma análise filogenética com dados moleculares, recuperou Scarabaeidae como um clado monofilético, e Melolonthinae volta a ser considerado um clado de besouros fitófagos de Scarabaeidae, também monofilético, sendo a classificação atualmente utilizada. Posteriormente esta classificação foi corroborada pela filogenia proposta por Dietz et al., 2024.

Melolonthinae é uma das subfamílias mais diversas de Scarabaeoidea, reunindo 28 tribos, 750 gêneros e 11.000 espécies aproximadamente, registrada no mundo (EVANS, 2002; BOUCHARD ET AL., 2011; SCHOLTZ e GREBENNIKOV, 2016). Seis destas tribos ocorrem no Brasil: Diplotaxini, Macrodactylini, Melolonthini, Tanyproctini, Sericini e Sericoidini, somando 621 species and 32 genera (CHERMAN e VAZ-DE-MELLO, 2025). A maioria dos escarabeídeos fitófados possui hábito crepuscular ou noturno, período em que os espécimes são encontrados voando próximos a luzes artificiais, seja copulando, se alimentando ou descansando sobre a folhagem de plantas hospedeiras (RITCHER, 1958; RATCLIFFE et al., 2002). Tal comportamento, permite que as espécies de scarabeídeos fitófagos contribuem de forma benéfica para edafogênese e boa qualidade do solo, ao realizarem aberturas de galerias e auxiliarem na ciclagem de nutrientes (MORÓN, 1997; 2004). Entretanto, as larvas, que se alimentam de diferentes partes de plantas, podem ser fitosaprófagas, rizófagas ou xilófagas (ENDRÖDI, 1966; MORÓN, 1997), muitas vezes consideradas importantes pragas agrícolas pelos danos causados a diferentes culturas de interesse econômico (SALVADORI e PEREIRA, 2006).

Apesar da importância econômica e diversidade dos melolontíneos, existem imprecisões quanto à definição dos táxons que a compõem, tanto no nível taxonômico de espécies, como em gêneros e tribos da subfamília (SMITH, 2006). Com isso, estudos de cunho aplicados e ecológicos podem apresentar dados enviesados e preocupantes, uma vez que as identificações taxonômicas podem se dar de forma incorreta. O mesmo pode acontecer quando se trata da conservação dos ecossistemas (CHERMAN et al., 2013). Da mesma forma, parte dos estudos referentes à família, como pesquisas referentes à ecologia e evolução dos grupos, é inviabilizada em virtude dos obstáculos oriundos de dados taxonômicos incompletos e do material, sem informações precisas, depositados em acervos de coleções de museus. Além disso, são poucos os trabalhos de revisão taxonômica da maioria dos gêneros de Melolonthidae, o que dificulta, por sua vez, os estudos filogenéticos relacionados a este grupo (RATCLIFFE et al., 2002). Recentemente, Dietz et al. (2024), verificaram a parafilia de Melolonthinae e propuseram uma nova classificação onde a subfamília é desmembrada em dois novos clados irmãos monofiléticos, Sericinae Kirby, 1837, composto pelas tribos Ablaberini, Diphucephalinie e Sericini, e Sericoidinae Erichson, 1847, e Sericinae composto pelas tribos: Automoliini, Heteronychini, Liparetrini, Maechidiini, Phyllotocini, Scitalini e Sericoidini.

Dentre as tribos incluídas em Sericoidinae, Sericoidini Erichson, 1847, destaca-se por apresentar 75 espécies alocadas em cinco gêneros: *Apterodemidea* Gutiérrez, 1952, *Blepharotoma* Blanchard, 1850, *Manonychus* Moser, 1919, *Ovomanonychus* Costa, Cherman & Iannuzzi, 2020, e *Sericoides* Guérin-Méneville, 1839 (EVANS e SMITH 2009; COSTA ET AL. 2020). As espécies pertencentes a essa tribo são primariamente identificadas pela seguinte combinação de caracteres:

labrum abaixo do clípeo, em planos distintos; clípeo e labro separados (com o lábio projetando-se além do clípeo em vista dorsal) ou fusionados (com sutura diferenciando as parte); antena com 8-9 antenômeros (incluindo 3-5 antenômeros da lamela); processo meso- e metasternal ausente; abdômen com 6 ventritos (ventrito I abaixo da metacoxa), com aproximadamente a mesma altura, igualmente convexos, separados por sutura distinta; tergitos e ventritos dos segmentos abdominais distintos, separados por sutura longitudinal; metatibia com dois esporões apicais, abaixo e acima da articulação tarsal; toda as garras tarsais simétricas (SMITH, 2008).

Nos últimos anos, Sericoidini tem sido alvo de trabalhos taxonômicos importantes. Smith (2008), transferiu a espécie-tipo de *Aplodema* Blanchard, 1850 (*A. magellanica* Blanchard, 1846) para *Sericoides*, além de realizar novas combinações em *Blepharotoma*. Cherman et al. (2016), em análise filogenética, testaram o relacionamento entre os Diplotaxini e transferiram quatro espécies de *Hilarianus* Blanchard, 1850 (*Hilarianus ovalis* Blanchard, 1850; *H. rufinus* Blanchard, 1850; *H. suboblongus* Blanchard, 1850 e *H. uniformis* Blanchard, 1850) para Sericoidini. Smith e Evans (2018) transferiram *Ulata* Saylor, 1945, gênero que anteriormente fazia parte de Sericoidini (SMITH, 2008), para a tribo recém-criada Athliini Smith e Evans, 2018. Costa et al. (2020), propuseram um novo gênero, *Ovomanonychus*, para a tribo. Os últimos autores também foram responsáveis pela transferência de *Manonychus* Moser, 1919 para Sericoidini após estudo filogenético envolvendo tribos próximas (COSTA et al., 2021). Acerca de *Apterodemidea*, até o momento o gênero é reconhecido como monotípico tendo como representante, *A. paraguayensis* (ARROW, 1903).

Blepharothoma Blanchard, 1850, é um dos gêneros mais diversos de Sericoidini, e assim como a tribo, o gênero passou por importantes alterações na sua história taxonômica desde a sua descrição original. O táxon foi proposto por Blanchard (1850), monotípico [*B. tarsalis* Blanchard, 1850], dentro de Melolonthini, e posteriormente transferido para outras tribos ao longo dos anos (e.g., Macrodactylini por Dalla-Torre (1912-1913); Sericini por Frey (1973); Liparetrini por Evans (2003); Sericoidini por Smith (2008)). *Blepharotoma* se distingue dos demais gêneros de Melolonthinae pela seguinte combinação de caracteres: labro oculto pelo clípeo, em vista dorsal; labro e clípeo separados por uma fina sutura; margem clipeal elevada; antena com oito antenômeros; processo meso e metasternal ausente; abdome com seis ventritos convexos e de igual comprimento (ventrito I oculto pelas metacoxas); metatíbias com dois esporões apicais, posicionados acima e abaixo da articulação tarsal; garras simétricas e apicalmente denteadas (SMITH, 2008). Os machos são distintos das fêmeas por apresentarem tarsômeros I-IV aplanados e cobertos por tufo de cerdas ventralmente.

Atualmente, *Blepharotoma* inclui 20 espécies, 12 espécies possuem registros Brasil (GROSSI e VAZ-DE-MELLO, 2025). Além do Brasil, o gênero possui registros na Argentina (cinco espécies), Bolívia (três espécies), Paraguai (uma espécie) (EVANS e SMITH, 2009). Após a descrição original

do gênero, Moser (1918; 1924) descreveu mais duas espécies para o gênero, *B. nitidula* Moser, 1918 e *B. petropolisana* Moser, 1924. Martínez (1959) descreveu *B. confusa* Martínez, 1959, com riqueza de detalhes, ao contrário das descrições anteriores, com destaque para o tórax e a tíbia principalmente, além disso, transferiu *Heteronyx ohausiana* (Saylor, 1938) para *Blepharotoma*. Frey (1973) realizou um importante passo na taxonomia do gênero, propondo uma chave de identificação e descrição de seis novas espécies (*B. argentina*, *B. boccainae*, *B. calvicollis*, *B. martinezi*, *B. nitens* e *B. plaumanni*). Adicionalmente, Frey (1973) apresentou caracteres de genitália juntamente com desenhos esquemáticos desta estrutura pela primeira vez para o gênero. Smith (2008) transferiu *Aplodema angustata* Blanchard; 1850, *Heteronyx boliviana* Moser; 1919, *H. corumbana* Moser, 1921; *H. cuyabana* Moser, 1919; *H. heney* Moser, 1919; e *H. schencklingi* Moser, 1919 para *Blepharotoma*, mencionando sobre a possibilidade dessas espécies serem sinonímias daquelas alocadas previamente nesse gênero e destaca a necessidade de revisão do gênero para que essas dúvidas pudessem ser sanadas. Cherman et al. (2016) transferiram *Hilarianus suboblongus* Blanchard, 1850 e *H. uniformis* Blanchard, 1850 para o gênero em estudo, mencionando que tais transferências deveriam ser confirmadas na ocasião da revisão de *Blepharotoma*. Por fim, Pacheco and Ahrens (2024), em estudo realizado com Sericini, transferiram *Omaloplia nitida* Mannerheim, 1829 para o gênero.

Em termos ecológicos, existem pouquíssimas informações quanto ao hábito dessas espécies. Polesel e Damborsky (2017), capturaram indivíduos de *B. plaumanni* Frey nos Chacos argentinos, utilizando armadilha de luz, durante as estações de primavera e verão. Valmorbida et al. (2018) coletaram larvas de *B. uniformis* Blanchard em áreas de cultivo de soja e milho, nos Pampas brasileiros, sugerindo que estes se alimentavam de partes das plantações. Tais informações sugerem a possibilidade de espécies de Blepharotoma possuírem uma importante relação com cultivos agrícolas e a correta identificação tanto do gênero quanto de suas espécies teriam um papel determinante. Já que identificações errôneas destas espécies podem enviesar os resultados das pesquisas de cunho bioecológico e da conservação da riqueza nos agroecossistemas (CHERMAN et al., 2013).

Tendo em vista alterações taxonômicas ocorridas em *Blepharotoma*, incluindo transferências e novas descrições de espécies, é possível perceber uma certa dificuldade de delimitação entre elas. Consequentemente, a devida identificação de suas espécies torna-se difícil, visto que além de ausência de descrições mais detalhadas, há carência de uma chave de identificação atualizada. Outro fator importante está na incerteza de seu posicionamento tribal, dado o grande histórico de transferências de táxons. Todos estes fatores levantam a necessidade da revisão taxonômica do gênero, como já mencionado por Cherman et al. (2016) e Costa et al. (2021), com a devida inclusão de métodos integrativos como a filogenia e morfometria para que hipóteses mais robustas sejam propostas.

Diante das questões taxonômicas apresentadas, consideramos importante o uso de ferramentas integradas à taxonomia morfológica. Uma delas, a análise filogenética é um método que procura estudar as relações de parentesco entre os organismos, representadas através da distribuição de caracteres em cladogramas denominados de árvores filogenéticas (BRINKMAN e LEIPE, 2001). Através desse método de reconstrução filogenética é possível propor hipóteses sobre as relações de parentesco e tentar entender a história evolutiva das espécies, o que pode auxiliar na identificação dos táxons (WOOD, 2010). De fato, o método se mostra muito importante para a taxonomia integrativa, muitas vezes oferecendo suporte a decisões taxonômicas, como no caso da família Scarabaeidae já citada. Proposições de transferências realizadas por Cherman et al., 2016, por exemplo foram baseadas em análises filogenéticas, bem como a atual nomenclatura para Scarabaeidae proposta por Dietz et al., 2024.

Outra ferramenta útil para os estudos de taxonomia integrativa, a morfometria geométrica, tem se mostrado importante por analisar a variação da forma e oferece suporte estatístico, que podem auxiliar na delimitação de táxons (SCHLICK-STEINER et al., 2010). O método morfométrico baseia-se no estudo da forma dos indivíduos ou parte destes considerando os seus marcos anatômicos, assim como, seus fatores causais (BOOKSTEIN, 1997). Procrustes é um dos métodos da morfometria geométrica que alinha as coordenadas baseando-se nos quadrados mínimos, através da translação, rotação e ajuste de escala dos marcos anatômicos. Com isso, possibilita uma análise comparativa mais precisa, excluindo variações que não estejam relacionadas à forma (DRYDEN e MARDIA, 2016). Bookstein (1997) define a forma em estudos morfométricos como medidas geométricas que permanecem as mesmas independentemente da sua escala física. Na morfometria geométrica baseada em marcos anatômicos, a forma se dá pela distribuição destes pontos, que são pontos de correspondência homóloga e identificáveis nos espécimes estudados (WEBSTER e SHEETS, 2010).

Insetos, especialmente besouros, são comumente utilizados em análises morfométricas, por possuírem estruturas corporais externas rígidas, até mesmo em áreas membranosas como asas (SU et al., 2015). De fato, estudos morfométricos têm se mostrado bastante úteis para responder perguntas para o grupo. Em Sericoidinae, o método vem sendo usado para identificação de padrões de variação intraespecífica (BARROS et al., 2020; POLIHRONAKIS, 2006). Contudo, Li et al. (2016), utilizando o método foram capazes de diferenciar as espécies chinesas do gênero *Oreoderus* Burmeister, 1842, demonstrando a importância que esta fonte de dados pode representar em estudos taxonômicos.

1.1. OBJETIVOS

1.1.1. **Objetivo geral**

Revisar a taxonomia de *Blepharotoma* Blanchard, 1850, propor uma hipótese de relação filogenética para as linhagens atualmente incluídas no gênero; e verificar se existem padrões morfométricos para as espécies atualmente incluídas no gênero.

1.1.2. **Objetivos específicos**

- ➔ Redescrever o gênero e suas espécies, incluindo caracteres ainda não abordados;
- ➔ Propor uma chave de identificação para as espécies de *Blepharotoma*;
- ➔ Verificar as relações de parentesco entre as espécies atualmente incluídos em *Blepharotoma*;
- ➔ Analisar a variação morfométrica das espécies incluídas em *Blepharotoma*;
- ➔ Atualizar a distribuição geográfica das espécies de *Blepharotoma*.

2 PHYLOGENETIC ANALYSES OF *BLEPHAROTOMA* (BLANCHARD, 1850) (SCARABAEIDAE; SERICOIDINAE; SERICOIDINI) BASED ON MORPHOLOGICAL CHARACTERS*

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ABSTRACT

Blepharothoma is a genus from the tribe Sericoidini (Sericoidinae) with 20 species. The genus already passed through several tribes within its existence (Melolonthini, Macrodactylini, Sericini and Liparetrini). Also originally described as monotypic, of course it has received various insertions by new species descriptions and transferences from other genera. Since it was created the genera never received a study related to its intern phylogenetic relationships or focused on its relationship with other tribes. In this research we aim to analyse these relationships through morphological phylogenetics. Thus, we analysed 41 taxa from eight tribes, 19 of them are species of *Blepharotoma*, ten species from tribes *Blepharotoma* was a member previously, six from geographically near tribes, and the other genera from Sericoidini. Analyses were made with equal and implied weighing, using *Aegidielus zezaoi* as the root species. As a result, it was possible to construct 84 morphological characters, and one tree retained in each analyses (equal and implied weighing). In both trees *Blepharotoma* behaves as a monophyletic clade, also its position as a Sericoidini is corroborated. Also, this work offers a clue of the relation of Sericoidini among the other neotropical clades of Scarabaeidae as a monophyletic clade.

Keywords: Beetles; Chafers; Neotropical; South America.

1. Introduction

Blepharotoma Blanchard, 1850 is a neotropical genus currently allocated in Sericoidini (Smith, 2008), which has an extensive tribal history. Currently, Sericoidini is part of the subfamily Sericoidinae with Automoliini, Heteronychini, Liparetrini, Maechidiini, Phyllotocini, Scitalini (Dietz et al., 2023). Originally, it was classified as Melolonthini at the time of this description (Blanchard, 1850). After that it was transferred to Macrodactylini by Dalla-Torre (1912-1913); to Sericini by Frey (1973); to Liparetrini by Evans (2002); and to Sericoidini by Smith (2008), where it is at the moment (Smith 2008, Cherman et al., 2016 and Costa et al., 2021).

There are 20 species included in this genus, with *Blepharotoma tarsalis* Blanchard, 1850 as the type species designated by monotypy. Most species (10) were described in this genus, of the remaining ones, six have been transferred from *Heteronyx* Guerin-Meneville, 1831 (Frey, 1973; Smith, 2008), two from *Hilarianus* Blanchard, 1851 (Cherman, 2016), one from *Aplodema* Blanchard, 1850 (Smith, 2008) and one from *Omaloplia* Schönherr, 1817 (Pacheco and Ahrens, 2024). Currently, accepted names within *Blepharotoma* are *B. angustata* (Blanchard, 1850) (=*Aplodema angustata*), *B. argentina* Frey, 1973, *B. boccainae* Frey, 1973, *B. boliviana* (Moser, 1919) (=*Heteronyx bolivianus*), *B. calvicolis* Frey, 1973, *B. confusa* Martínez, 1959, *B. corumbana* (Moser, 1921) (=*Heteronyx corumbanus*), *B. cuyabana* (Moser, 1919) (=*Heteronyx cuyabanus*), *B. heynei* (Moser, 1919) (=*Heteronyx heynei*), *B. martinezi* Frey, 1973, *B. nitens* Frey, 1973, *B. nitida* (Mannerheim, 1829) (=*Omaloplia nitida*), *B. nitidula* Moser, 1918, *B. ohausiana* (Saylor, 1938) (=*Heteronyx ohausina*), *B. petroposilana* Moser, 1924, *B. plaumanni* Frey, 1973, *B. schenklingi* (Moser, 1919) (= *Heteronyx schenklingi*), *B. suboblongus* (Blanchard, 1850) (=*Hilarianus suboblongus*), *B. tarsalis* Blanchard, 1850 e *B. uniformis* (Blanchard, 1850) (=*Hilarianus uniformis*) (Cherman et al., 2016; Frey, 1973; Smith, 2008).

Knowing that *Blepharotoma* is a genus with a vast history of taxonomic changes, passing through various tribes, a series of genus transferences and new species descriptions. It was noticeable that its internal relationships became uncertain. Since the genus has never undergone any phylogenetic analysis to test its evolutive relationships, this paper proposes a hypothesis of phylogenetic relationship for the *Blepharotoma* species of the genus, based on morphological data from adult males and females. Also, test the actual tribal position of the *Blepharotoma* and

its relation to near genera, including other neotropical ones. Our hypothesis is that *Blepharotoma* is part of Sericoidini tribe as proposed by Smith, 2008, and that *Blepharotoma* is a monophyletic genus.

2. Material and methods

2.1. Examined material

We analyzed 76 specimens, which correspond to the 41 Scarabaeidae terminal taxa included, from 8 tribes. Most of the specimens analyzed were obtained by loan from various entomological collections. Only specimens of *B. suboblongus* and *B. uniformis* were analyzed through high-definition pictures. The material examined is housed in the following institutions: **CERPE** - Coleção Entomológica da Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brazil (P. C. Grossi); **CEUFPE** - Coleção Entomológica da Universidade Federal de Pernambuco, Recife, Pernambuco, Brazil (L. Iannuzzi); **DZUP** - Coleção Entomológica Pe. J.S. Moure, Universidade Federal do Paraná, Curitiba, Brazil (L. Massutti and C. S. Ribeiro-Costa); **MNHN** - Muséum National d'Histoire Naturelle, Paris, France; **MNRJ** – Museu Nacional do Rio de Janeiro, Rio de Janeiro, Brazil(M. Couri); **MZSP** - Museu de Zoologia, Universidade de São Paulo, São Paulo, São Paulo, Brazil (S. Casari); **NHMB** - Naturhistorisches Museum Basel, Basel, Switzerland (M. Borer); **ZMHB** - Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (J. Frisch and J. Willers).

2.2.Taxon sampling

The ingroup consisted of 19 *Blepharotoma* species. *Blepharotoma angustata* (Blanchard, 1850) has not been analyzed since the material is unavailable.

The outgroups include species of the current tribe (Sericoidini), plus species within the tribes used in past classifications to place *Blepharotoma*: Liparetrini (*Liparetrus discipennis* (Guérin-Méneville, 1831)); Macrodactylini (*Alvarinus hilarii* Blanchard, 1850, *Macrodactylus subspinosus* (Fabricius, 1775), *Plectris tomentosa* Saint-Fargeau & Audinet-Serville, 1828);

Melolonthini (*Modialis prasinella* Fairmaire & Germain, 1860, *Melolontha melolontha* (Linnaeus, 1758), *Phylophaga* sp.); Sericini (*Astaena* sp., *Serica brunnea* e *Symmela mutabillis* Erichson, 1835); and Sericoidini (*Apterodemidea paraguyaensis* (Arrow 1903) and *Manonychus unguicularis* Moser, 1919). Also, other neotropical tribes were included, since they share the same geographical distribution and some morphological similarities (Cherman, 2016): Athliini (*Athlia rustica* Erichson, 1835), Diplotaxini (*Apogonia rauca* Blanchard, 1851, *Diplotaxis tristis* Kirby, 1837, *Liogenys palpalis* (Eschscholtz, 1822), *Liogenys diodon* Burmeister. 1855, *Pachrodema castanea* Blanchard, 1851) (Costa et al., 2020) (Table 1), and Aegidiini (*Aegidielus zezaoi*).

2.3. Character construction

This study was based on the external morphology of males and females to construct the characters (Figure 1). Therefore, data was collected from relevant body structures, including the mouthparts, and male genitalia, the last one, only when a male specimen was available. The specimens were examined using stereomicroscope Zeiss Stemi DV4. To analyze characters from mouthparts and male genitalia, the specimens underwent dissection. In this process, the specimens were softened using boiling water and the structures were removed with tweezers, observed and lately glued in a card affixed to the pin of its respective specimen. External morphology of males and females, including mouthparts and male genitalia have been used to construct the characters. The character construction were primarily based on the methodologies of Cherman et al. (2016) and Costa et al. (2021)

2.4.Phylogenetic analysis

The character matrix was generated through Delta 1.04 software and edited by Mesquite 3.81. The characters not visualized were marked as "-". Phylogenetic analysis was performed on TNT 1.1, with equal weighting and implied weighting characters. On the "*Data*" menu, in "*Outgroup taxa "* we chose *A. zezaoi* to root the tree, as Orphninae is considered the outermost tribe examined (Dietz et al., 2023). The following commands have been followed to perform the analysis with equal weights: "*Analyze* > *Traditional search* > *Random seed*: 10*; reppls*: 9999*; tree bisection reconection* (*TBR*)". To analyze the matrix with implied weighting

characters, the following commands were used: *Settings > Implied weighting > using implied weights*". For both analyses (equal and weighting), values of k from 0-10 and the optimal value were obtained, using the script aaa.run. Finally, a tree was generated, respecting the principle of parsimony by using the one with the least number of steps (k10 = 37,161).

Bremmer support was calculated using "*Analyze > Suboptimal >*, where the values are increased until all clades are lost". We follow with "*Analyze > Traditional search > Random seed*: 10; *reppls*: 9999; *tree bisection reconection* (*TBR*); *Tree from RAM*; *Stop when maxtree hit*".

The tree edition was made through Winclada 1.61 and Adobe Photoshop.

3. Results and Discussion

We constructed 84 morphological characters, including mouthparts and male genitalia (Supplementary Material 1), listed below. (CI = Consistency index; RI= Retention index)

1. Frons, width, relation between interocular distance and eye width: (0) 2x eyes width (Figure 2A); (1) 3x eyes width; (2) 5x or more eyes width (Figure 2B) (Cherman et al., 2016) (CI: 0,167; RI: 0600).
2. Frons, punctures: (0) coarse (Figure 2B); (1) thin (Figure 2A) (CI: 0,125; RI: 0,500).
3. Frons, punctures intensity: (0) dense (Figure 2B); (1) sparse (Figure 2A) (CI: 0,111; RI: 0,529).

   Dense punctures are when the distance among punctures is smaller than the diameter of the punctures; Sparse, when the distance among the punctures is bigger than the punctures diameter.
4. Clypeus, surface: (0) concave; (1) plane (Cherman et al., 2016) (CI: 1; RI: 1).
5. Clypeus, frontoclipeal suture: (0) present; (1) absent (Costa et al., 2021) (CI: 0,250; RI: 0,250).
6. Clypeus, teeth on anterior margin: (0) present; (1) absent (Costa et al., 2021) (CI: 1,000; RI: 1,000).
7. Clypeus, ocular *canthus*: (0) covered by lateral projection; (1) not covered (Furhrmann, 2015) (CI: 0,250; RI: 0,700).

8. Clypeus, separation from labrum: (0) with suture (Figure 2C); (1) without suture (CI: 0,500; RI: 0,500).
9. Clypeus, rugosity: (0) smooth; (1) rugose(Figure 2D) (CI: 0,500; RI: 0,000).
10. Mouthparts, position in relation to clypeus: (0) hidden; (1) not hidden (Costa et al., 2021) (CI: 0,333; RI: 0,500).
11. Labrum, relation with the head: (0) vertical; (1) horizontal ou subhorizontal (Cherman et al., 2016) (CI: 0,333; RI: 0,500).
12. Labrum, in relation to the clypeus: (0) fused with clypeus; (1) separated from the clypeus (CI: 0,200; RI: 0,714).
13. Labrum, plane in relation to the clypeus: (0) same plane; (1) plane below (Costa et al., 2021) (CI: 0,200; RI: 0,636).
14. Labrum, frontal view, apical emargination, intensity: (0) shallow; (1) deep (Lacroix, 1989) (CI: 0,167; RI: 0,286).
15. Labrum, base: (0) curved; (1) straight; (2) angulous (Cherman et al., 2016) (CI: 0,250; RI: 0,250).
16. Mandibule, mola, surface: (0) ornate; (1) smooth (Coca-Abia, 2007) (CI: 0,200; RI: 0,789).
17. Mandibule, mola, surface ornamentation: (0) faired; (1) grooved (Coca-Abia 2007; Cherman et al., 2016) (CI: 0,333; RI: 0,750).
    This character is dependent from the previous one (character 17).
18. Mandible, mola, distal groove, surface: (0) toothed; (1) smooth (CI: 0,250; RI: 0,000).
    Character dependent on the previous one (character 18) (Costa et al., 2021).
19. Maxilla, basal margin of galea, lobe: (0) present; (1) absent (Costa et al., 2021) (CI: –; RI: –).
20. Maxilla, galea, basal margin, sinuosity after the lobe: (0) present; (1) absent (Costa et al., 2021) (CI: 0,250; RI: 0,571).
21. Maxilla, lacinia, tooth: (0) present; (1) absent (CI: 0,167; RI: 0,545).
22. Maxilla, apical palpomere, relation medial width/distal width: (0) 2x or larger; (1) same width (Cherman et al., 2016) (CI: 1,000; RI: 1,000).
23. Maxilla, galea, teeth, relation between torsion and maxilla axis: (0) present; (1) absent (Cherman et al., 2016) (CI: 0,250; RI: 0,250).
24. Labium, shape: (0) wider than long; (1) longer than wide; (2) as wide as it is long (Costa et al., 2021) (CI: 0,143; RI: 0,368).

25. Labium, palp insertion: (0) visible; (1) not visible (Cherman et al., 2016) (CI: 0,143; RI: 0,684).
26. Labium, number of palpomers: (0) two; (1) three (CI: 1,000; RI: 1,000).
27. Labium, medial emargination on apical margin: (0) present; (1) absent (Costa et al., 2021) (CI: 0,333; RI: 0,600).
28. Labium, medial emargination on apical margin, shape: (0) narrow and triangular; (1) wide and semicircular (Costa et al., 2021) (CI: 0,250; RI: 0,250).
    Character dependent on the previous one (character 27).
29. Labium, suture ligula-prementum: (0) present; (1) absent (Costa et al., 2021) (CI: 0,167; RI: 0,545).
30. Labium, apical margin, lateral lobes: (0) present; (1) absent (Costa et al., 2021; Lawrence et al., 2011) (CI: 0,167; RI: 0,643).
31. Pronotum, setae: (0) present; (1) absent (Costa et al., 2021) (CI: 0,167; RI: 0,643).
32. Pronotum, length-width ratio: (0) longer than wide; (1) wider than long (Costa et al., 2021) (CI: 0,250; RI: 0,400).
33. Pronotum, lateral margin, longitudinal row of setae: (0) present; (1) absent (Costa et al., 2021) (CI: 0,200; RI: 0,200).
34. Pronotum, posterolateral region, cavity: (0) present; (1) absent (Costa et al., 2021) (CI: 0,500; RI: 0,500).
35. Pronotum, posterior region: (0) projected; (1) not projected (Costa et al., 2021) (CI: 0,500; RI: 0,500).
36. Pronotum, punctures distribution: (0) sparse (Figure 2E); (1) dense (Figure 2F) (CI: 0,100; RI: 0,400).
    Dense punctuation occurs when the distance between two punctures are smaller than diameter of one puncture; Sparse, when the distance among the punctures are larger than the diameter of one punctuation (CI: 0,083; RI: 0,313);
37. Pronotum, punctures: (0) coarse (Figure 2F); (1) thin (CI: 0,125; RI: 0,588).
38. Pronotum, setae distribution in dorsal surface: (0) sparse (Figure 2E)/ (1) dense (Figure 2F).
    Sparse: there is no bristle overlapping; Dense: when there bristle overlapping (CI: 0,167; RI: 0,444).
39. Scutellum, apex: (0) rounded (Figure 3A); (1) angular (Figure 3B) (CI: 0,083; RI: 0,083).

40. Scutellum, punctures (Figure 3B): (0) present; (1) absent (Costa et al., 2021) (CI: 0,200; RI: 0,200).
41. Escutelum, setae: (0) absent; (1) present (CI: 0,167; RI: 0,286).
42. Mesosternum, setae, length: (0) short; (1) long (CI: 0,143; RI: 0,684).
    Short ≤ 0,05 mm; Long > 0,05 mm (Costa et al., 2021).
43. Mesepimerum, inner, posterior corner: (0) projected; (1) not projected (Costa et al., 2021) (CI: 0,167; RI: 0,286).
44. Metaventrite, length in relation to the metacoxae: (0) shorter; (1) equal; (2) longer (Cherman et al., 2016) (CI: 0,222; RI: 0,611).
45. Metaventrite, male, setae: (0) dense and long; (1) sparse and short (CI: 0,143; RI: 0,400)
    Sparse: refers to when there is no bristle overlapping / Dense: when there is bristle overlapping / Long > 0,05 mm/ Short ≤ 0,05 mm.
46. Elitra, costae on interistriae: (0) present; (1) absent (Costa et al., 2021) (CI: 0,200; RI: 0,750).
47. Elytra, apex of each elytrum: (0) separated; (1) contiguous (CI: 0,111; RI: 0,385).
48. Elytra, shape: (0) oblong (Figure 3C); (1) oval (CI: 0,091; RI: 0,412).
49. Elytra, punctures: (0) coarse (Figure 3D); (1) thin (Figure 3C) (CI: 0,200; RI: 0,429).
50. Elytra, punctures distribution: (0) sparse; (1) dense (CI: 0,167; RI: 0,500).
    Dense punctures is when the distance among punctures are smaller than the diameter of each puncture; Sparse, when the distance among the punctures are bigger than the diameter of each puncture.
51. Procoxae, shape: (0) transversal; (1) conic (Costa et al., 2021) (CI: 0,200; RI: 0,333).
52. Protibiae, external margin, basal denticle: (0) present; (1) absent (CI: 0,333; RI: 0,667).
53. Protibiae, external margin, position of denticle: (0) above medial line; (1) under medial line (Figure 4A) (CI: 0,182; RI: 0,667).
    This character depends on the previous one (character 52).
54. Protibiae, angle formed between teeth II and III: (0) obtuse; (1) straight; (2) acute (Costa et al., 2021) (CI: 0,182;RI: 0,400).
55. Protarsi, protarsomeres: (0) lobed; (1) not lobed (CI: 0,333; RI: 0,000).
    Lobed refers to the presence of lateral projection on tarsomeres.
56. Protarsomeres, male dimorphism: (0) present (Figure 4B); (1) absent (CI: 0,333; RI: 0,714).
    Male dimorphism refers to the presence of lobed tarsomers plus the presence of tuff os setae in the protarsomeres only on males.

57. Protarsomeres II- IV, shape: (0) cylindrical; (1) piriform (CI: 0,333; RI: 0,778).
58. Pro-, meso- and metatarsomeres, claws: (0) simple; (1) bifid (Costa et al., 2021) (CI: 0,250; RI: 0,500).
59. Pro- and mesotarsomeres, ventral face, tuff of setae: (0) present; (1) absent (Costa et al., 2021) (CI: 0,200; RI: 0,714).
60. Mesocoxae: (0) contiguous; (1) not contiguous (Costa et al., 2021) (CI: 0,250; RI: 0,571).
61. Mesocoxae, relation length/width: (0) up to twice as longer than wide; (1) three times longer than wide (Costa et al., 2021) (CI: 0,167; RI: 0,286).
62. Mesofemurs, posterior region, double row of punctures, confluence: (0) present; (1) absent (Costa et al., 2021) (CI: 0,250; RI: 0,667).
63. Mesotibiae, anterior region, transversal keel II: (0) present; (1) absent (Ahrens, 2005) (CI: 0,200; RI: 0,765).
64. Metacoxae, length compared to ventrite II length: (0) smaller or subequal; (1) bigger (Cherman et al., 2016) (CI: 0,200; RI: 0,429).
65. Metacoxae, lateral: (0) straight; (1) angular (Costa et al., 2021) (CI: 0,167; RI: 0,375).
66. Metatibiae, base, transversal keel II: (0) present; (1) absent (Costa et al., 2021) (CI: 0,250; RI: 0,400).
67. Metatibiae, spurs, relation to the tarsal insertion: (0) close to each other on medial face in the middle of tibia (left and right side of tarsal articulation); (1) widely separated on medial or apical face of left and right side of tarsal articulation; (2) ventrally and contiguously on apical face; (3) close to each other but separated on apical face, sublateral in respect to tarsal articulation (Ahrens, 2005) (CI: 0,273; RI: 0,667).
68. Metatibiae, spurs, length: (0) equal; (1) unequal (Costa et al., 2021) (CI: 0,111; RI: 0,333).
69. Metatibiae, apex, disc surface in dorsal view: (0) proeminent; (1) not prominent (Costa et al., 2021) (CI: 0,125; RI: 0,222).
70. Abdomen, longitudinal keel between ventrite and tergite: (0) spare; (1) not spare (Costa et al., 2021) (CI: 0,200; RI: 0,667).
71. Ventrites II-VI, disc, transverse row of punctures: (0) present; (1) absent (Costa et al., 2021) (CI: 0,111; RI: 0,385).
72. Ventrites, length of ventrite V related to ventrite VI: (0) longer; (1) shorter or equal (Katovich, 2008) (CI: 0,333; RI: 0,714).

73. Ventrite V, suture with propygidium: (0) present; (1) absent (Katovich 2008) (CI: 0,143; RI: 0,571).
74. Ventrites, setae distribution: (0) dense; (1) sparse (CI: 0,167; RI: 0,583).
    Sparse: refers to when there is no bristle overlapping; Dense: when there is bristle overlapping.
75. Ventrites, setae diameter: (0) coarse; (1) thin (CI: 0,111; RI: 0,385).
76. Pygidium, visible portion, punctures: (0) present (Figure 4C); (1) absent (CI: 0,167; RI: 0,167).
    Visible portion refers to the area of pygidium that is not covered by the elytra.
77. Pygidium, relation length/width: (0) larger than long; (1) as large as long; (2) longer than large (Costa et al., 2021) (CI: 0,400; RI: 0,400).
78. Parameres, relation length/width: (0) as long as wide; (1) longer than wide; (2) less long than wide (CI: 0,333; RI: 0,000).
79. Parameres, distal area, intern margin: (0) straight; (1) curvy (Costa et al., 2021) (CI: 0,125; RI: 0,300).
80. Parameres, apex, direction: (0) convergent; (1) parallel (Costa et al., 2021) (CI: 0,100; RI: 0,250).
81. Parameres, lateral, surface: (0) grooved; (1) smooth (Costa et al., 2021) (CI: 0,167; RI: 0,286).
82. Falobasis, dorsal area, distal margin: (0) smooth; (1) grooved (Costa et al., 2021) (CI: 0,167; RI: 0,615).
83. Falobasis, dorsal area, longitudinal midline: (0) visible; (1) not visible (Costa et al., 2021) (CI: 0,200; RI: 0,200).
84. Falobasis, midline constriction: (0) present; (1) absent (Costa et al., 2021) (CI: 0,143; RI: 0,571).

Traditional search with equal weights (best score = 477; CI = 0.195; RI = 0.517) and with implied weights (best score = 8,91026; CI = 0.195; RI = 0.517) retained only one tree each (Figures 5,6). In this study, we recovered the positioning of *Blepharotoma* in Sericoidini corroborating the determination of Smith (2008). But, opposed to what is found in Costa et al., 2021, *Blepharotoma* seems to be closer to the other Sericoidini without Athliini. In the mentioned study *Blepharotoma* appears as a sister group from Athliini + other Sericoidini, while in our study the placement of the *Blepharotoma* and Athliini are inverted, with Athliini being

sister group of all Sericoidini including *Blepharotoma*, thus offering a clue to the monophyly of Sericoidini. Still, as is mentioned by Smith (2008) it is possible that Athliini may be a synonym of Sericoidini, but further investigation is necessary to verify this statement.

In this study the phylogenetic position of *Blepharotoma* in Sericoidini corroborates the current tribal classification (Smith, 2008). Smith (2008) justified the current classification because of the clypeal characters and mentioned the resemblance between *Blepharotoma* and *Sericoides* than with any other lineages of phytophagous pleurostict scarabs. In fact, a clypeus character (projection of the *ocular cantus* (7:0)) seems to be determinant to the grouping of the Sericoidini, corroborating this hypothesis. Also, our results corroborate the phylogenies of Cherman et al., Costa et al., 2021, that shows *Blepharotoma* as a Sericoidini.

Still the phylogeny points to what seems to be a likely monophyly of Sericoidini tribe, in which the five genera, *Apterodemidea, Blepharotoma, Manonychus, Ovomanonychus* and *Sericoides* form a clade. The group (Sericoidini) is supported by the homoplastic characters 7:0 (*ocular canthus* covering the eyes), 13:1 (labrum in a plane below the clypeus), 20:0 (scutellum apex rounded), 29:1 (absence of the suture ligule-prementum on labium), 58:0 (Pro-, meso- and metatarsomeres with claws), 62:1 (posterior region of mesofemurs without confluence of double row of punctures, 82:1 (phalobasis dorsal area with distal margin grooved). The tribe has as main diagnostic characters the relation between labrum and clypeus that can be found and different planes. This character seems to be important also in a phylogenetic point of view, beside that our results the *ocular cantus* and the shape of scutellum can now be added as determinants to the tribe characterization, contributing with the taxonomic positioning determination of the group.

All species that were previously *Heteronyx* (*B. boliviana, B. corumbana, B. cuyabana, B. heiney and B. ohausiana*), except *B. schenklingi*, are positioned next to each other not forming groups with the other species of *Blepharothoma*. On the other hand, *B. schenklingi* shares a clade with *B. uniformis*, showing that they share some similarities, in this case the characters 57:0 and 61:1 (protarsomers II-IV cylindrical and metacoxae three times longer than wide). *Heteronyx* is an Australian genus, in his review, Britton (2000) removes all non-Australian from the genus, proposing that the Brazilian species should be a new genus. After observing the characters of these species, Smith (2008) determinates that not only the Brazilian, but other neotropical *Heteronyx* species as *Blepharotoma*, now this statement is corroborated by our results. On the other hand, *B. suboblongus* and *B. uniformis*, formerly part of *Hilarianus,* behaved differently. *Blepharotoma suboblongus* appears as a sister group of a big clade of other

Blepharotoma including the ones transferred from other genera, while *B. uniformis* form a small clade with *B. schenklingi* as previously discussed in this paragraph. Besides this species, our analysis corroborates the recent placement of *O. nitida* in the genus *Blepharotoma* which can be seen in this work on the foremost position of the three grouped with *B. calvicolis* by the characters labium as large as wide and tibial spurs with the same length.

Both analyses recovered the monophyly of *Blepharotoma* (Figure 6, Clade A) by the characters 16:1, 30:0, 31:0, 58:1, 74:0, 83:0, 84:1 (surface of mandible mola smooth, presence of lateral lobes on apical margin of the labium, presence of setae on pronotum, pro-, meso- and metatarsomeres with bifid claws, dense roof of setae on ventrites and phalobasis longitudinal midline visible, and phalobasis midline constriction absent, respectively). In an assessment of the neotropical Melolonthinae, Smith (2008) defines *Blepharotoma* labrum covered by the clypeus (in dorsal view) and separated from it by a suture, clypeal margin elevated, antennae with eight antennomeres, meso- and metasternal process absent, abdomen with six ventrites, esternites with almost the same height and curvature, male tarsi lobed with tuft of setae, metatibiae with two spurs and all the claw symmetric and toothed. These characters still are very important to identify the genus, here we present a new set of characters that are equally important to a taxonomic identification. All the characters supporting *Blepharotoma* are homoplastic, as they are shared by other taxa outside Sericoidini, the characters 16:1, 30:0, 58:1, 74:0, 83:0 and 84:1 (surface of mandible mola smooth, presence of lateral lobes on apical margin of the labium, pro-, meso- and metatarsomeres with bifid claws, dense roof of setae on ventrites and phalobasis longitudinal midline visible, and phalobasis midline constriction absent) are not shared internally with the other Sericoidini allowing us to consider them synapomorphic for *Blepharotoma* clade. For example, the character 16:1 appears also in *Astaena* sp. (Sericini), *Alvarinus hilarii* (Macrodactylini) and *Liparetrus dicipennis* (Liparetrini). The same occurs with character 30:0 that is found in terminal taxa from tribes like Diplotaxini, Macrodactylini and Sericini, 74:1 is shared with the clade Macrodactylini + Melolonthini, 83:0 and 84:1 appear in most of the cases isolated in terminal taxa of tribes Diplotaxini and Melolonthini. This probably occurs due to the distance among the clades studied and justifies why *Blepharotoma* was through all these tribes.

As for intern relationships of *Blepharotoma* (Figure 6, Clade A), our analysis shows the following relationships between the species: *B. cuyabana* + (*B. corumbana* + (*B. suboblonga* + (*B. boccainae* + (*B. boliviana* + (*B. heynei* + (Clade B)))))). Clade B is supported by a homology 56:0 (presence of dimorphism on male protarsomere) and by 48:1 (elytra shape

rounded) and is formed by *B. plaumanni* + Clade C. Clade C formed by Clade D (*B. nitens* + *B.petropolisana*) + Clade E and it is supported by 45:0, 53:0 and 75:0 (metasternum setae on males dense and long, denticule on protibiae above de the medial line and coarse ventrites setae). Following, on Cade E (*B. nitidula* + Clade F). Clade F reunites G (*B. confusa* + *B. tarsalis*) + Clade H have 2:0 and 37:1 (frons punctures coarse and pronotum punctures thin) as synapomorphic. Finally, Clade H with characters 45:1 and 54:0 (metaventrites with setae sparse and short, and angle between teeth II-III obtuse) giving support to this topology, grouping Clade I - *B. argentina* + (*B. martinezi* + *B. ohausiana*)) + Clade J (*B. schenkling* + *B. uniformis*) + (*B. calvicolis* + *B. nitida*))). This is the first time that this number of *Blepharotoma* is analysed in this aspect. Here, it is possible to observe that all species currently allocated in the genus are grouped (except *B. angustata*, not rested), corroborating the actual statement of the taxon.

4. Conclusion

With this we can conclude that *Blepharotoma* is recovered as monophyletic and is part of Sericoidini as proposed by Smith (2008). Also, it is confirmed that all species currently allocated in *Blepharotoma* are indeed part of the genus. Finally, the phylogenies here show evidence of Sericoidini monophyly considering its recent representatives *Apterodemidea*, *Blepharotoma*, *Manonychus*, *Ovomanonychus*, *Sericoides* corroborating with Smith (2008) and Costa (2021).

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Supplementary material 1 – Table with distribution of characters states by terminal. (0) plesiomorphic state; (1) apomorphic state (-) unobservable

Terminal	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
External group																				
Aegidiellus zezaoi	2	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	1	-	1	0
Apogonia rauca	2	-	0	1	1	1	0	0	-	0	0	1	1	0	0	0	1	-	1	1
Diplotaxis tristis	2	1	0	1	0	1	0	0	0	0	0	1	1	0	0	0	1	-	1	1
Pachrodema castanea	2	0	0	1	0	1	1	0	0	0	0	1	0	1	0	0	1	-	1	1
Liogenys palpalis	2	0	1	0	1	0	1	0	0	0	0	1	1	0	0	0	1	-	1	0
Liogenys diodon	0	1	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	-	1	0
Symmela mutabilis	2	0	1	1	1	1	1	1	0	0	-	0	0	-	1	0	1	1	1	1
Astaena sp.	0	0	1	1	0	1	1	1	0	0	-	0	0	1	0	1	-	1	1	1
Serica brunnea	0	0	1	1	0	1	1	1	1	0	-	0	0	-	-	0	1	1	1	1
Liparetrus discipennis	2	0	1	1	0	1	1	0	0	0	0	1	1	0	0	1	-	-	1	
Macrodactylus subspinosus	2	0	1	1	1	1	1	0	0	0	1	1	0	0	-	0	0	1	1	0
Alvarinus hilarii	2	0	1	1	0	1	0	0	0	0	0	1	0	0	1	1	-	-	1	0
Plectris tomentosa	0	1	0	1	0	1	1	0	0	0	0	1	0	1	1	0	0	1	1	0
Modialis prasinella	1	0	0	1	0	1	0	0	0	0	0	1	0	-	1	0	0	1	1	0
Melolontha melolontha	1	0	0	1	0	1	0	0	0	0	0	1	1	1	0	0	0	1	1	0
Phyllophaga sp.	1	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	1	1	0
Athlia rustica	2	0	1	1	0	1	1	0	0	1	1	0	0	-	1	0	0	1	1	1
Sericoides obesa	1	-	0	1	0	1	0	0	-	1	1	1	1	0	2	0	0	1	1	0
Sericoides glacialis	2	0	1	1	0	1	0	0	0	1	1	1	1	1	2	0	0	1	1	0
Apterodemidea paraguayensis	2	1	0	1	0	1	0	0	0	1	1	1	1	0	0	0	0	1	1	0

Manonychus unguicularis	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
Ovomanonychus rosettae	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	
Internal group																					
Blepharotoma cuyabana	0	0	1	1	0	1	0	0	0	0	0	0	1	1	2	1	-	1	1	0	
Blepharotoma corumbana	0	0	1	1	0	1	1	0	0	0	0	0	1	0	0	1	-	1	1	0	
Blepharotoma suboblonga	0	1	1	1	0	1	0	0	0	0	0	0	1	0	1	1	-	1	1	0	
Blepharotoma boccainae	0	1	1	1	0	1	0	0	0	0	0	0	1	1	0	1	-	1	1	0	
Blepharotoma boliviana	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0	1	-	1	1	0	
Blepharotoma heynei	1	1	1	1	0	1	0	0	0	0	0	0	1	0	0	1	-	1	1	0	
Blepharotoma plaumanni	1	1	0	1	0	1	0	0	0	0	0	0	1	0	0	1	-	1	1	0	
Blepharotoma nitens	2	1	0	1	0	1	0	0	0	0	0	0	1	0	0	1	-	1	1	0	
Blepharotoma petroposilana	1	1	0	1	0	1	0	0	0	0	0	0	1	0	1	1	-	1	1	0	
Blepharotoma nitidula	2	1	0	1	0	1	0	0	0	0	0	0	1	0	0	1	-	0	1	0	
Blepharotoma confusa	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	1	-	1	0	
Blepharotoma tarsalis	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	1	-	-	1	0	
Blepharotoma argentina	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	-	1	1	0	
Blepharotoma martinezi	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	-	1	1	0	
Blepharotoma ohausiana	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	-	0	1	0	
Blepharotoma schenklingi	1	0	1	1	0	1	1	0	0	0	0	0	1	0	0	1	-	1	1	0	
Blepharotoma uniformis	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	1	-	-	-	
Blepharotoma calvicolis	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	-	1	1	0	
Blepharotoma nitida	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	1	0	

Terminal	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
External group																				
Aegidiellus zezaoi	0	1	1	1	0	1	1	0	1	1	1	1	0	1	1	0	0	-	1	0
Apogonia rauca	0	0	1	0	0	1	1	-	0	0	1	1	1	1	1	-	-	-	-	0

Diplotaxis tristis	0	0	1	2	0	1	1	-	0	0	1	1	1	1	1	0	0	-	0	1
Pachrodema castanea	0	1	1	0	0	0	0	1	0	1	1	1	0	1	1	1	0	-	1	0
Liogenys palpalis	0	1	0	0	0	0	0	1	0	0	1	1	0	1	1	0	0	-	0	1
Liogenys diodon	0	1	0	0	0	0	0	1	0	1	1	0	1	1	1	0	0	-	1	0
Symmela mutabilis	0	1	1	1	0	1	0	1	1	0	1	0	0	1	1	0	1	-	1	1
Astaena sp.	1	1	1	1	0	1	0	1	1	0	1	1	0	1	1	0	1	-	1	1
Serica brunnea	1	1	1	1	0	1	0	1	0	1	1	1	1	1	1	0	0	-	1	0
Liparetrus discipennis	0	1	1	2	0	1	0	0	0	1	0	1	0	1	1	0	1	0	1	1
Macrodactylus subspinosus	1	1	1	1	0	1	1	-	1	0	1	0	1	1	1	0	1	1	0	0
Alvarinus hilarii	1	1	1	1	1	1	1	-	1	1	0	0	0	1	1	0	1	1	1	0
Plectris tomentosa	0	1	1	0	0	1	0	1	0	0	1	1	0	1	1	1	0	1	1	0
Modialis prasinella	1	1	1	1	0	1	0	0	0	1	0	1	0	1	1	0	1	0	1	0
Melolontha melolontha	1	1	1	1	1	1	1	-	0	1	0	1	1	1	1	1	1	1	0	0
Phyllophaga sp.	1	1	1	2	0	1	0	1	1	1	0	1	0	1	1	1	0	1	1	0
Athlia rustica	1	1	1	0	1	1	0	1	0	1	0	1	0	1	1	0	0	0	1	0
Sericoides glacialis	1	1	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Sericoides obesa	1	1	0	1	0	1	0	0	1	1	1	0	0	0	0	-	-	-	-	0
Apterodemidea paraguayensis	1	1	1	0	1	1	0	1	1	1	1	1	0	1	1	1	0	-	1	0
Manonychus unguicularis	0	1	1	0	1	1	0	1	1	1	1	1	0	0	1	0	1	-	0	0
Ovomanonychus rosettae	1	1	0	0	1	1	0	1	1	1	1	1	0	1	0	1	1	-	0	1
Internal group																				
Blepharotoma cuyabana	0	1	1	0	1	1	0	1	1	0	0	1	0	1	1	1	1	0	1	0
Blepharotoma corumbana	0	1	1	1	1	1	0	1	1	0	0	1	0	1	1	0	1	1	1	0
Blepharotoma suboblonga	0	1	1	1	1	1	0	1	1	0	0	1	0	1	1	0	0	0	1	0
Blepharotoma boccainae	0	1	1	1	1	1	0	1	1	0	0	1	0	1	1	0	0	0	0	0
Blepharotoma boliviana	0	1	1	2	1	1	0	1	1	0	0	1	0	1	1	1	0	0	1	0
Blepharotoma heynei	0	1	1	2	0	1	0	1	1	0	0	1	0	1	1	1	0	1	1	0
Blepharotoma plaumanni	0	1	1	0	1	1	0	1	1	0	0	1	0	1	1	0	0	0	1	0

Blepharotoma nitens	0	1	1	2	1	1	0	1	1	0	0	1	0	1	1	1	0	1	1	0
Blepharotoma petropolisana	0	1	1	1	1	1	0	1	1	0	0	1	0	1	1	1	1	1	0	0
Blepharotoma nitidula	0	1	1	1	1	1	0	1	1	0	0	1	0	1	1	1	0	0	0	0
Blepharotoma confusa	0	1	0	1	0	1	0	1	0	0	0	1	0	1	1	1	1	0	1	0
Blepharotoma tarsalis	0	1	1	1	0	1	0	1	1	0	0	1	0	1	1	0	1	1	0	0
Blepharotoma argentina	0	1	1	1	1	1	0	1	1	0	0	1	0	1	1	1	1	0	1	0
Blepharotoma martinezi	0	1	1	2	1	1	0	1	1	0	0	1	0	1	1	1	1	0	0	0
Blepharotoma ohausiana	0	1	1	2	0	1	0	1	1	0	0	1	0	1	1	1	1	0	1	0
Blepharotoma schenklingi	0	1	1	1	1	1	0	1	1	0	0	1	0	1	1	0	1	0	1	0
Blepharotoma uniformis	-	-	-	-	-	-	-	-	-	-	0	1	0	1	1	0	1	0	1	0
Blepharotoma calvicolis	0	1	1	2	1	1	0	1	1	0	0	1	0	1	1	0	1	0	0	0
Blepharotoma nitida	0	1	1	2	1	1	0	1	1	0	0	1	0	1	1	0	1	0	1	0

Terminal	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
External group																				
Aegidiellus zezaoi	-	0	1	1	1	1	1	1	1	0	0	0	0	2	1	1	0	0	0	1
Apogonia rauca	-	0	1	2	1	0	-	-	-	-	1	0	-	2	-	-	0	1	1	1
Diplotaxis tristis	-	0	1	2	1	0	0	0	1	0	1	0	0	1	1	1	0	1	0	0
Pachrodema castanea	-	0	1	2	1	0	1	0	1	0	1	0	0	2	1	1	0	1	1	0
Liogenys palpalis	-	1	1	2	0	0	1	1	0	1	1	0	0	2	1	1	1	1	1	0
Liogenys diodon	-	0	1	2	1	0	0	0	1	0	1	0	0	2	1	1	1	1	1	0
Symmela mutabilis	0	0	0	0	1	0	1	1	0	0	1	1	1	2	1	1	0	1	0	0
Astaena sp.	0	0	1	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	-	0
Serica brunnea	-	1	0	0	0	0	1	1	0	0	1	1	1	2	1	1	0	1	0	1
Liparetrus discipennis	0	1	-	2	-	1	1	1	0	0	1	1	1	1	1	1	0	0	-	1
Macrodactylus subspinosus	1	1	1	0	0	0	1	0	-	-	1	1	1	1	1	1	0	1	0	1
Alvarinus hilarii	1	1	1	0	0	0	1	0	0	0	1	1	1	2	1	1	0	1	0	1

Plectris tomentosa	1	1	1	2	0	0	1	0	1	1	1	1	1	0	1	1	0	1	0	1
Modialis prasinella	-	1	1	2	1	0	1	1	1	0	0	1	1	2	1	1	0	1	0	1
Melolontha melolontha	0	1	1	2	1	0	0	0	1	1	0	0	0	1	1	1	0	1	0	0
Phyllophaga sp.	1	1	1	2	1	1	1	0	0	1	0	0	1	2	1	1	0	1	0	0
Athlia rustica	0	0	0	2	1	0	1	0	1	0	1	0	1	2	1	1	0	1	1	0
Sericoides glacialis	1	0	1	1	1	0	1	0	0	0	1	0	0	2	1	1	0	0	0	0
Sericoides obesa	-	1	1	1	1	0	-	-	-	-	1	0	-	2	-	-	0	0	0	0
Apterodemidea paraguayensis	-	0	1	1	0	1	1	1	0	0	1	0	1	2	1	1	0	0	0	0
Manonychus unguicularis	-	0	0	2	1	1	1	1	0	0	1	0	1	1	1	1	0	0	1	0
Ovomanonychus rosettae	-	0	0	1	0	0	1	1	0	0	1	0	1	2	1	1	0	0	0	0
Internal group																				
Blepharotoma cuyabana	0	0	1	1	1	1	1	0	0	0	0	0	1	2	1	1	0	1	0	0
Blepharotoma corumbana	0	0	1	1	1	1	0	0	0	0	1	0	1	2	-	-	-	1	-	0
Blepharotoma suboblonga	0	0	1	1	-	1	0	0	0	0	1	0	0	1	1	-	0	1	-	0
Blepharotoma boccainae	0	0	1	1	1	1	0	0	0	1	1	0	1	2	1	1	0	1	1	0
Blepharotoma boliviana	0	1	1	2	1	1	0	0	0	1	1	0	1	2	-	-	-	1	-	0
Blepharotoma heynei	1	1	1	1	1	1	1	0	0	1	1	0	1	2	1	1	0	1	1	0
Blepharotoma plaumanni	0	1	1	1	1	1	1	1	0	1	1	0	1	2	1	0	0	1	1	0
Blepharotoma nitens	0	1	1	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	1	0
Blepharotoma petropolisana	1	1	1	1	-	1	1	1	0	1	1	0	0	1	1	1	0	1	-	0
Blepharotoma nitidula	0	1	1	1	0	1	1	1	0	0	1	0	0	2	0	0	1	1	1	0
Blepharotoma confusa	0	0	0	1	0	1	1	1	0	0	1	0	0	2	1	0	1	1	1	0
Blepharotoma tarsalis	0	0	0	1	0	1	1	0	0	0	1	0	0	2	0	0	1	1	1	0
Blepharotoma argentina	0	0	0	2	1	1	0	1	0	1	1	0	0	0	1	0	1	1	1	0
Blepharotoma martinezi	0	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	1	1	1	0
Blepharotoma ohausiana	0	1	1	1	-	1	0	0	0	0	1	0	1	1	1	-	1	1	-	0
Blepharotoma schenklingi	0	1	1	1	-	1	0	0	0	0	1	0	0	0	1	-	0	1	-	0
Blepharotoma uniformis	0	1	1	1	1	1	0	1	0	0	1	0	0	0	1	1	0	1	1	0

Blepharotoma calvicolis	0	0	1	0	1	1	1	1	0	0	1	0	0	0	1	0	1	1	1	0
Blepharotoma nitida	1	1	1	1	-	1	1	1	0	0	0	0	0	0	1	-	1	1	-	0

Terminal	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
External group																				
Aegidiellus zezaoi	1	0	0	1	1	1	1	0	1	1	1	1	1	1	0	-	0	1	1	1
Apogonia rauca	0	0	0	0	0	0	0	1	0	1	0	1	1	-	-	0	0	-	1	0
Diplotaxis tristis	0	1	0	0	1	0	0	0	0	1	1	1	1	1	1	0	0	1	0	1
Pachrodema castanea	0	1	0	1	1	0	0	0	0	1	1	1	1	1	1	1	2	-	0	1
Liogenys palpalis	-	1	0	1	1	0	0	1	1	1	0	1	1	1	1	0	2	1	0	1
Liogenys diodon	0	1	0	1	1	0	0	1	1	1	0	1	1	1	1	1	2	1	0	1
Symmela mutabilis	0	0	0	1	1	0	1	1	1	1	0	0	1	1	0	1	0	0	0	1
Astaena sp.	0	0	0	1	0	0	1	0	1	0	1	0	0	1	1	0	0	2	0	0
Serica brunnea	0	0	0	1	0	0	1	0	0	1	0	0	0	1	1	0	1	1	1	-
Liparetrus discipennis	-	0	0	1	1	0	2	0	0	1	0	0	1	-	-	0	2	1	1	0
Macrodactylus subspinosus	0	0	1	1	1	1	3	1	0	1	0	0	1	0	0	0	2	1	1	0
Alvarinus hilarii	0	0	1	1	1	1	3	0	1	1	0	0	1	0	0	0	0	1	1	0
Plectris tomentosa	1	-	1	1	0	1	3	-	1	1	0	0	1	0	1	0	0	1	1	0
Modialis prasinella	-	0	1	0	0	1	3	-	1	1	-	0	0	0	1	0	0	1	1	0
Melolontha melolontha	-	-	0	0	0	0	3	1	0	1	-	0	0	-	-	0	2	-	0	-
Phyllophaga sp.	0	1	0	0	0	0	3	1	1	1	1	0	0	0	1	0	0	0	1	1
Athlia rustica	0	0	0	1	1	0	2	1	1	0	-	1	0	1	1	1	0	1	1	0
Sericoides glacialis	0	1	0	1	1	0	1	0	0	0	1	0	0	1	1	1	0	1	1	0
Sericoides obesa	0	1	0	1	1	0	2	0	1	0	1	0	0	-	-	1	0	-	0	0
Apterodemidea paraguayensis	0	1	0	1	1	0	1	1	0	0	0	0	0	-	-	0	0	0	1	1
Manonychus unguicularis	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	0	1	0	1

Ovomanonychus rosettae	1	1	0	1	1	0	1	1	0	0	0	0	0	1	1	0	0	1	1	0
Internal group																				
Blepharotoma cuyabana	0	1	0	1	1	0	1	1	1	1	1	0	0	0	1	0	0	1	1	0
Blepharotoma corumbana	0	1	-	1	1	0	1	1	1	0	1	0	0	0	0	0	0	1	0	1
Blepharotoma suboblonga	0	1	1	1	1	0	2	1	1	0	-	0	-	1	1	-	0	-	-	-
Blepharotoma boccainae	0	1	1	1	1	0	2	1	1	0	1	0	0	0	0	1	0	1	1	0
Blepharotoma boliviana	0	1	1	1	1	0	2	1	1	0	1	0	0	1	1	0	0	-	-	-
Blepharotoma heynei	0	1	1	1	1	0	2	1	1	1	1	0	1	0	1	0	0	1	1	1
Blepharotoma plaumanni	1	1	1	1	1	0	2	1	1	1	1	0	0	0	1	0	0	-	-	-
Blepharotoma nitens	0	1	1	1	1	0	3	1	1	1	1	0	1	0	0	0	-	-	-	-
Blepharotoma petropolisana	0	1	1	1	1	0	3	1	1	1	1	0	0	0	0	0	0	-	-	-
Blepharotoma nitidula	0	1	1	1	0	0	2	1	1	1	1	0	-	1	0	0	0	-	-	-
Blepharotoma confusa	0	1	0	1	1	0	2	0	1	0	1	0	0	1	1	0	0	1	0	1
Blepharotoma tarsalis	0	1	0	1	1	0	2	0	1	0	0	0	0	1	1	0	0	0	1	0
Blepharotoma argentina	0	1	1	1	1	0	2	1	1	1	1	0	1	1	0	0	0	0	1	0
Blepharotoma martinezi	1	1	1	1	1	0	1	1	1	1	1	0	1	1	0	0	0	1	1	1
Blepharotoma ohausiana	1	1	1	1	0	0	1	1	1	1	1	0	-	1	1	0	0	-	-	-
Blepharotoma schenklingi	1	1	1	0	1	0	2	1	1	1	1	0	0	1	1	0	0	-	-	-
Blepharotoma uniformis	1	1	0	1	1	0	0	1	1	1	1	0	0	1	0	0	0	-	-	-
Blepharotoma calvicolis	0	1	1	1	1	0	0	0	1	1	0	0	0	1	0	0	0	1	1	0
Blepharotoma nitida	0	1	1	0	1	1	2	0	1	1	1	1	0	0	0	-	-	-	-	-

	81	82	83	84	85
Terminal					
External group					
Aegidiellus zezaoi	1	0	1	1	
Apogonia rauca	1	0	0	1	
Diplotaxis tristis	1	0	1	1	
Pachrodema castanea	1	0	1	1	

Liogenys palpalis	0	0	1	1
Liogenys diodon	0	0	1	1
Symmela mutabilis	0	0	1	0
Astaena sp.	0	0	1	0
Serica brunnea	1	1	1	1
Liparetrus discipennis	1	-	-	0
Macrodactylus subspinosus	1	1	1	1
Alvarinus hilarii	0	0	1	1
Plectris tomentosa	1	1	1	0
Modialis prasinella	1	0	0	0
Melolontha melolontha	1	0	1	1
Phyllophaga sp.	1	0	1	0
Athlia rustica	1	0	1	0
Sericoides glacialis	1	1	1	0
Sericoides obesa	1	1	1	0
Apterodemidea paraguayensis	1	1	1	0
Manonychus unguiculari	0	0	1	0
Ovomanonychus rosettae	1	0	1	0
Internal group				
Blepharotoma cuyabana	1	1	0	1
Blepharotoma corumbana	1	1	0	1
Blepharotoma suboblonga	-	-	-	-
Blepharotoma boccainae	0	1	0	1
Blepharotoma boliviana	-	-	-	-
Blepharotoma heynei	1	0	1	1
Blepharotoma plaumanni	-	-	-	-
Blepharotoma nitens	-	-	-	-
Blepharotoma petropolisana	-	-	-	-

Blepharotoma nitidula	-	-	-	-
Blepharotoma confusa	1	1	1	0
Blepharotoma tarsalis	1	1	1	0
Blepharotoma argentina	1	1	1	0
Blepharotoma martinezi	0	1	0	1
Blepharotoma ohausiana	-	-	-	-
Blepharotoma schenklingi	-	-	-	-
Blepharotoma uniformis	-	-	-	-
Blepharotoma calvicolis	1	1	1	0
Blepharotoma nitida	-	-	-	-

FIGURES

Fig 1. External morphology of a Sericoidini (*Manonychus unguicularis* Moser). (A) clypeus; (B) front; (C) pronotum disc; (D) scutelum; (E) left elytra; (F) elytral suture; (G) pygidium; (H) protarsal claws; (I) right protarsomer; (J) antennae, left antenomere; (K) right protibia, ventral view; (L) prosternum; (M) right profemur, ventral view; (N) mesoesternum; (O) metepisternum; (P) metasternum; (Q) left metacoxae; (R) ventrite II; (S) right metatibiae. Scale:1mm. (Costa et al., 2021).

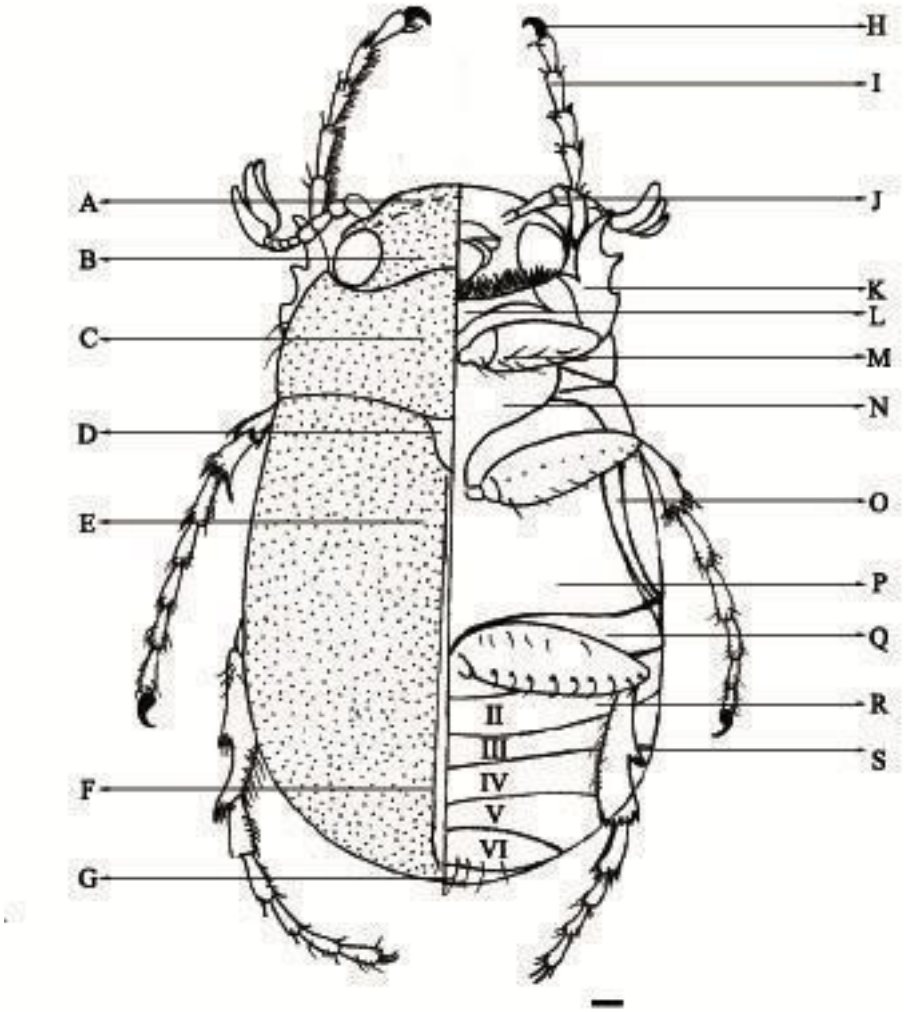


Fig 2. (A) *Blepharotoma schenklingi* head in dorsal view thin and sparse punctuation, short and sparse setae; (B) *B. nitens* head in dorsal view coarse and dense punctures, long and dense setae; (C) *B. suboblonga* head frontal view, red arrow - suture clypeus/labrum; (D) *B. tarsalis* head in dorsal view, red arrow - clypeus roughness; (E) *B. suboblonga* pronotum in dorsal view thin and sparse punctures, short and sparse setae; (F) *B. martinezi* pronotum in dorsal view coarse and dense punctures, long and dense setae.

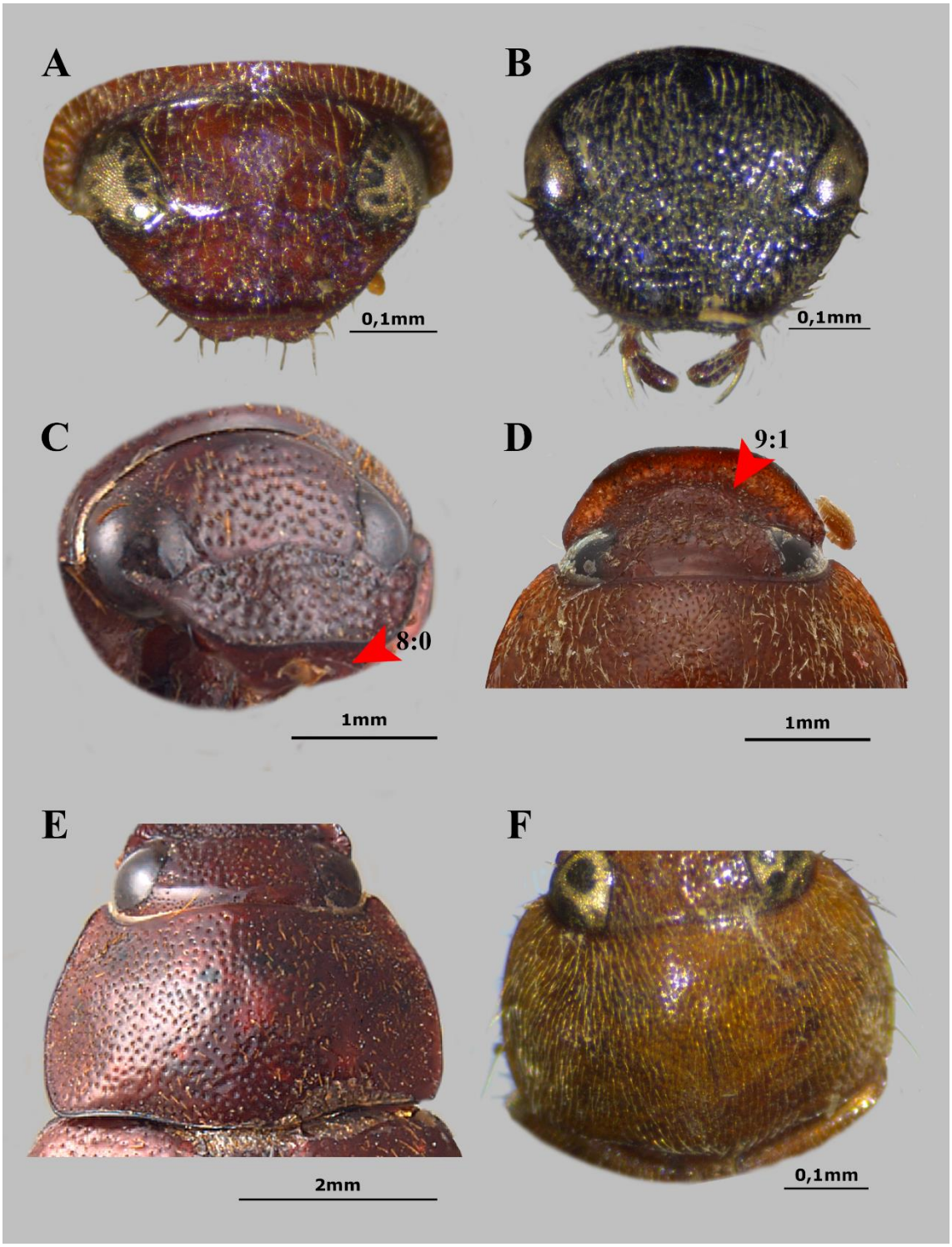


Fig 3. (A) *Blepharotoma calvicolis* dorsal view of a rounded apex scutellum; (B) *B. nitens* dorsal view of a acute apex scutellum; (C) *B. confusa* elytra dorsal view with setae distribution sparse; (D) *B. uniformis* elytra dorsal view with bristle distribution sparse.

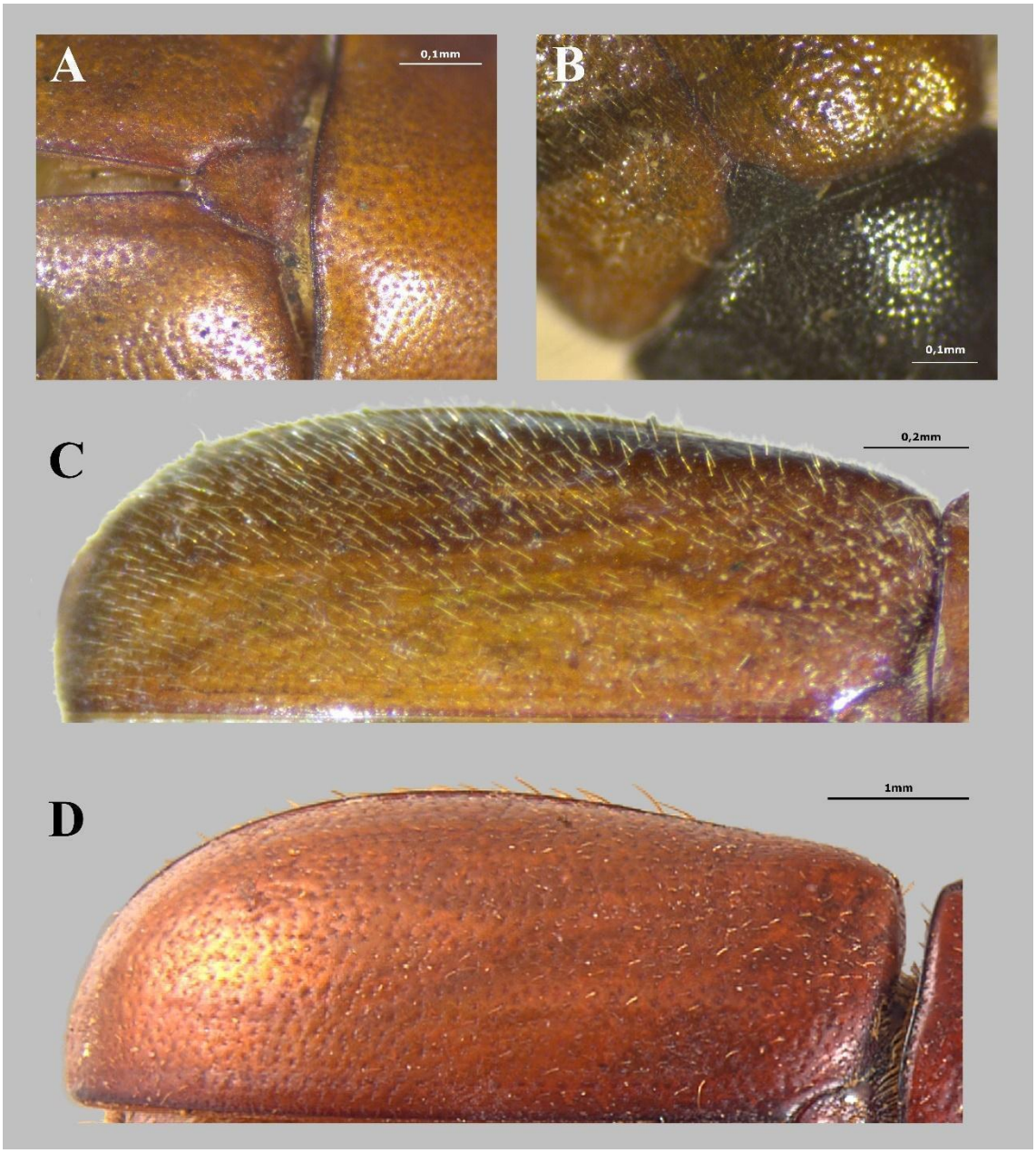


Fig 4. Fig 4. (A) *Blepharotoma suboblonga* teeth of tibiae in the dorsal view; (B) *B. tarsalis* protarsus with lobbed tarsomeres in dorsal view; (C) *B. suboblonga* back view of pygidium.

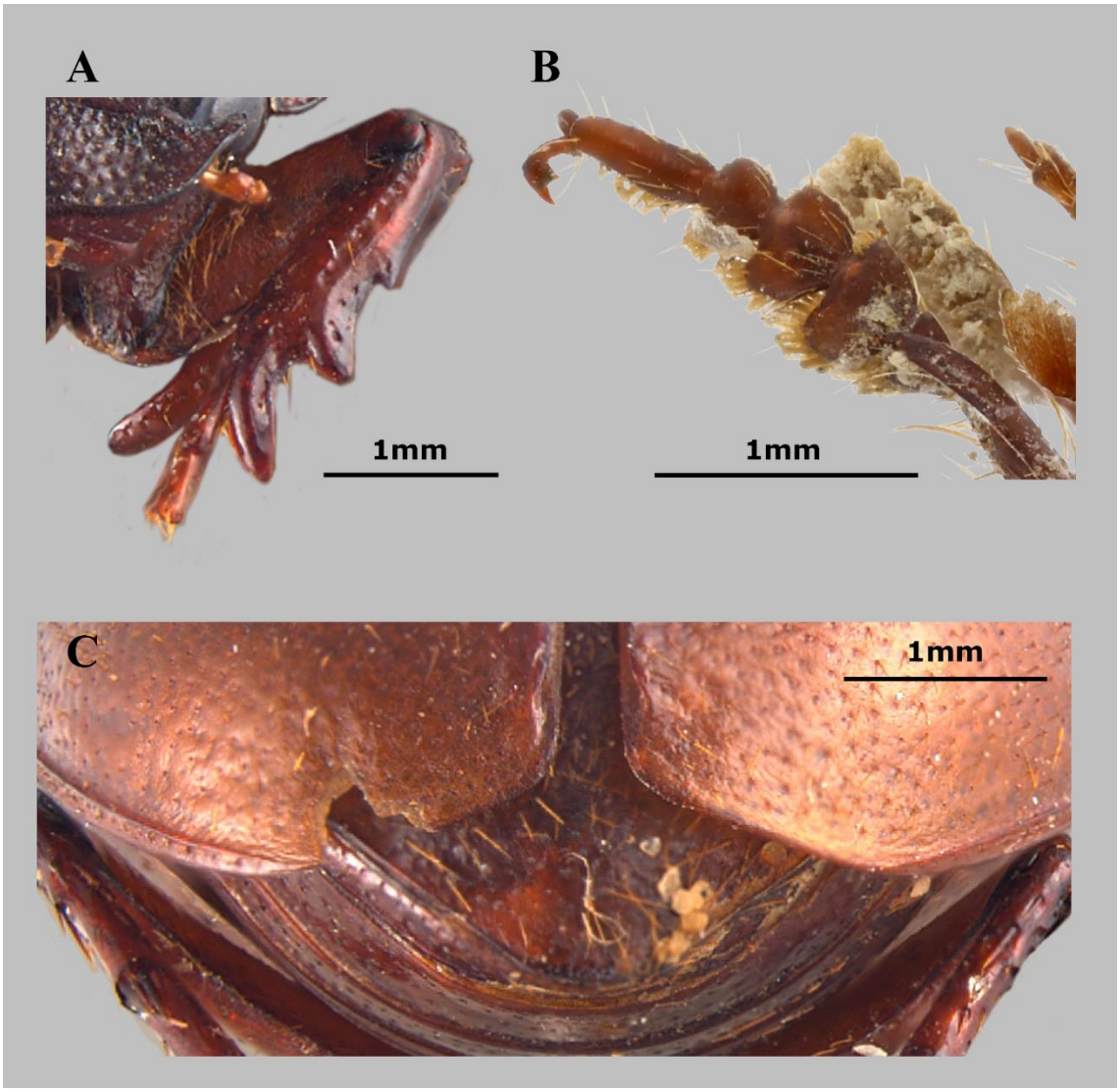


Fig. 5: Tree of *Blepharotoma* Blanchard, 1850 genus with equal weights. Characters represented by circles: black - synapomorphic; white - homoplastic. Above circle: correspondent number to the character; Under the circle: correspondent number of the state of the character. Highlighted next to the node: above - Bremer value; under - symmetric resampling value.

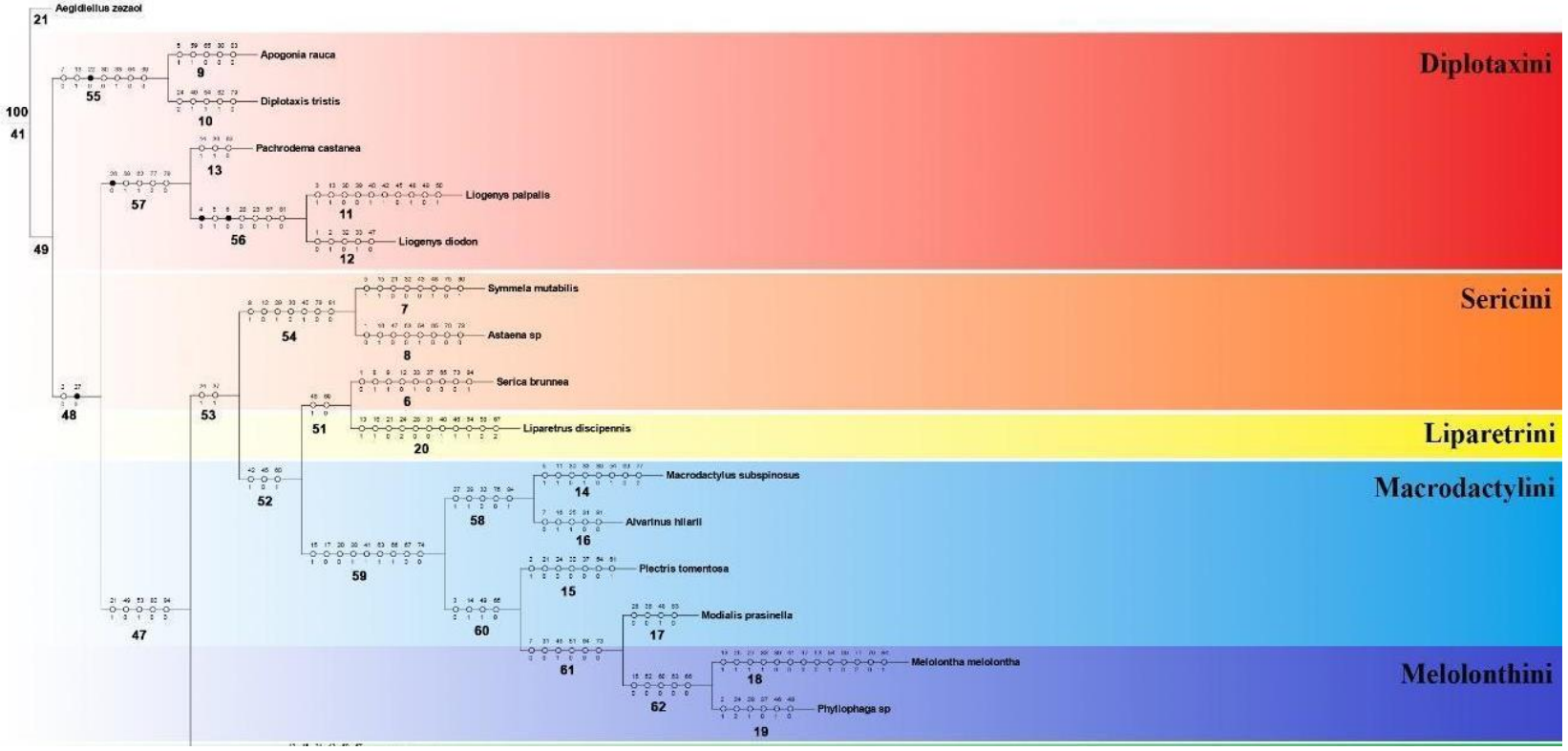


Fig 5 cont.

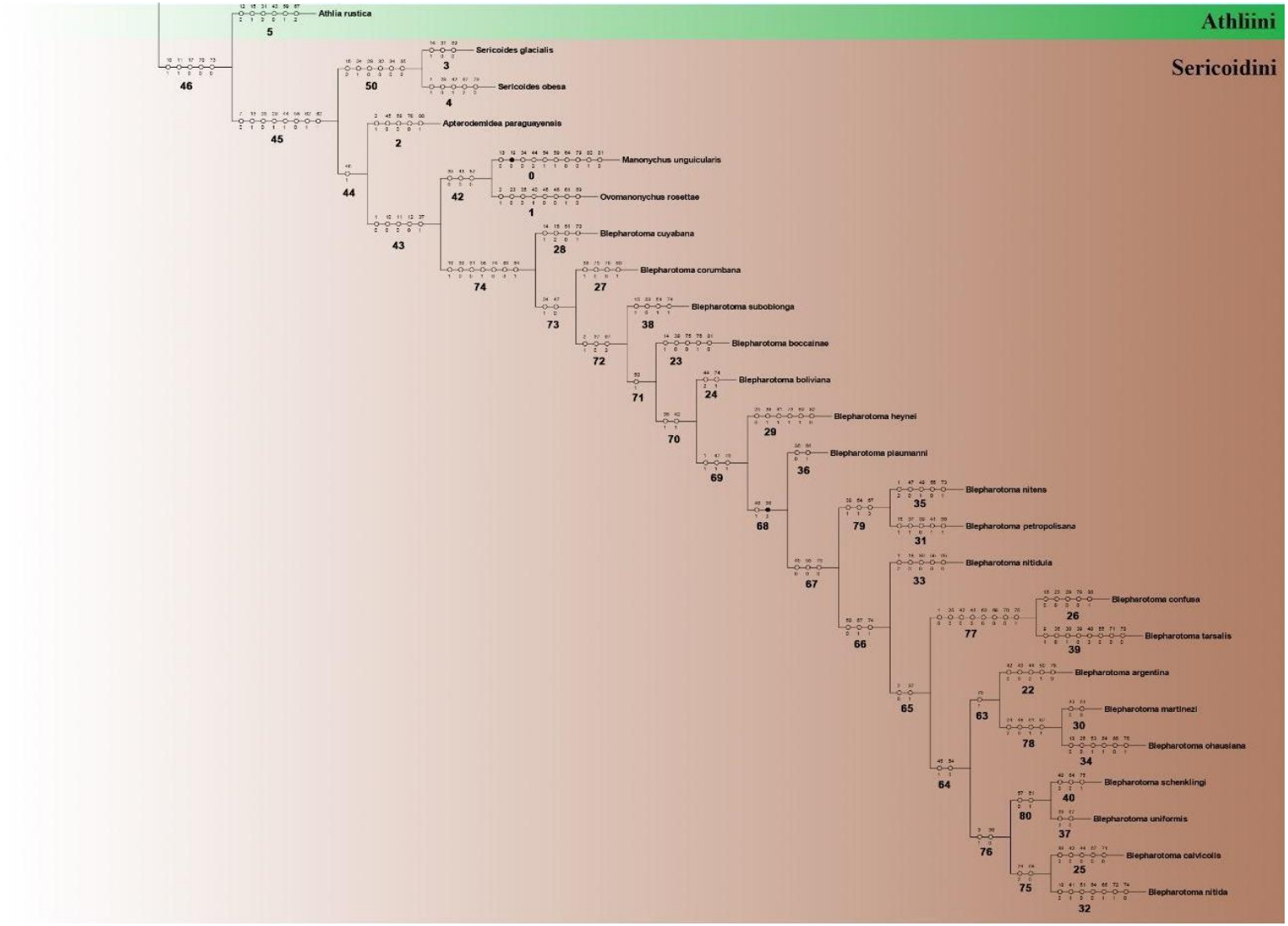
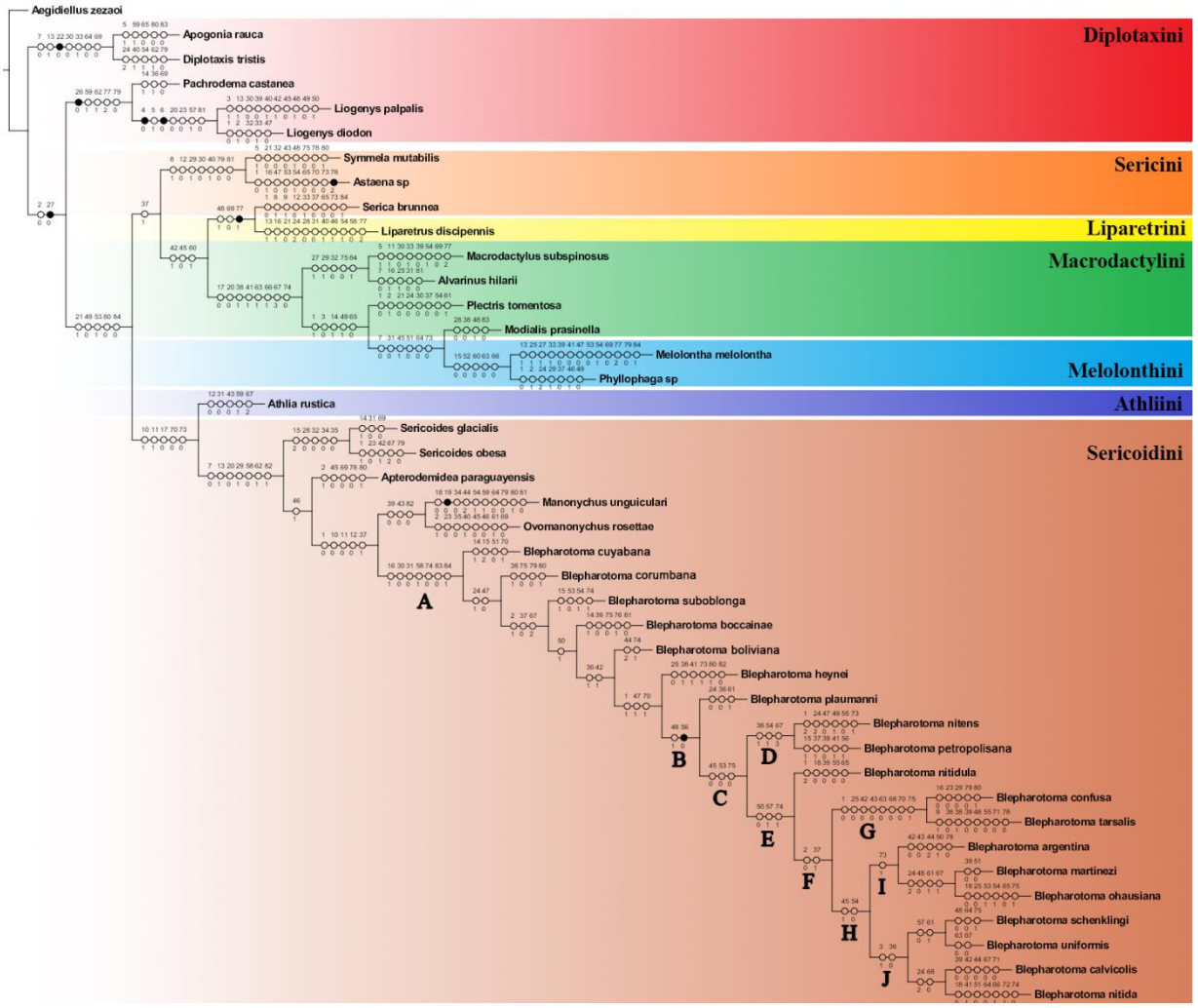

Athliini
Sericoidini
Athlia rustica
Sericoides glacialis
Sericoides obesa
Apterodemidea paraguayensis
Manonychus unguicularis
Ovomanonychus rosettae
Blepharotoma cuyabana
Blepharotoma corumbana
Blepharotoma suboblonga
Blepharotoma boccainae
Blepharotoma boliviana
Blepharotoma heynei
Blepharotoma plaumanni
Blepharotoma nitens
Blepharotoma petropolisana
Blepharotoma nitidula
Blepharotoma confusa
Blepharotoma tarsalis
Blepharotoma argentina
Blepharotoma martinezi
Blepharotoma ohausiana
Blepharotoma schenklingi
Blepharotoma uniformis
Blepharotoma calvicollis
Blepharotoma nitida

Fig. 6: Phylogeny of *Blepharotoma* Blanchard, 1850 genus with implied weights. Characters represented by circles: black: synapomorphic; white: homoplastic. Above circle: Correspondent number to the character; Under the circle: Correspondent number to the character. Highlighted above the lines: clades of *Blepharotoma.*



TABLES

Table 1: Terminal taxa used in phylogenetic analysis of *Blepharotoma* (Blanchard, 1850) with their current classification, geographical distribution, number of analyzed specimens, and home institution.

Subfamily	Tribe	Species	Geographical distribution	Number of specimens examined	Material storage institute
		External group			
Melolonthinae	Diplotaxini	*Apogonia rauca*	Neotropical	1	CERPE
Melolonthinae	Diplotaxini	*Diplotaxis tristis*	Nearctic	1	MZUSP
Melolonthinae	Diplotaxini	*Liogenys diodon*	Neotropical	1	CEUFPE
Melolonthinae	Diplotaxini	*Liogenys palpalis*	Neoartic	1	CEUFPE
Melolonthinae	Diplotaxini	*Pachrodema castanea*	Neotropical	2	CERPE
Sericoidinae	Liparetrini	*Liparetrus discipennis*	Australia	1	MHNH
Melolonthinae	Macrodactylini	*Alvarinus hilarii*	Neotropical	1	MNHN
Melolonthinae	Macrodactylini	*Athlia rustica*	Neotropical	1	MZUSP
Melolonthinae	Macrodactylini	*Macrodactylus subspinosus*	Neoartic/Neotropical	1	DZUP

Melolonthinae	Macrodactylini	*Modialis prasinella*	Neotropical	1	MZUSP
Melolonthinae	Macrodactylini	*Plectris tomentosa*	Neotropical	1	MZUSP
Melolonthinae	Melolonthini	*Melolontha melolontha*	Paleartic/Oriental	1	MZUSP
Melolonthinae	Melolonthini	*Phyllophaga* sp.	Neotropical	1	CEUFPE
Sericinae	Sericini	*Astaena* sp.	Neotropical	5	CE-UFPE
Sericinae	Sericini	*Serica brunnea*	Neoartic	2	MNRJ
Sericinae	Sericini	*Symmela mutabilis*	Neotropical	2	MZUSP
Sericoidinae	Sericoidini	*Apterodemidea paraguayensis*	Neotropical	2	CERPE
Sericoidinae	Sericoidini	*Manonychus unguicularis*	Neotropical	9	ZMHB
Sericoidinae	Sericoidini	*Ovomanonychus rosettae*	Neotropical	3	CERPE
Sericoidinae	Sericoidini	*Sericoides glacialis*	Neotropical	1	CEUFPE
Sericoidinae	Sericoidini	*Sericoides obesa*	Neotropical	1	CEUFPE
Orphninae	Aegidiini	*Aegidiellus zezaoi*	Neotropical	2	CERPE
		Internal Group			
Sericoidinae	Sericoidini	*Blepharotoma argentina*	Neotropical	2	NHMB

Sericoidinae	Sericoidini	*Blepharotoma boccainae*	Neotropical	3	NHMB
Sericoidinae	Sericoidini	*Blepharotoma bolivianus*	Neotropical	2	ZMHB
Sericoidinae	Sericoidini	*Blepharotoma calvicolis*	Neotropical	1	NHMB
Sericoidinae	Sericoidini	*Blepharotoma confusa*	Neotropical	5	NHMB
Sericoidinae	Sericoidini	*Blepharotoma corumbanus*	Neotropical	2	ZMHB
Sericoidinae	Sericoidini	*Blepharotoma cuyabanus*	Neotropical	2	ZMHB
Sericoidinae	Sericoidini	*Blepharotoma heynei*	Neotropical	2	ZMHB
Sericoidinae	Sericoidini	*Blepharotoma martinezi*	Neotropical	1	NHMB
Sericoidinae	Sericoidini	*Blepharotoma nitens*	Neotropical	2	NHMB

Sericoidinae	Sericoidini	*Blepharotoma nitida*	Neotropical	1	CERPE
Sericoidinae	Sericoidini	*Blepharotoma nitidula*	Neotropical	1	NHMB
Sericoidinae	Sericoidini	*Blepharotoma ohausiana*	Neotropical	1	MZUSP
Sericoidinae	Sericoidini	*Blepharotoma petroposilana*	Neotropical	2	NHMB
Sericoidinae	Sericoidini	*Blepharotoma plaumanni*	Neotropical	3	NHMB
Sericoidinae	Sericoidini	*Blepharotoma schenklingi*	Neotropical	1	MZUSP
Sericoidinae	Sericoidini	*Blepharotoma suboblongus*	Neotropical	1	MNHN
Sericoidinae	Sericoidini	*Blepharotoma tarsalis*	Neotropical	3	NHMB

Sericoidinae	Sericoidini	*Blepharotoma uniformis*	Neotropical	1	MNHN

3 TAXONOMIC REVIEW OF *Blepharotoma* (BLANCHARD, 1850) (COLEOPTERA: SCARABAEIDAE, SERICOIDINAE)*

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ABSTRACT

Blepharotoma is a genus described by Blanchard (1850) as monotypic through a male exemplar of *Blepharotoma tarsalis* Blanchard, 1850. Currently the genus has 20 species distributed in South America with nine descriptions and ten transferences from other genera after its description. Such a number of insertions caused a certain uncertainty of its limits. This is evidenced by recent phylogenetic analysis which authors have been citing the need of a taxonomic review to establish the real situation of the genus today. Due to this, plus the fact that *Blepharotoma* and some of its species lacks details on its descriptions, this work aims to review the genus *Blephatoma* and its species. To do this, 263 specimens identified as belonging to the genus were analyzed. We analyzed external morphology, including mouthparts and male genitalia when possible. To visualize these structures, some specimens were dissected and mounted. Both these structures as the body of the specimens were observed in stereomicroscope to construct the descriptions. Data from labels were used to assemble distribution maps to the genus and species. As a result, we were able to redescribe *Blepharotoma* and 19 from its species, with a greater richness of details. With the characters from description, we constructed an identification key. Lastly, we were able to amplify the distribution data of *Blepharotoma* and its species due to the distribution maps.

Keywords: Neotropical, beetles, chafers, revision, morphology

1. Introduction

Blepharotoma is a genus from Sericoidini (Coleoptera, Scarabaeidae, Sericoidinae), and it was proposed by Blanchard (1850) as monotypic [type: *B. tarsalis* Blanchard, 1850], for Melolonthini. With an extensive tribal history, it was transferred to Macrodactylini, Sericini, Liparetrini, and at last to Sericoidini, where is currently allocated (Dalla-Torre, 1912-1913; Evans, 2003; Frey, 1973; Smith, 2008).

Different from others Sericoidini, *Blepharotoma* has labrum hided by the clypeus in dorsal view and separated from this by a thin suture; clypeal margin elevated; antennae with eight antennomeres; meso- and metasternal process absent; abdomen with six convex ventrites with the same length (ventrite I hind by the metacoxae); metatibiae with two apical spurs, positioned above and below tarsal articulation; claws symmetrical and apically toothed (Smith, 2008). Males are distinguished by females for tarsomeres I-IV flattened, ventrally covered by a tuff of seate.

Over time, 20 species were included and at the moment *Blepharotoma* includes 20 valid species distributed along Brazil (13 species), Argentina (5 species), Bolivia (3 species) and Paraguay (1 species) (Evans and Smith, 2009). The first additions to the genus after its description started by Moser (1918; 1924), who described *B. nitidula* Moser, 1918 and *B. petropolisana* Moser, 1924. After one hundred years, the genus was again accessed, with the proposal of *B. confusa* and transference of *Heteronyx ohausiana* Saylor, 1938 (Martínez, 1959). Frey in 1973 described six species (*B. argentina*, *B. boccaine*, *B. calvicollis*, *B. martinezi*, *B. nitens* e *B. plaumanni*) and included characters of male genitalia in the descriptions, this being a first for the genus. In addition, Frey constructed a taxonomic identification key for the genus. Smith (2008) transferred *Aplodema angustata* Blanchard, 1850, *Heteronyx boliviana* Moser, 1919, *H. corumbana* Moser, 1921, *H. cuyabana* Moser, 1919 *H. heynei* Moser, 1919 and *H. schencklingi* Moser, 1919 to *Blepharotoma*, mentioning about the possibility of these species being synonyms of other species of *Blepharotoma*, but he didn't mention which species they could be synonymized with. Also, the author highlights the necessity of the genus revision to solve these questions. Cherman et al. (2016) transfer *Hilarianus uniformis* Blanchard, 1850 and *H. suboblongus* Blanchard, 1850 to *Blepharotoma*, mentioning that those modifications must be confirmed at the time of the

review of *Blepharotoma*. Finally, Pacheco and Ahrens (2024) identifies *Omaloplia nitida* Mannerheim, 1829 as a *Blepharotoma* species and transferred it to the genus during its studies of Sericini.

Three main reasons led us to review *Blepharotoma*. 1) Smith (2008), Cherman et al. (2016) and Costa et al. (2021), during the performance of their studies, commented on the need for a review of the genus due to phylogeny results; 2) The large number of taxonomic acts that occurred may have resulted in the imprecision of the limits of the genus and its species; 3) Descriptions with little morphological detail, both of the genus and of some species, may hinder accurate identification of taxa. Based on the above, this study aimed to conduct a taxonomic review study of the species currently allocated in *Blepharotoma*.

2. Material and Methods

2.1. Material examined

We analyzed a total of 263 specimens of 19 species of *Blepharothoma*. *B. angusta* was not analyzed due to unvailabily of any specimen from this species. The specimens were available through loan or photographic (marked with *) material from the following institutions: **CERPE -** Coleção Entomológica da Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brazil (P. C. Grossi); **CEUFPE -** Coleção Entomológica da Universidade Federal de Pernambuco, Recife, Pernambuco, Brazil (L. Iannuzzi); **DZUP -** Coleção Entomológica Pe. J.S. Moure, Universidade Federal do Paraná, Curitiba, Brazil (L. Massutti and C. S. Ribeiro-Costa); **MNHN -** Muséum National d'Histoire Naturelle, Paris, France; **MNRJ –** Museu Nacional do Rio de Janeiro, Rio de Janeiro, Brazil(M. Couri); **MZSP -** Museu de Zoologia, Universidade de São Paulo, São Paulo, São Paulo, Brazil (S. Casari); **NHMB** - Naturhistorisches Museum Basel, Basel, Switzerland (M. Borer); **ZMHB -** Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (J. Frisch and J. Willers).

2.2. Taxonomic description

The external morphology of the material was examined through observation in stereomicroscope Zeiss Stemi DV4. When possible, the mouthparts and male genitalia were dissected after softening the material using boiling water, using scissors. The pieces were glued in a card pinned in the same pin of its source specimen.

The terminology used was: a) body and mouthparts (Blanchard 1850; Lawrence et al., 2011; Moser 1918, 1921, 1924; Martínez 1959; Frey 1973; Smith 2008); b) male genitalia (Ahrens & Lago 2008; Tarasov & Génier 2015). The redescriptions were made following the recommendations of Ratcliffe (2013) to taxonomic works.

The opposite morphological characters during comparison between genus and/or species in the remarks are indicated within parentheses. The identification key to species is based mainly on male features, except those species that only have females available.

To the maps of distribution, we used data from location labels, this data was reunited in a georeferenced matrix. The matrix then was used on QGIS with a shapefile referent to South America countries political division.

3. Results and Discussion

Blepharotoma Blanchard, 1850

Blepharotoma Blanchard, 1850:115 [holotype Brésil[sic]]; Martínez, 1859:29 (*B. ohausina* new comb.); Gerard, 1852 (checklist); Dalla-Torre, K.W., 1912-1913 (catalog); Frey, 1973: 315 (genus review); Evans, 2003 (checklist); Evans and Smith, 2005:39 (checklist); Katovich, 2008 (Macrodactylini phylogenetic review); Smith, 2008:3 (checklist, new comb.); Evans and Smith, 2009:32 (checklist); Cherman et al., 2016 (phylogenetic analysis); Weir et al., 2019 (catalog); Costa et al., 2021 (phylogenetic analysis); Pacheco et al., 2021 (*Astaena* (Melolonthinae: Sericini) review); Cherman et al., 2024 (Diplotaxini phylogenetic analysis); Costa-Silva et al., 2024 (Brazilian Scarabaeoidea overview); Pacheco and Ahrens, 2024:298 (*B. nitida* new combination).

Type species. *Blepharotoma tarsalis* Blanchard, 1850

Diagnosis. Body brownish, ovate to suboblongus, dorsally covered with punctures and setae, punctures and setae size and distribution varies among species. Clypeus emarginate, suture between clypeus and labrum.

Redescription. Length 3-12 mm, body brownish-yellow, brownish-red, brown or black, ovate to suboblongous. ***Head.*** Eyes rounded, interocular distance two or three times the size of one eye; front with bristled punctutation that varies in size and quantity; clypeus trapezoidal, punctate, rugose in some species, margin reflexed; *ocular cantus* projected and covering the eyes, separated from the labrum by suture; labrum attached with the clypeus, hidden beneath clypeus in dorsal view, with emargination at medium line, apical margin mostly rounded. ***Mouthparts.*** Mandible with mole surface smooth, toothed at the apical sulcus; maxillary lacinia toothed, maxillary palps with four articules, articule I shorter, articule II-IV with similar size, articule IV conical, palps with 2x longer than wide, teeth of galea without torsion; labial palps with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes; antenna with eight antennomeres (including three flagellomeres), club ovate. ***Prothorax.*** Wider than long, punctate and with setae, lateral margin rounded and with a longitudinal row of setae, basal angles rounded, apical angles acute; mesosternum with long setae, mesepimerum with inter posterior corner not projected; metasternum wider than metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, with or without setae. ***Elytra.*** Ovate or oblongous, convex, with bristled punctures varying from thin to coarse to thin and sparse to dense distribution. ***Procoxae.*** Mostly conical. ***Protibiae.*** With three teeth at external margin, first one much shorter than the others, angle between teeth II-III highly variable. ***Protarsus.*** Filiform, protarsomeres II-IV cilyndric. ***Mesocoxae.*** Contiguous, two or 3x wider than long. ***Metacoxae.*** Longer than the ventrite II, external margin in obtuse angle. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifidus, symmetrical, apically toothed. ***Abdomen.*** With six sternites (sternite I partially hidden by metacoxae); ventrites approximately equal in length and evenly convex, with or without a row of punctures; ventrites covered by setae varying from thin to coarse and sparse to densely; ventrite V longer than the VI. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Longer than

wide, with suture between ventrite V and propygidium. ***Male genitalia.*** Parameres symmetrical, shape varies between square or rectangular, internal margin straight or curved, apex convergent or parallel, surface flattened or escavated; phalobasis surface flattened or excavated, with or without longitudinal medial line visible, with or without constriction at the medial line, shorter or larger than the parameres.

Sexual dimorphism. Males protarsomeres I-IV with setae on ventral surface and modified into cup-like pads. Females with protarsomeres I-IV cylindrical.

Geographical distribution. Brazil, Peru, Bolivia, Paraguay, Argentina. (Figure 1)

Remarks. *Blepharotoma* was defined more than 200 years ago, and its original description is lacking some details commonly used nowadays. For example, the use of genitalia and mouthparts.

Now, in its current tribe, Sericoidini, *Blepharotoma* can be easily differentiated from other genera of the tribe due to its body covered, more specifically the dorsal region, with setae. Other characters mentioned by Blanchard in its original description remain as important guides to identify the genera as diagnostic characters, like the punctures along the body that varies from species to species and the number of protibiae teeth. In his reassessment, Frey, 1973, highlights characters from antennae, setae of elytra and male tarsal dimorphism in his identification keys, which allow the genus to a certain level, but it still lacks more complete information about other body parts like mouthparts. Smith, 2008, brings a new set of characters in his diagnosis, including the ones of the mouthparts, like labrum hidden beneath clypeus in dorsal view, labrum separated from clypeus by suture and clypeal margin reflexed, showing the value of characters from this structure to identification that were not used in the group until then. Still, in this revision we present a new set of useful characters that will help in the distinction of both genus and species, like the mouthparts characters and the ones of male genitalia when possible.

In the original description, *Blepharotoma* is defined by Blanchard, 1850 mainly by characters from labial and maxillary palps and antennae, like number of articles and shape of them, and from the first pair of legs, mainly from tarsus, with highlight to shape of tarsomeres and presence of setae. Many of these characters still play an important

role in the identification of the genus. Smith (2008), uses in his assessment to Sericoidini the characters from antennae and legs as diagnostics. In this work, the author also includes the suture between labrum and clypeus, highly important to identification and the shape of clypeus itself, that is very useful, to distinguish this genus for other similar genera. In the present work, we identified and included a new range of characters. Highlighting the ones from body parts punctures and setae (shape and distribution) not approached before, that are in fact very helpful to an easy identification of the genus among the tribe and for the species inside the genus.

It is important to note that a great part of the specimens analyzed were female. Little is known about the biology of this genera, but apparently females have a catch rate way higher than the males, maybe due to flight dispersion, emerge time or differences in trap attractiveness as occurs in other groups (Bleiker and Hezewijk, 2016; Hesler and Sutter., 1993; Tanaka and Yamanaka, 2009). Meanwhile there's no studies about biology or collect methods that will remain unsolved.

3.1 Taxonomic identification key to *Blepharotoma* Blanchard species

1. Body unicolor.....2

   Body bicolor (head and pronotum black/ elytra brownish). Brazil, Argentina. …….....***B. nitens*** Frey, 1973 (Figure 1)

2(1). Body color black/dark brown.....3

   Body with other colors.....5

3(2). Body size smaller or equal to 3mm. Dorsal surface of the pronotum with coarse punctures (Figure 2A). Interocular distance 5x the size of the eye diammeter. Brazil. ……..... ***B. nitidula*** Moser, 1918 (Figure 2)

Body size greater than 3mm. Dorsal surface of the pronotum with thin punctures. Interocular distance 3x the size of the eye diameter. 4

4(3). Scutellum with apex straight. Brazil, Argentina. ……. ***B. ohausiana*** (Saylor, 1938) (Figure 3)

Scutellum with apex rounded. Brazil. ..... ***B. petropolisana*** Moser, 1924 (Figure 4)

5(2). Body shape rounded (Figure 2) …….....6

Body shape suboblong (Figure 1).....10

6(5). Protibiae with obtuse angle between teeth II and III.....7

Protibiae with straight angle between teeth II and III.....9

7(6). Front surface with dense punctures. Clypeus apex emarginate. Pronotum dorsal surface with dense punctures. Argentina. ……..... ***B. martinezi*** Frey, 1973 (Figure 5)

Front surface with sparse punctures. Clypeus apex straight. Pronotum dorsal surface with sparse punctures (Figure 6) 8

8(7). Clypeus with coarse punctures on the surface; Pronotum setae distribution uniform in dorsal surface. Body yellowish. Scutellum apex acute. Head with long setae. Brazil. ..... ***B. schenklingi*** (Moser, 1919) (Figure 6)

Clypeus with thin punctures on the surface; Pronotum setae distribution sparce at disc becoming denser next to the lateral margins. Body brownish. Scutellum apex rounded. Head with short setae. Brazil, Argentina. .....***B. calvicolis*** Frey, 1973 (Figure 7)

9(6). Clypeus rough. Body yellowish. Front with thin and sparse punctures. Brazil. ..... ***B. tarsalis*** Blanchard, 1850 (Figure 8)

Clypeus smooth, not rough. Body brownish. Front with coarse and dense punctures. Brazil, Argentina…..... ***B. plaumanni*** Frey, 1973 (Figure 9)

10(5). Metasternum with length smaller than Metacoxae. Protibiae with straight angle between teeth II and III. Brazil, Argentina…… ……..……***B. suboblonga*** (Blanchard, 1850) (Figure 10)

Metasternum with length bigger or equal to Metacoxae. Protibiae with acute angle between teeth II-III 11

11(10). Propygidium smooth surface, without punctures. Brazil, Bolivia. ..... ***B. boccaine*** Frey, 1973 (Figure 11)

Propygidium with punctate surface. ….……..... 12

12 (11). Front with coarse punctures. Bolivia (Chaco). ... ***B. boliviana*** (Moser, 1919) (Figure 12)

Front with thin punctures. ….....13

13(12). Pronotum with long setae and coarse punctures (Figure 14). Paraguay. ..... ***B. heynei*** (Moser, 1919) (Figure 13)

Pronotum with short setae and thin punctures. …….....14

14(13). Scutellum with setae. Clypeus with coarse punctures. Labium as wide as long. Brazil. ..... ***B. nitida*** (Mannerheim, 1829) (Figure 14)

Scutellum glabrous. Clypeus with thin punctures. Labium longer than wide. 15

15(14). Clypeus with dense punctures. ….....16

Clypeus with sparse punctures. 17

16(15). Front with interocular distance 3x the size of the eye diameter. Body round dorso-ventrally. Clypeus apex emarginated. Metatibia spurs with unequal length. Argentina. …….. ***B. argentina*** Frey, 1973 (Figure 15)

Front with interocular distance 2x the size of the eye diameter. Body flattened dorso-ventrally. Clypeus apex straight. Metatibia spurs with equal length. Brazil, Bolivia, Argentina. ..... ***B. confusa*** Martínez, 1959 (Figure 16)

17(15). Pronotum with dense punctures. Clypeus apex rounded. Brazil, Bolivia, Argentina. ..... ***B. cuyabana*** (Moser, 1919) (Figure 17)

Pronotum with sparse punctures. Clypeus apex emarginate. ……..…….....18

18(17). Head with long setae. Protibiae with angle acute between teeth II and III. Brazil, Bolivia (Santa Cruz de La Sierra). …….....…….... ***B. corumbana*** (Moser, 1921) (Figure 18)

Head with short setae. Protibiae with angle obtuse between teeth II and III. Brazil, Peru. ..... ***B. uniformis*** (Blanchard, 1850) (Figure 19)

3.2 Taxonomy

Blepharotoma argentina Frey 1973 (Figure 15)

Blepharotoma argentina Frey, 1973:319 [holotype Argentinien, Urundel, Salta, Tabilla [sic]]; Evans and Smith, 2005:39 (checklist); Evans and Smith, 2009:32 (checklist)

Type material. ARGENTINA. **Salta.** Oran, 11/12.X.1968, Pena: 2 males (NHMB).

Diagnosis. Body brownish, oblong; front densely punctate with thin punctures, densely covered by short setae; clypeus trapezoidal shallowly emarginate at the apex, densely punctate with thin punctures; pronotum with thin punctures densely distributed and short setae densely distributed; protibia with two teeths at external margin, first one much shorter, angle between teeth II-III obtuse.

Redescription. Length 5.0 mm, body brownish, oblong. ***Head*.** Eyes rounded, interocular distance three times the size of the eye, front densely punctate, punctures thin, densely covered by short setae, clypeus format trapezoidal densely punctate, punctures thin, densely covered by short setae, margin reflexed, *ocular cantus* projected covering the eyes, apex with shallow emargination, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts*.** Labrum merged with the clypeus, with shallow emargination at medium line, apical margin rounded; mandible with spring smooth, toothed at the apical sulcus; maxillary lacinia toothed, maxillary palps with 2x longer than wide, teeth of galea without torsion; labium longer than wide, with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax*.** Wider than long, densely punctate, thin punctures, densely covered by short setae, lateral margin with a longitudinal row of

setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with short setae, mesepimerum with intern posterior corner projected; metasternum larger than the metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum with apex acute, punctate, without setae. ***Elytra.*** Rounded, convex, densely punctate, thin punctures, densely covered with long setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeths at external margin, first one much shorter than the others, angle between teeth II-III obtuse. ***Protarsus.*** Cylindrical, protarsomeres II-IV enlarged at the distal portion. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** Spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, bifid claws. ***Abdomen.*** With six ventrites (ventrite I partially hidden by metacoxae), ventrites approximately equal in length and evenly convex; ventrites densely covered with long setae, ventrite V ventrite longer than the last, ventrites II-IV without transversal row of punctures, suture between ventrite V and Propygidium. ***Propygidium.*** Visible portion punctate. ***Pygidium.*** larger than wide. ***Male genitalia*** **(Figure 20A).** Parameres symmetrical as large as wide, distal margin dorsally rounded, apex convergent, lateral surface smooth, phalobasis distal margin dorsally excavated, with constriction at medial line.

Type locality. Argentina, Urundel, Salta, Tabilla.

Geographical distribution. Argentina. (Figure 21).

Remarks. *Blepharotoma argentina* is very similar *B. heyney* by the dense distribution of punctures and setae on pronotum but is different by the angle between protibial teeth II-III obtuse (acute); and the thin punctures on pronotum (coarse punctures); and male genitalia is as large as wide (longer than wide). Besides the similarity shared by this species except by the male genitalia (Frey, 1973), as is established here other characters can help to identify these species.

Blepharotoma boccaine **Frey, 1973 (Figure 11)**

Blepharotoma boccaine Frey, 1973: 319 [holotype Brazilien, Serra de Boccaina, S. Paulo [sic]]; Evans and Smith, 2005:39 (checklist); Evans and Smith, 2009:33 (checklist).

Type material. BRAZIL. **Bahia**. Encruzilhada, 920 m, XI.72, Alvarenga: 1 male, 1 female. (NHMB).

Non-type material. BOLIVIA. **Santa Cruz**. Chiquitos, Santiago de Chiquitos, 20.XI.2008, W.D. Edmonds & T. Vidaurre: 1 female (CEMT); BRAZIL. **Bahia**. 10km NE from Encruzilhada, 15.XII.2012, G.Melo e P. Grossi: 1 female (CERPE); **Espírito Santo**. Santa Teresa, 670 m, 19.I.1964, N. Papavero: 1 female (MZUSP); **Goiás**. Jataí, Faz. Aceiro, X.1962, Exp. Dep. Zool.: 2 female (MZUSP) **Mato Grosso**. Chapada dos Guimarães, Trilha Casa do Mel, XII.2008, R.V. Nunes, J. Cabra & M. Rossini: 1 female (CEMT); Salobra, 24.X.1938, F. Lane: 2 female (MZUSP); Urucum, I.1955, Comissão I.O. Cruz, 1 female (MNHRJ); **Minas Gerais**. Itamonte, Casa de Pedra, 27-28.III.2014, M.L. Monné, A. Carelli & M. Cupello: 1 female (MNHRJ); São Gonçalo do Rio Abaixo, 17.I.1997: 1 female (CERPE); São João Batista, Serra da Canastra, Cachoeira do Seta, 16.XI.2014, J.L. Nessimian, A.L.H. Oliveira, I.C. Rocha & P.M. Souto: 2 females (CE-UFPE); Serra do Caraça, 1880 m, XI.1961, Kloss, Lenko, Martins & Silva, 1 female (MZUSP); Serra do Caraça, XI.1961, Exp. Dep. Zool.: 1 female (MZUSP); **Paraná**. Tamarana, 22.XII.2000, Lopes, J.: 1 female (CEMT); **Rio de Janeiro**. Itatiaia, 12/13.IX.1950, Albuquerque & Silva: 1 female (MNHRJ); **Rio Grande do Sul**. São Francisco de Paula, Pro-Mata, 15.I.2002, R. Ott: 1 female; **Rondônia**. Vilhena, 29.X.1986, C. Elias: 1 female (DZUP); Vilhena, 19.XII.1986, C. Elias: 1 female (DZUP); Vilhena, 27.XII.1986, C. Elias: 1 female (DZUP); **São Paulo**. Barueri, 13.X.1955, K. Lenko: 1 female (MZUSP); Barueri, X.1958, K. Lenko: 1 female (MZUSP); Barueri, X.1962, K. Lenko: 1 female (MZUSP); Barueri, XI.1964, K. Lenko: 1 female (MZUSP); Barueri, XI.1965, K. Lenko: 1 female (MZUSP); Barueri, 10.XII.1965, K. Lenko: 2 female (MZUSP); Barueri, 14.X.1966, K. Lenko: 1 female (MZUSP); Castilho, Marg. Esq. Rio Paraná Faz. Canaã, X.1964, Exp. Dep. Zool.: 2 females (MZUSP); Itú, Fazenda Pau d'Alho, 28.I.1958, U. Martins: 1 female (MZUSP); P.E. Jacupiranga (Núcleo Cedro 656m), 24°57'47.0"S, 48°25'00.0"W, 10-17.XI.2005, EAguiar & PMSMartinez: 1 female (MZUSP); Pindamonhangaba, Eugênio Lefévre, 26.X.1962, Exp. Dep. Zool.: 1 female (MZUSP); Pindamonhangaba, Eugênio Lefévre,

24.I.1963, Exp. Dep. Zool.: 1 female (MZUSP); Serra da Bocaína, 20.X.2013, Mermudes et al.: 1 female (MNRJ).

Diagnosis. Body brownish, oblong; front densely punctate with coarse punctures, sparsely covered by long setae; clypeus trapezoidal shallowly emarginate at the apex, densely punctate with coarse punctures; pronotum with coarse punctuation densely distributed and long setae densely distributed; protibia with two teeth at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 5.0 mm, body brownish, oblong. ***Head.*** Eyes rounded, interocular distance 2x the size of the eye, front densely punctate, punctures coarse, densely covered by long setae, clypeus format trapezoidal densely punctate, punctures coarse, densely covered by long setae, margin reflexed, *ocular cantus* projected covering the eyes, apex with shallow emargination, separated from the labrum by suture, antenna with eight antenomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, with shallow emargination at medium line, apical margin rounded; mandible with spring smooth, toothed at the apical sulcus; maxillary lacinia toothed, maxillary palps with 2x longer than wide, teeth of galea without torsion; labium longer than wide, with three articles, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, densely punctate, coarse punctures, densely covered by long setae, lateral margin with a longitudinal row of setae, long setae, basal angles rounded, apical acute angles, lateral margin rounded; mesosternum with short setae, mesepimerum with inner posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, with setae, apex acute. ***Elytra.*** Oblong, convex, densely punctate, thin punctures, densely covered with short setae. ***Procoxae.*** conical. ***Protibiae.*** Three teeths at external margin, first one much shorter than the others, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** Spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, bifid claws, symmetrical, apically toothed. ***Abdomen.*** With six ventrites (ventrite I partially hidden by metacoxae), ventrites approximately equal in length and evenly convex; ventrites sparsely covered with coarse setae, ventrite V longer than the last, ventrites II-

IV without transversal row of punctures, suture between ventrite V and Propygidium. ***Propygidium.*** Visible portion punctate, densely covered by thick setae. ***Pygidium.*** Larger than wide. ***Male genitalia*** **(Figure 20B).** Parameres symmetrical longer than wide, distal margin dorsally rounded, apex convergent, lateral surface with excavated, phalobasis distal margin dorsally excavated, with constriction at medial line.
Type locality. Brazil, São Paulo, Serra da Bocaína.

Geographical distribution. Brazil (Mato Grosso, Bahia, Goiás, Minas Gerais, Espírito Santo, São Paulo, Rio de Janeiro, Paraná), Bolivia (Santa Cruz). (Figure 21).

Remarks. *Blepharotoma boccaine* is morphologically similar to *B. argentina* and *B. heyney* by its color, shape and dense punctures distribution on clypeus and pronotum. It is different by interocular distance with 2x the eye diameter (3x) and the scutellum apex rounded (acute). Besides the similarity shared by this species except by the male genitalia (Frey, 1973), as is established here other characters can help to identify these species.

Blepharotoma boliviana **(Moser, 1919) (Figure 12)**

Heteronyx bolivianus Moser, 1919 [holotype Bolivia, Chaco[sic]];

Heteronyx boliviana Moser; Blackwelder, 1944: 221 9 [emendation];

Blepharotoma boliviana (Moser); Smith, 2008: 5 [new combination]; Evans and Smith, 2009:33 (checklist).

Type material. HOLOTYPE and PARATYPE. BOLIVIA. **Chaco.** 2 (ZMHB).

Diagnosis. Body brownish, oblong; front densely punctate with coarse punctures, sparsely covered by short setae; clypeus trapezoidal rounded at the apex, densely punctate with coarse puncta; pronotum with coarse punctuation densely distributed and short setae densely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 9.0 mm, body brownish, oblong. ***Head.*** Eyes rounded; interocular distance about 2x larger than the eye, front densely punctate with coarse punctures, sparsely covered by short setae; clypeus format trapezoidal densely punctate, punctures coarse, sparsely covered by short setae, margin reflexed, *ocular cantus* projected covering the eyes, apex round, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, with shallow emargination at medium line, apical margin rounded; mandible with spring smooth, toothed at the apical sulcus; maxillary lacinia toothed, maxillary palps with 2x longer than wide, teeth of galea without torsion; labium longer than wide, with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, densely punctate, coarse punctures, covered with short setae, setae densely distributed, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with short setae, mesepimerum with intern posterior corner not projected; metasternum with length bigger than metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, with apex acute, punctate. ***Elytra.*** Oblong, convex, densely punctate, thin punctures, densely covered by setae, long setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeth at external margin, one shorter, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** Spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, bifid claws. ***Abdomen.*** Ventrites weakly covered by thin setae, ventrite V longer than the last, propygidium visible portion punctate, densely covered by coarse setae, pygidium larger than wide, with suture between ventrite V and Propygidium;

Type locality. Bolivia, Chaco.

Geographical distribution. Bolivia (Chaco). (Figure 21).

Remarks. This species differs from the other ones mainly by the combination of the two characters' size and color, being one of the largest species (9 mm) and dark brown body. The congeneric species are brownish or yellowish and they are smaller (7 mm), like *B. petropolisana or B. martinezi*.

***Blepharotoma calvicolis* Frey, 1973 (Figure 9)**

Blepharotoma calvicollis Frey, 1973: 321 [holotype Resistencia, Argentinien[sic]]; Evans and Smith, 2005:39 (checklist); Evans and Smith, 2009:33 (checklist).

Type material. ARGENTINA. **Resistencia**. 21.XI.1971: 1 male (NHMB).

Non-type material. BRAZIL. **Rio Grande do Sul**. Cabanha Sobrado Branco, IV.2002, Santos, Dias, Carneiro & Zacca: 1 female (CERPE).

Diagnosis. Body brownish, ovate; front sparsely punctate with thin punctures, sparsely covered by short setae; clypeus trapezoidal straight at the apex, densely punctate with thin puncta; pronotum with thin punctures sparsely distributed and short setae sparsely distributed at the center becoming more dense towards the edges; protibia with two teeths at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 8,5 mm, body brownish, ovate. ***Head.*** Eyes rounded, interocular distance three times the size of the eye, front sparsely punctate, punctures thin, sparsely covered by short setae, clypeus format trapezoidal densely punctate, punctures thin, sparsely covered by short setae, margin reflexed, *ocular cantus* projected covering the eyes, apex straight, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface smooth, toothless at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium longer than wide, palpus with three palpomeres, apical margin with emargination large and semicircular, with separation ligule/labium, with lateral lobes. ***Prothorax.*** Wider than long, sparsely punctate, thin punctures, covered with short setae, setae distribution sparse at the central region and becoming more dense in the edges, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with short setae, mesepimerum with intern posterior corner not projected; metasternum with small length than metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum

triangular, punctate, without setae, apex rounded. ***Elytra.*** Oblong, convex, sparsely punctate, thin punctures, sparsely covered with short setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeths at external margin, first one much shorter than the others, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV piriform. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, equal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventritws (ventrite I partially hidden by metacoxae), ventrites approximately equal in length and evenly convex; ventrites sparsely covered with long setae, ventrite V longer than the last, ventrites II-IV with transversal row of punctures, suture between ventrite V and Propygidium. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide. ***Male genitalia*** **(Figure 20C).** Parameres symmetrical, longer than wide, internal margin curved, apex convergent, surface smooth, phalobasis excavated, without longitudinal medial line visible, with constriction at the medial line.

Type locality. Argentina, Resistencia.

Geographical distribution. Brazil (Rio Grande do Sul), Argentina (Resistencia). (Figure 21).

Remarks. This species differs from the other *Blepharotoma* mainly by the body shape rounder and pronotum bristle disposition, which is more scarce next to the disc on the contrary of the edges, creating a bald pattern. In other species the body shape pattern is a gradient from suboblong in most of the cases to a body rounder, never being as round as *B. calvicolis*. Also, the setae are distributed continuously along the pronotum.

Blepharotoma confusa **Martínez, 1959 (Figure 16)**

Blepharotoma confusa Martínez, 1959: 27 [holotype Argentina, Salta, Dep. Gral. San Martin, Salvador Mazza (Pocitos, Km 1455)[sic]]; Evans and Smith, 2005:40 (checklist); Evans and Smith, 2009:33 (checklist); Costa et al., 2021: 3,5,7 (phylogenetic analysis).

Non-type material. ARGENTINA. **Cordoba**. 14.XII. 2002, J.L. Forest: 1 female (CEMT); BOLIVIA. **Beni**. San Borja, 22.XI.1998, V. Tichy; 1 female (CEMT); **Cochabamba**. 2600 m, 2.XII.1959, Zischka: 1 male, 3 female (ZWMB); BRAZIL. **Minas Gerais**. Unaí, Faz. Bolívia, 22-24.X.1959, Exp. Dep. Zool.; 1 female (MZUSP); **São Paulo**. Barueri, X.1958, K. Lenko: 1 female (MZUSP).

Diagnosis. Body yellowish, oblong; front densely punctate with thin punctures, sparsely covered by short setae; clypeus trapezoidal straight at the apex, densely punctate with thin puncta; pronotum with thin punctuation densely distributed and short setae sparsely distributed; protibia with three teeths at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 5.0 mm, body yellowish, oblong. ***Head*.** Eyes rounded, interocular distance 2x the size of the eye diameter, front densely punctate, punctures thin, sparsely covered by short setae, clypeus format trapezoidal densely punctate, punctures thin, sparsely covered by short setae, margin reflexed, *ocular cantus* projected covering the eyes, apex straight, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), antennal club ovated. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface rough, toothless at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium longer than wide, palpus with three palpomeres, apical margin with emargination large and semicircular, with separation ligule/labium, with lateral lobes. ***Prothorax.*** Wider than long, densely punctate, thin punctures, sparsely covered with short setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with short setae, mesepimerum with intern posterior corner projected; metasternum with the same length of metacoxae, meso- and metasternal process absent ***Pterothorax.*** Scutellum triangular, punctate, without setae, apex acute. ***Elytra.*** oblong, convex, sparsely punctate, thin punctures, densely covered with long setae. ***Procoxae.*** conical. ***Protibiae.*** three teeths at external margin, first one much shorter than the others, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV piriform. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the

ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, equal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrites (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered with thin setae, ventrite V longer than the last, ventrites II-IV without transversal row of punctures, suture between ventrite V and Propygidium. ***Propygidium.*** Visible portdion punctate, covered by setae. ***Pygidium.*** Larger than wide. ***Male genitalia*** **(Figure 20D).** Parameres symmetrical, longer than wide, internal margin straight, apex parallel, surface smooth, phalobasis excavated, without longitudinal middle line visible, with constriction at the medial line.

Type locality. Argentina, Salta, Salvador Mazza.

Geographical distribution. Brazil (Minas Gerais, São Paulo), Bolivia (Beni, Cochabamba), Argentina (Cordoba). (Figure 21).

Remarks. *Blepharotoma confusa* differs from the others by the flatter body, combined with lighter color and clypeal shape with apex straight. It is similar to *B. tarsalis* but differs from this by clypeus smooth (clypeus rough) and by its body which is more elongated.

Blepharotoma corumbana **(Moser, 1921) (Figure 18)**

Heteronyx corumbanus Moser, 1921: 138 [holotype Mato Grosso (Corumba)[sic]];

Heteronyx corumbana Moser; Blackwelder, 1944: 221 [emendation];

Blepharotoma corumbana (Moser); Smith, 2008: 5 [new combination]; Evans and Smith, 2009:33 (checklist).

Type material. SYNTYPE. BRAZIL. **Mato Grosso**. Corumba: 1 male, 1 female (NHMB)

Non-type material. BOLIVIA. **Santa Cruz**. Parapeti, X.1960, A. Martinez,: 1 male, 2 females (MZUSP); BRAZIL. **São Paulo**. Castilho, Marg. Esq. Rio Paraná, XI.1964,

Exp. Dep. Zool.: 1 male (MZUSP); Pindamonhangaba, Eugênio Lefévre, 26.X.1962, Exp. Dep. Zool.: 1 female (MZUSP).

Diagnosis. Body brownish, oblong; front sparsely punctate with thin punctures, sparsely covered by long setae; clypeus trapezoidal shallowly emarginate at the apex, sparsely punctate with coarse puncta; pronotum with thin punctuation sparsely distributed and long setae densely distributed; protibia with three teeths at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 5.0 mm, body brownish, oblong. ***Head.*** Eyes rounded, interocular distance 2x the size of the eye diameter, front sparsely punctate, punctures thin, sparsely covered by long setae, clypeus format trapezoidal densely punctate, punctures coarse, sparsely covered by long setae, margin reflexed, *ocular cantus* projected covering the eyes, apex with shallow emargination, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts*.** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with deep emargination at medium line, apical margin rounded; mandible with mole surface smooth, toothless at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium longer than wide, palpus with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, sparsely punctate, thin punctures, densely covered with long setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with short setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, without setae, apex acute. ***Elytra.*** Oblong, convex, sparsely punctate, thin punctures, densely covered with long setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeths at external margin, first one much shorter than the others, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden

by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered with long setae, ventrite V longer than the last, ventrites II-IV without transversal row of punctures, suture between ventrite V and Propygidium. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide. ***Male genitalia*** **(Figure 22A).** Parameres symmetrical, longer than wide, internal margin curved, apex parallel, surface smooth, phalobasis excavated, with longitudinal medial line visible, without constriction at the medial line.

Type locality. Brazil, Corumba.

Geographical distribution. Brazil (Mato Grosso, São Paulo, Mato Grosso do Sul), Bolívia (Santa Cruz de La Sierra). (Figure 23).

Remarks. In the original description, Moser reported that *B. corumbana* has a smooth head. However, when the type material was examined, it was noted that the head of this species is covered with punctures just like all the genus species. In the same way, this species has three protibial teeth, different from the original description that point two protibiale teeth. Probably the first teeth may have remained unnoticed by Moser since they are very small, compared to the other two.

This species is similar to *B. cuyabana* but can be differentiated by clypeal apex emarginated (rounded), and the punctures on its pronotum sparser than *B.cuyabana*.

Blepharotoma cuyabana **(Moser, 1919) (Figure 17)**

Heteronyx cuyabanus Moser, 1919:5 [holotype Brasilien (Cuyaba)[sic]]

Heteronyx cuyabana Moser; Blackwelder, 1944:221 [emendation]

Blepharotoma cuyabana (Moser); Smith, 2008:5 [new combination]; Evans and Smith, 2009:33 (checklist).

Type material. SYNTYPE. BRAZIL. **Mato Grosso**. Cuiabá: 1 male, 1 female (NHMB)

Non-type material. ARGENTINA. **Salta**. Aquaray, XII.1959, A. Martinez: 1 female (MZUSP); BOLIVIA. **Ichigo**. Buenavista, II.1950, A. Martinez: 1 female (MZUSP); BRAZIL. **Mato Grosso**. Cáceres, 14.I.1985, C. Elias: 1 female (DZUP); Cáceres, 26.I.1985, C. Elias: 2 females (DZUP); Cáceres, 28.I.1985, C. Elias: 2 females (DZUP); Cáceres, 30.I.1985, C. Elias: 1 female (DZUP); Maracaju, III.1937, Shannon Lane: 1 female (MZUSP); **Minas Gerais**. Morro da Garça, 18-20.X.1964, Exp. Dep. Zool.: 1 female (MZUSP); Santana do Riacho, PARNA Serra do Cipó, Campo Sujo, 11.XII.2004, G. Schiffer: 1 female (CEMT); **Rio de Janeiro**. Nova Friburgo, XII.2002, E. Grossi; 1 female (CEMT); **São Paulo**. Barueri, X.1958, K. Lenko: 1 female (MZUSP).

Diagnosis. Body brownish, oblong; front sparsely punctate with thin punctures, sparsely covered by long setae; clypeus trapezoidal rounded at the apex, sparsely punctate with thin puncta; pronotum with thin punctuation densely distributed and long setae densely distributed; protibia with two teeth at external margin, first one much shorter, angle between teeth II-III acute.

Description. Length 4.0 mm, body brownish, oblong. ***Head.*** Eyes round, interocular distance 2x the size of the eye, front sparsely punctate, punctures thin, sparsely covered by long setae, clypeus format trapezoidal sparsely punctate, punctures thin, sparsely covered by long setae, margin reflexed, *ocular cantus* projected covering the eyes, apex rounded, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with deep emargination at medium line, apical margin angulous; mandible with mole surface smooth, toothless at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium wider than long, palpus with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, densely punctate, thin punctures, densely covered with long setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with short setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, without setae,

apex acute. ***Elytra.*** Oblong, convex, sparsely punctate, thin punctures, densely covered with long setae. ***Procoxae.*** Transversal. ***Protibiae.*** Two teeth at external margin, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV cylindric: ***Mesocoxae.*** contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered with long setae, ventrite V longer than the last, ventrites II-IV with transversal row of punctures, suture between ventrite V and propygidium. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide. ***Male genitalia*** **(Figure 22B).** Parameres symmetrical, longer than wide, internal margin curved, apex convergent, surface smooth, phalobasis excavated, with longitudinal medial line visible, without constriction at the medial line.

Type locality. Brasil, Cuiabá.

Geographical distribution. Brazil (Mato Grosso, Minas Gerais, São Paulo, Mato Grosso do Sul, Rio de Janeiro), Bolivia (Ichilo), Argentina (Salta). (Figure 23).

Remarks. *Blepharotoma cuyabana* is similar to *B. corumbana*, but it differs from this species and almost all the others by the absence of the first protibial denticule, besides the other characters mentioned in the remarks of this species.

Blepharotoma heynei **(Moser, 1919) (Figure 13)**

Heteronyx heynei Moser, 1919:5 [holotype Paraguay[sic]]

Blepharotoma heynei (Moser); Smith, 2008:5 [new combination]; Evans and Smith, 2009:33 (checklist).

Type material. SYNTYPE. PARAGUAY. 1male, 1 female (NHMB).

Non-type material. BRAZIL. **Mato Grosso**. Cuiabá, 06.XI.2015, A. Frovolov: 1 female (CEMT); Paconé, 28.II.1998: 1 female (CEMT); **Minas Gerais**. Morro da

Garça, 18-20.X.1964, Exp. Dep. Zool.: 1 female (MZUSP); Santana do Riacho, PN Serra do Cipó sede, 1500m, I.2001, F.Z. Vaz de Mello: 1 female (CEMT); Santana do Riacho, PARNA Serra do Cipó, Campo Sujo, 11.XII.2004, G. Schiffler: 1 female (CEMT); Serra do Caraça, XI.1961, 1880 m, Kloss, Lenko, Martins & Silva: 3 females (MZUSP); **Rio de Janeiro**. Nova Friburgo, XII.2001, E. Grossi: 1 female (CEMT); Nova Friburgo, III.2006, V.D.R. & P.C. Grossi: 1 female (CEMT); Nova Friburgo, XII.2009, E. Grossi: 1 female (CEMT); **São Paulo**. Castilho, Marg. Esq. Rio Paraná, XI.1964, Exp. Dep. Zool.: 2 females; Pindamonhangaba, Eugênio Lefévre, 26.X.1962, Exp. Dep. Zool.: 1 female (MZUSP).

Diagnosis. Length 5 mm, body brownish, oblong; front sparsely punctate with thin punctures, sparsely covered by long setae; clypeus trapezoidal rounded at the apex, densely punctate with coarse puncta; pronotum with coarse punctuation densely distributed and long setae densely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 5 mm, body brownish, oblong. ***Head.*** Eyes round, interocular distance three times the size of the eye, front sparsely punctate, punctures thin, sparsely covered by long setae, clypeus format trapezoidal sparsely punctate, punctures coarse, sparsely covered by long setae, margin reflexed, *ocular cantus* projected covering the eyes, apex rounded, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface smooth, toothed at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labial palps with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, densely punctate, coarse punctures, densely covered with long setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with long setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, with setae, apex acute. ***Elytra.*** Oblong, convex, punctate, sparsely punctate, thin punctures, sparsely

covered with setae. ***Procoxae.*** Conical. ***Protibiae*** Three teeth at external margin, first one much shorter than the others, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites densely covered with long setae, ventrite V longer than the last, ventrites II-IV without transversal row of punctures, suture between ventrite V and propygidium. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide. ***Male genitalia*** **(Figure 22C).** Parameres symmetrical, as longer than large, internal margin curved, apex parallel, surface smooth, phalobasis smooth, without longitudinal medial line visible, constriction at the medial absent.

Type locality. Paraguay.

Geographical distribution. Brazil (Mato Grosso, Minas Gerais, São Paulo, Rio de Janeiro), Paraguay. (Figure 23).

Remarks. *Blepharothoma heynei* can be found inside the group of species mentioned by Frey (1973) that can only be identified with male genitalia comparison. Originally, it can be identified using its distribution, only in Paraguay, but with the expansion of that in this paper, this characteristic becomes irrelevant for identification purposes. It is similar to *B. boccaine* but in *B. heynei* the parameres are as wide as they are long, while in *B. boccaine* they are longer than wide.

Blepharotoma martinezi **Frey, 1973 (Figure 5)**

Blepharotoma martinezi Frey, 1973:319 [holotype Argentinien Urundel, Salta, Cordoba[sic]]**;** Evans and Smith, 2005:40 (checklist); Evans and Smith, 2009:33 (checklist).

Type material. PARATIPE. ARGENTINA. **Salta**. Urundel, 10/11.X.1968, Pena: 1 male (NHMB)

Non-type material. ARGENTINA. **Cordoba**. Diquecito, XII.1954, A. Martinez: 1 female (MZUSP).

Diagnosis. Body yellowish, ovate; front densely punctate with thin punctures, sparsely covered by thin setae; clypeus trapezoidal shallowly emarginate at the apex, sparsely punctate with thin puncta; pronotum with thin punctuation densely distributed and short setae densely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III obtuse.

Redescription. Length 4.0 mm, body yellowish, ovate. ***Head.*** Eyes rounded, interocular distance three times the size of the eye, front densely punctate, thin punctures, sparsely covered by thin setae, clypeus format trapezoidal sparsely punctate, punctures thin, sparsely covered by thin setae, margin reflexed, *ocular cantus* projected covering the eyes, apex with shallow emargination, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface smooth, toothed at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium as large as long, palpus with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, densely punctate, thin punctures, densely covered with short setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with long setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, without setae, apex rounded. ***Elytra.*** Oblong, convex, punctate, sparsely punctate, thin punctures, sparsely covered with short setae. ***Procoxae.*** Transversal. ***Protibiae*** Three teeth at external margin, first one much shorter than the others, angle between teeth II-III obtuse. ***Protarsus***. Filiform, protarsomeres II-IV piriform. ***Mesocoxae.*** Contiguous, three times wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite

(ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered with long setae, ventrite V longer than the last, ventrites II-IV without transversal row of punctures, suture between ventrite V and propygidium. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide. ***Male genitalia*** **(Figure 22D).** Parameres symmetrical, longer than wide, internal margin curved, apex parallel, surface excavated, phalobasis excavated, longitudinal medial line visible without constriction.

Type locality. Argentina, Urundel, Salta, Córdoba.

Geographical distribution. Argentina (Salta, Cordoba). (Figure 23).

Remarks. *Blepharotoma martinezi* is one of the smallest species of the genus, with only 3 mm. Besides its size, it is very similar to *B. confusa* by its color and thin punctures of its body. But differs from it by its body rounder (suboblong) and clypeus apex with a shallow emargination (straight).

Blepharotoma nitens **Frey, 1973 (Figure 1)**

Blepharotoma nitens Frey, 1973:320 [holotype Brasilien, Nova Teutonia, Sinisuba (Plaumann), Caviuna Parana[sic]]**;** Evans and Smith, 2005:40 (checklist); Evans and Smith, 2009:33 (checklist)

Type material. PARATYPE. BRAZIL. **Santa Catarina**. Nova Teutônia, 27° 11’ S, 52°, 23’ E, IX.1962, Fritz Plaumann: 1 male, 1 female (NHMB).

Non-type material. ARGENTINA. **Formosa**. Formosa, XII.1949, A. Martínez: 1 female (MZUSP).

Diagnosis. Body bicolor (head and pronotum black and body brownish), ovate; front densely punctate with coarse punctures, densely covered by coarse setae; clypeus trapezoidal shallowly emarginate at the apex, densely punctate with coarse puncta; pronotum with coarse punctuation densely distributed and long setae densely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III straight.

Redescription. Length 7mm, body with pronotum and head black and elytra brown, ovate. ***Head.*** Eyes rounded, interocular distance five times the size of the eye, front densely punctate, punctures coarse, densely covered by coarse setae, clypeus format trapezoidal densely punctate, punctures coarse, densely covered by coarse setae, margin reflexed, *ocular cantus* projected covering the eyes, apex with shallow emargination, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface smooth, toothless at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labial palps with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, densely punctate, coarse punctures, densely covered with long setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with long setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, without setae, apex acute. ***Elytra.*** Oblong, convex, punctate, sparsely punctate, thin punctures, sparsely covered with setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeths at external margin, first one much shorter than the others, angle between teeth II-III straight. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites densely covered with long setae, ventrite V longer than the last, ventrites II-IV without transverse row of punctures, suture between ventrite V and Propygidium. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide. ***Male genitalia.*** Parameres symmetrical, as large as long, internal margin curved, apex convergent, surface smooth, phalobasis excavated, without longitudinal medial line visible, constricted at the medial line.

Type locality. Brazil, Santa Catarina, Nova Teutônia.

Geographical distribution. Brazil (Santa Catarina), Argentina (Formosa). (Figure 23).

Remarks. *Blepharotoma nitens* can be easily distinguished from the other members of the genus by bicolor body, with the head and pronotum black and elytra light brown. The other species present only one color pattern like *B. boliviana w*hich is only black or *B. cuyabana* only brownish. Also, they present greater distance between the eyes (5x) (in *B. nitens*) than this species cited previously (2x) (*B. boliviana and B. cuyabana*).

***Blepharotoma nitida* (Mannerheim, 1829) (Figure 13)**

Omaloplia nitida Mannerheim, 1829: 68 [holotype Brasilia Sarra da Lappa [sic]]

Blepharotoma nitida **(**Mannerheim, 1829) Pacheco and Ahrens, 2024 [new combination]

Non-type material. BRAZIL. **Rio de Janeiro**. Serra da Lapa, Grossi; 1 female (CERPE).

Diagnosis. Body brownish, round; front sparsely punctate with thin punctures, sparsely covered by short setae; clypeus trapezoidal straight at the apex, denselly punctate with coarse puncta; pronotum with thin punctuation sparsely distributed and short setae sparsely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III obtuse.

Redescription. Length 5.0 mm, body brownish, round. ***Head.*** Eyes rounded, interocular distance three times the size of the eye, front sparsely punctate, punctures thin, sparsely covered by short setae, clypeus format trapezoidal densely punctate, punctures coarse, sparsely covered by thin setae, margin reflexed, *ocular cantus* projected covering the eyes, apex straight, separated from the labrum by suture**,** antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts*.** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface smooth, toothed at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth

of galea without torsion; labial palps with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, sparsely punctate, thin punctures, sparsely covered with short setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with long setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, with setae, apex acute. ***Elytra.*** Rounded, convex, sparsely punctate, thin punctures, sparsely covered by short setae. ***Procoxae.*** Transverse. ***Protibiae.*** Three teeth at external margin, first one much shorter than the others, angle between teeth II-III obtuse. ***Protarsus.*** Filiform, protarsomeres II-IV piriform. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With smaller or subequal than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, equal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered with short setae, ventrite V shorter or equal than the last, ventrites II-IV without transversal row of puncta. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide.

Type locality. Brazil, Serra da Lapa.

Geographical distribution. Brazil (Rio de Janeiro). (Figure 24).

Remarks. *Blepharotoma nitida* was recently transferred to *Blepharotoma* (Pacheco and Ahrens, 2024), *and* the type material and all non-type material of this species is composed only by females. In this way further investigation is needed when a male specimen is found. This species is similar to *B. heynei* by its sparsely thin pattern of punctures and sparsely short setae on the head but differs from each other due to the angle between teeth acute (obtuse) and the straight clypeus apex (rounded). It was not possible to analyze any male since all specimens available and the images from type species available in Pacheco and Ahrens (2024) were all females.

***Blepharotoma nitidula* Frey, 1973 (Figure 2)**

Blepharotoma nitidula Frey, 1973:320 [holotype Brasilien (R. Grande do Sul)[sic]]**;** Evans and Smith, 2005:4.0 (checklist); Evans and Smith, 2009:33 (checklist)

Type material. SYNTIPE. BRAZIL. 1 male (ZWMB)

Diagnosis. Length 3.0 mm, body black, round; front densely punctate with coarse punctures, densely covered by coarse setae; clypeus trapezoidal straight at the apex, densely punctate with coarse puncta; pronotum with coarse punctuation densely distributed and short setae sparsely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 3.0 mm, body black, round. ***Head.*** Eyes rounded, interocular distance five times the size of the eye, front densely punctate, punctures coarse, densely covered by coarse setae, clypeus format trapezoidal densely punctate, punctures coarse, sparsely covered by coarse setae, margin reflexed, *ocular cantus* projected covering the eyes, apex straight, separated from the labrum by suture, antenna with eight antenomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface smooth, toothed at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium longer than wide, labial palps with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, densely punctate, coarse punctures, sparsely covered with short setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with short setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, with setae, apex rounded. ***Elytra.*** Rounded, convex, sparsely punctate, thin punctures, sparsely covered by long setae. ***Procoxae.*** Conical. ***Protibiae.*** With three teeth at external margin, first one much shorter than the others, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV piriform. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** Same length as the ventrite II, external margin angle straight. ***Metatibiae.*** With two transversal carenas, with two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid,

symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered with long setae, ventrite V longer than the last, ventrites II-IV without transversal row of puncta. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide.

Type locality. Brazil, Rio Grande do Sul.

Geographical distribution. Brazil (Rio Grande do Sul). (Figure 24).

Remarks. *Blepharotoma nitidula* is the only one in its genus with this small size (3 mm) on the contrary of the rest of the genus' average size which is about 7 mm. Similar to *B. nitens*, their eyes are more distant from each other (about 5x the size of the eye) than in other *Blepharotoma* species (varies between 2x and 3x the size of the eye). But *B. nitidula* differs from *B. nitens* by its color pattern only black (two colors, black on the head and pronotum and brown on the rest of the body). Also, the labium shape is longer than large (as long as large).

***Blepharotoma ohausiana* (Saylor, 1938) (Figure 3)**

Heteronyx ohausiana Saylor, 1938: 135 [holotype Brazil, S. Paulo (Alto d.S.) [sic]];

Blepharotoma ohausiana (Saylor, 193) Martínez, 1959: 29 [new combination]; Evans and Smith, 2005:40 (checklist); Evans and Smith, 2009:33 (checklist).

Non-type material. ARGENTINA. **Buenos Aires**. II.1961, A. Martínez: 1 female (MZUSP); BRAZIL. **Goiás**. Campinaçu, Serra da Mesa, 18.II-02.III.1996, 13°52'S 48°23'W, Silvestre, Brandão & Yamamoto: 1 female (MZUSP); Leop. Bolhões, XII.33, Spitz: 1 female (MZUSP); **Mato Grosso**. Nossa Senhora do Livramento, 12.XII.1992, R. Oliveira: 1 female (CEMT); **Mato Grosso do Sul**. Bodoquena, 09-14.XII.2013: 1 female (MZUSP); Porto Murtinho, 10-15.XII.2013: 1 female (MZUSP); **Minas Gerais**. Vila Monte Verde, 11.XI.1970, Halik: 1 female (MZUSP); **Paraná**. Marumbi, 05.XI.1965, Laroce & Otaro: 1 female (DZUP); **Rio de Janeiro**. Itatiaia, Maromba, 18.XII.1925, J.F. Zikán: 1 female (CEMT); Itatiaia, II.1959, W. Zikán: 1 female

(MHNRJ); Nova Friburgo, XII.2002, E.Grossi: 2 females (CEMT); **São Paulo**. Pindamonhangaba, Eugênio Lefévre, 26.X.1962, Exp. Dep. Zool.: 1 female (MZUSP); Salesópolis, Estação Biológica da Boracéia, 02.VIII-01.IX.2008, Malaise, 23°38'28.96"S 45°51'22.49"W, Figueiredo, R & Leite, P.: 1 female (MZUSP); Terezópolis, 12.XII.1958, D. Zajciw: 1 female (MHNRJ).

Diagnosis. Body back, oblong; front sparsely punctate with thin punctures, densely covered by long setae; clypeus trapezoidal shallowly emarginate at the apex, densely punctate with coarse puncta; pronotum with thin punctuation densely distributed and long setae densely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III straight.

Redescription. Length 8.0 mm, body black, oblong. ***Head.*** Eyes rounded, interocular distance three times the size of the eye, front sparsely punctate, punctures thin, densely covered by coarse setae, clypeus format trapezoidal densely punctate, punctures coarse, sparsely covered by thin setae, margin reflexed, *ocular cantus* projected covering the eyes, apex with shallow emargination separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin straight; mandible with mole surface smooth; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium wider than long, palpus with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, densely punctate, thin punctures, densely covered with long setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with long setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, with setae, apex acute. ***Elytra.*** Oblong, convex, densely punctate, thin punctures, densely covered with long setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeth at external margin, first one much shorter than the others, angle between teeth II-III straight. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex

continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites densely covered with coarse setae, ventrite V longer than the last, ventrites II-IV without transversal row of punctures, separated from Propygidium by suture. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide.

Type locality. Brazil, São Paulo, Alto d.S.

Geographical distribution. Brazil (Mato Grosso, Goiás, Minas Gerais, Mato Grosso do Sul, São Paulo, Rio de Janeiro, Paraná). Argentina (Buenos Aires). (Figure 24).

Remarks. Unfortunately, we did not have access to type material of this species, but similarly as mentioned by Frey (1979) the specimen available had all characteristics of *B. ohausiana*, more importantly this author identification key was very helpful to reach specific identification. Therefore, further investigations with type species are necessary to determine if this is a valid species. *Blehaprotoma ohausiana* is very similar to *B. petroposilana* in various aspects at first sight by its color dark brown and shape suboblongous, but by characters also like clypeus apex emarginate, interocular distance of 3x the size of the eye. But it is different by the shape of the labium, as long as large (longer than large) and its scutellum apex acute (round).

***Blepharotoma petropolisana* Frey, 1973 (Figure 4)**

Blepharotoma petropolisana Frey, 1973:320 [holotype Rio de Janeiro (Petropolis)]; Evans and Smith, 2005:40 (checklist); Evans and Smith, 2009:34 (checklist).

Non-type material. BRAZIL. **Distrito Federal**. 29.II.1954, Newton Santos: 1 female (MHNRJ); **Paraná**. Ponta Grossa, 5.XII. 1938: 1 female (MZUSP); **Rio de Janeiro**. Corcovado, 5-10.XI.1937, Friedr, Tippmann, Wien: 1 male, 1 female (ZWMB); Parque Nacional do Itatiaia, 22-24.X.2010, Wallace Beiroz & Mario Cupello: 1 female (MHNRJ); **Santa Catarina**. São Bento do Sul, I.1948: 1 female; São Bento do Sul, I.1950: 1 female, **São Paulo**. Barueri, 17.X.1966, K. Lenko: 1 female (MZUSP);

Barueri, X.1958, K. Lenko: 2 female (MZUSP); Barueri, XI.1965, K. Lenko: 1 female (MZUSP); São Paulo, 19.X.1987: 1 female (MHNRJ).

Diagnosis. Length 8.0 mm, body dark brown, oblong; front sparsely punctate with thin punctures, sparsely covered by coarse setae; clypeus trapezoidal shallowly emarginate at the apex, densely punctate with coarse puncta; pronotum with thin punctuation densely distributed and long setae densely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III straight.

Redescription. Length 8.0 mm, body dark brown, oblong. ***Head***. Eyes rounded, interocular distance three times the size of the eye, front sparsely punctate, punctures thin, densely covered by coarse setae, clypeus format trapezoidal densely punctate, punctures coarse, sparsely covered by thin setae, margin reflexed, *ocular cantus* projected covering the eyes, apex with shallow emargination separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts***. Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin straight; mandible with mole surface smooth; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium wider than long, palpus with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax*** wider than long, densely punctate, thin punctures, densely covered with long setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with long setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax*** scutellum triangular, punctate, with setae, apex round. ***Elytra*** oblong, convex, densely punctate, thin punctures, densely covered with long setae. ***Procoxae*** conical. ***Protibiae*** three teeth at external margin, first one much shorter than the others, angle between teeth II-III straight. ***Protarsus*** filiform, protarsomeres II-IV cylindrical. ***Mesocoxae*** contiguous, 2x wider than larger. ***Metacoxae*** with higher length than the ventrite II, external margin angle obtuse. ***Metatibiae*** with two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae*** cylindrical, all claws bifid, symmetrical, apically toothed; ***Abdomen*** with six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal

in length and evenly convex; ventrites densely covered with coarse setae, ventrite V longer than the last, ventrites II-IV without transversal row of punctures, separated from Propygidium by suture. ***Propygidium*** visible portion punctate, covered by setae. ***Pygidium*** larger than wide. ***Male genitalia***. Parameres as large as wide, distal margin dorsally rounded, apex convergent, lateral surface smooth, phalobasis distal margin dorsally excavated, with constriction at medial line.

Type locality. Brazil, Rio de Janeiro, Petrópolis.

Geographical distribution. Brazil (Distrito Federal, São Paulo, Rio de Janeiro, Paraná, Santa Catarina). (Figure 24)

Remarks. *Blepharotoma petropolisana* is a big sized *Blepharotoma* (8 mm), like *B. suboblongus*. It is different from *B.suboblongus* by longer setae in the head (short setae), rounded shape of the scutellum apex (acute shape) and the same length in the relation of metasternum/metacoxae length (smaller length).

***Blepharotoma plaumanni* Frey, 1973 (Figure 9)**

Blepharotoma plaumanni Frey, 1973: 319 [holotype Brasilien, Nova Teutonia [sic]]; Evans and Smith, 2005:40 (checklist); Evans and Smith, 2009:34 (checklist); Ibarra Polesel and Damborsky, 2018: 3 (ecological research).

Type material. BRAZIL. **Mato Grosso do Sul**. Rio Caraguatá, 21°48’S, 52°27’W, 400 m, III.1963, Fritz Plaumann: 3 females (ZWMB).

Non-type material. ARGENTINA. **Tucuman**. XII.1948: 1 female (MZUSP); BRAZIL. **Mato Grosso**. Salobra, 24.X.1938, F. Lane: 1 female (MZUSP); Três Lagoas, Marg. Esq. Rio Paraná, Faz. Canaã, IV.1967, F. Lane: 2 females (MZUSP) Três Lagoas, Marg. Esq. Rio Sucuriu, IV.1967, F. Lane: 1 female (MZUSP); **Minas Gerais**. Conceição do Mato Dentro, 01.XII.2012, Uceli and Borges: 1 female (CEMT); Lavras, 19.VIII.2003, E. Dias: 1 female (CEMT); Serra do Caraça, 27.XI-5.XII.1972, Exp. Dep. Zool.: 1 male, 8 females (MZUSP); **São Paulo**. Ipiranga, X.2008: 1 female (MZUSP);

Ipiranga, XI.2008: 1 female (MZUSP); Barueri, 17.X.1966, K. Lenko: 1 female (MZUSP).

Diagnosis. Body brownish, ovate; front densely punctate with coarse punctures, sparsely covered by short setae; clypeus trapezoidal rounded at the apex, densely punctate with thin puncta; pronotum with coarse punctuation sparsely distributed and long setae densely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 5.0 mm, body brownish, ovate. ***Head.*** Eyes rounded, interocular distance three times the size of the eye, front densely punctate, punctures coarse, sparsely covered by coarse setae, clypeus format trapezoidal sparsely punctate, punctures coarse, sparsely covered by thin setae, margin reflexed, *ocular cantus* projected covering the eyes, apex rounded separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface smooth; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium wider than long, palpus with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, sparsely punctate, coarse punctures, densely covered with long setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with long setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, without setae, apex acute. ***Elytra.*** Oblong, convex, densely punctate, thin punctures, densely covered with long setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeths at external margin, first one much shorter than the others, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical: ***Mesocoxae.*** Contiguous, three times wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite

approximately equal in length and evenly convex; ventrites sparsely covered with long setae, ventrite V longer than the last, ventrites II-IV without transversal row of punctures, separated from Propygidium by suture. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide.

Type locality. Brazil, Nova Teutônia.

Geographical distribution. Brazil (Mato Grosso, Minas Gerais, Mato Grosso do Sul, São Paulo, Santa Catarina), Argentina (Tucuman). (Figure 24)

Remarks. Frey (1973), in its original description includes *B. plaumanni* as one of the species hard to identify without the observation of male genitalia. In our study, the only paratypes accessed were females, thus we could not observe characters in male genitalia. But we were able to find some characters that could be useful to distinguish this species from the others, as can be seen in the diagnosis section. Besides its similarity with *B. boccaine* in the acute angle formed between the teeth II-III and the shape of the procoxae, they differ by its rounded body (suboblong), clypeus punctuation thin (coarse) and sparse punctation distribution on pronotum (dense).

***Blepharotoma schenklingi* (Moser, 1919) (Figure 6)**

Heteronyx schencklingi Moser, 1919: 4 [holotype Brasilien (Sao Paulo) [sic]];

Blepharotoma schencklingi (Moser); Smith, 2008: 5 [new combination]; Evans and Smith, 2009:34 (checklist).

Non-type material. BRAZIL. **Minas Gerais**. Serra do Caraça, 27.XI-5.XII.1972: 1 female (MZUSP).

Diagnosis. Body yellowish, ovate; front sparsely punctate with thin punctures, sparsely covered by coarse setae; clypeus trapezoidal straight at the apex, densely punctate with coarse puncta; pronotum with thin punctuation sparsely distributed and short setae sparsely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III obtuse.

Redescription. Length 7mm, yellowish, ovate. ***Head.*** Eyes rounded, interocular distance three times the size of the eye, front sparsely punctate, punctures thin, sparsely covered by coarse setae, clypeus format trapezoidal sparsely punctate, punctures coarse, sparsely covered by coarse setae, margin reflexed, *ocular cantus* projected covering the eyes, apex straight separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface smooth; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps 2x longer than wide, teeth of galea without torsion; labium longer than wide, palpus with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, sparsely punctate, thin punctures, sparsely covered with short setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with long setae, mesepimerum with intern posterior corner not projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, without setae, apex acute. ***Elytra.*** Oblong, convex, sparsely punctate, thin punctures, densely covered with long setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeths at external margin, first one much shorter than the others, angle between teeth II-III obtuse. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical. ***Mesocoxae.*** Contiguous, three times wider than larger. ***Metacoxae.*** With smaller length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered with long setae, ventrite V longer than the last, ventrites II-IV without transversal row of punctures, separated from Propygidium by suture. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide.

Type locality. Brazil, São Paulo.

Geographical distribution. Brazil (Minas Gerais, São Paulo). (Figure 25).

Remarks. *Blepharothoma schenklingi* is relatively large sized *Blepharothoma* such as *B. boliviana* and *B. suboblonga* but can be easily distinguished from both by its yellowish color pattern, the other ones are dark brown and browinish colored. Besides that, *B. schenklingi* have long setae in all their heads in contrast to short ones in these two species. The relation metasternum/metacoxae is equal in *B. schenklingi* and larger and smaller in *B. boliviana* and *B. suboblonga* respectively.

***Blepharotoma suboblonga* (Blanchard, 1851) (Figure 10)**

Hilarianus suboblongus Blanchard, 1851 [holotype Brésil [sic]];

Blepharotoma suboblongus (Blanchard, 1851) Cherman et al., 2016: 767 [new combination]

Type material. SYNTYPE. BRAZIL. Blanchard: 1 female (MNHN).

Non-type material. ARGENTINA. **Santiago**. Chaco, Wagner: 1 female (MZUSP). BRAZIL. **Minas Gerais**. Serra do Caraça, 27.XI-5.XII.1972, Exp. Dep. Zool.: 1 female.

Diagnosis. Body brownish, suboblong; front sparsely punctate with thin punctures, sparsely covered by short setae; clypeus trapezoidal straight at the apex, densely punctate with thin puncta; pronotum with thin punctuation sparsely distributed and short setae sparsely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 11.0 mm, brownish, suboblong. ***Head.*** Eyes rounded, interocular distance three times the size of the eye, front sparsely punctate, punctuation thin, sparsely covered with setae, short setae, clypeus format trapezoidal punctate, densely punctate with thin punctures, margin reflexed, *ocular cantus* projected covering the eyes, apex straight, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts***. Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin straight; mandible with mole surface smooth, toothed at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter,

article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium wider than long, palpus with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, sparsely punctate with thin punctures, sparsely covered with long setae, lateral margin with a longitudinal row of setae, basis angles rounded, apical angles acute, lateral margin rounded; mesepimerum with inter posterior corner not projected; mesosternum with short setae, metasternum smaller than metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, without setae, apex acute. ***Elytra.*** Oblongous, convex, sparsely punctate with thin punctures, densely covered with long setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeth at external margin, first one much shorter than the others, straight angle between teeth II and III. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical. ***Mesocoxae.*** Contiguous, 2x wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered with coarse setae, ventrites II-IV covered with row of punctures, ventrite V longer than the last. ***Pygidium.*** larger than wide, with suture between ventrite V and Propygidium.

Type locality. Brazil.

Geographical distribution. Brazil (Minas Gerais), Argentina (Santiago del Estero). (Figure 25)

Remarks. This species, along with *B. bolivianus* are the largest in the genera. Both can be differentiated by body color, brownish in *B. suboblonga* and black *B. bolivianus*. Also, the angle between teeth II-III is different, being straight in *B. suboblonga* and acute in *B. bolivianus*.

We were not able to analyze characters from propygidium and male genitalia characters due to limitations of photographic material.

***Blepharotoma tarsalis* Blanchard, 1850 (Figure 8)**

Blepharotoma tarsalis Blanchard, 1850: 115 [holotype Brésil[sic]]; Evans and Smith, 2005: 40; Smith, 2008: 3 (checklist); Evans and Smith, 2009: 33 (checklist); Costa et al., 2021 (phylogenetic analysis).

Type material. SYNTYPE. BRAZIL. Blanchard: 3 male (MNHN).

Diagnosis. Body yellowish, ovate; front sparsely punctate with thin punctures, sparsely covered by short setae; clypeus trapezoidal straight at the apex, punctate; wrinkled; pronotum with thin punctuation sparsely distributed and short setae sparsely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III acute.

Redescription. Length 7.0 mm, body yellowish, ovate. ***Head.*** Eyes rounded, interocular distance 2x the size of the eye, front sparsely punctate, punctures thin, sparsely covered by thin setae, clypeus format trapezoidal sparsely punctate, punctures thin, rough, sparsely covered by thin setae, margin reflexed, *ocular cantus* projected covering the eyes, apex straight separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, apical margin rounded; mandible with mole surface smooth, toothed at the apical sulcus; maxillary lacinia toothed, four maxillary palpomeres, article I shorter, article II-IV with similar size, article IV conical, palps with 2x longer than wide, teeth of galea without torsion; labium longer than wide, labial palps with three palpomeres, apical margin with emargination large and semicircular, with lateral lobes. ***Prothorax.*** Wider than long, sparsely punctate, thin punctures, densely covered with long setae, lateral margin with a longitudinal row of setae, long setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with short setae, mesepimerum with intern posterior corner projected; metasternum with the same length of metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, without setae, apex rounded. ***Elytra.*** Oblong, convex, punctate, sparsely punctate, thin punctures, sparsely covered with setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeths at external margin, first one much shorter than the others, angle between teeth II-III acute. ***Protarsus.*** Filiform, protarsomeres II-IV piriform: ***Mesocoxae.*** Contiguous, 2x wider than larger; ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, equal length.

Meso- and metatarsae. Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered with long setae, ventrite V longer than the last, ventrites II-IV with transversal row of punctures, suture between ventrite V and Propygidium. ***Propygidium.*** Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide. ***Male genitalia*** **(Figure 23E).** Parameres symmetrical, as large as long, internal margin curved, apex convergent, surface smooth, phalobasis excavated, without longitudinal medial line visible, constricted at the medial line.

Type locality. Brazil.

Geographical distribution. Brazil (Figure 25).

Remarks. *Blepharotoma tarsalis* has a light yellowish color pattern that is similar to *B. confusa* but differs from this species by the presence of wrinkles in the clypeus (clypeus smooth); body shape rounder opposite (suboblong and flatter).

Since this species has no precise location when it comes to collection area, we marked the capital of Brazil to represent the only known distribution until now, Brazil.

Blepharotoma uniformis **(Blanchard, 1851) (Figure 19)**

Hilarianus uniformis Blanchard, 1851: 170 [holotype Brésil[sic]];

Blepharotoma uniformis (Blanchard, 1851) Cherman et al., 2016: 767 [new combination]; Valmorbida et al., 2018: 3 (inventory).

Type material. HOLOTYPE. BRAZIL. Blanchard: 1 female (MNHN)

Non-type material. BRAZIL. **Minas Gerais**. Vila Monte Verde, 9.XII.1966, Halik: 2 females (MZUSP); Vila Monte Verde, 16.III.1966, Halik: 1 female (MZUSP); **Paraná**. S. José dos Pinhais, 8.XII.1986, Lev. Ent.: 1 female (DZUP) **Rio Grande do Sul**. Cabanha Sobrado Branco, IV.2012, Santos, Dias, Carneiro and Zacca: 3 females (CERPE); **São Paulo**. Barueri, XI.1965, K. Lenko: 14 females (MZUSP); Santo Amaro,

XI.1961, J. Lane: 1 female; Santo Amaro, X.1962, J. Lane: 1 female; Santo Amaro, XI.1962, J. Lane: 1 female; **Santa Catarina**. Rio Vermelho, III.1964, Diringa: 4 females (MZUSP); Nova Teutônia, III.1964, Diringa: 1 female (MZUSP). PERU. **Madre de Dios**. 18-22.VIII.2012, RR Cavichioli, JA Rafael, APM Santos and DM Takiya: 1 female (CERPE).

Diagnosis. Body brownish, suboblong; front sparsely punctate with thin punctures, sparsely covered by short setae; clypeus trapezoidal with shallow emargination at the apex, punctate; pronotum with thin punctuation sparsely distributed and short setae sparsely distributed; protibia with three teeth at external margin, first one much shorter, angle between teeth II-III obtuse.

Redescription. Length 8.0 mm, brownish, suboblong. ***Head.*** Eyes rounded, interocular distance three times the size of the eye, front sparsely punctate with thin punctures, with short and sparsely distributed setae, clypeus format trapezoidal, punctate, margin reflexed, *ocular cantus* projected covering the eyes, apex with shallow emargination, separated from the labrum by suture, antenna with eight antennomeres (including antennal club), club ovate. ***Mouthparts.*** Labrum merged with the clypeus, hidden beneath clypeus in dorsal view, with shallow emargination at medium line, superior margin rounded. ***Prothorax.*** Wider than long, with thin punctuation sparsely distributed, with short setae sparsely distributed, lateral margin with a longitudinal row of setae, basis angles rounded, apical angles acute, lateral margin rounded; mesosternum with long setae, mesepimerum with inter posterior corner not projected; metasternum larger than metacoxae, meso- and metasternal process absent. ***Pterothorax.*** Scutellum triangular, punctate, apex acute. ***Elytra.*** Oblong, convex, sparsely punctate, thin punctures, sparsely distributed thin setae. ***Procoxae.*** Conical. ***Protibiae.*** Three teeth at external margin, first one much shorter than the others, angle between teeth II-III obtuse. ***Protarsus.*** Filiform, protarsomeres II-IV cylindrical. ***Mesocoxae.*** Contiguous, three times wider than larger. ***Metacoxae.*** With higher length than the ventrite II, external margin angle obtuse. ***Metatibiae.*** With two spurs at the apex continuously distributed, unequal length, external margin angle obtuse. ***Meso- and metatarsae.*** Cylindrical, all claws bifid, symmetrical, apically toothed. ***Abdomen.*** With six ventrite (ventrite I partially hidden by metacoxae), ventrite approximately equal in length and evenly convex; ventrites sparsely covered by coarse setae, ventrite V longer than the last.

Propygidium. Visible portion punctate, covered by setae. ***Pygidium.*** Larger than wide, with suture between ventrite V and propygidium.

Type locality. Brazil**.**

Geographical distribution. Brazil (Minas Gerais, São Paulo, Paraná, Santa Catarina, Rio Grande do Sul), Peru (Madre de Dios). (Figure 25)

Remarks. This species is very similar morphologically to *B. suboblonga* by its brownish color, oblong body shape, punctures thin and short setae, but differs from it by the smaller size (8 mm) than its congener (11 mm). Some characters are also important to distinguish them, like the clypeal apex emarginate in *B. uniformis* and straight in *B. suboblonga*; and punctures sparse in *B. uniformis* and dense in *B. suboblonga*.

4. Concluding Remarks

With this work we were able to provide more detailed descriptions of *Blepharotoma* and all species of the genus and reinforce the internal limits of the taxa. Besides, the identification key was updated adding species and characters not included in the first one key published by Frey (1973). Also, while the data analysis from distribution of material it was possible compile information about the new compiled data from location labels available on specimens analyzed it was possible to widen the distribution data of *Blepharotoma.*

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FIGURES

Fig 1. *Blepharotoma nitens* Frey, 1973: (A) Habitus; (B) Head, front view; (C) Labels.

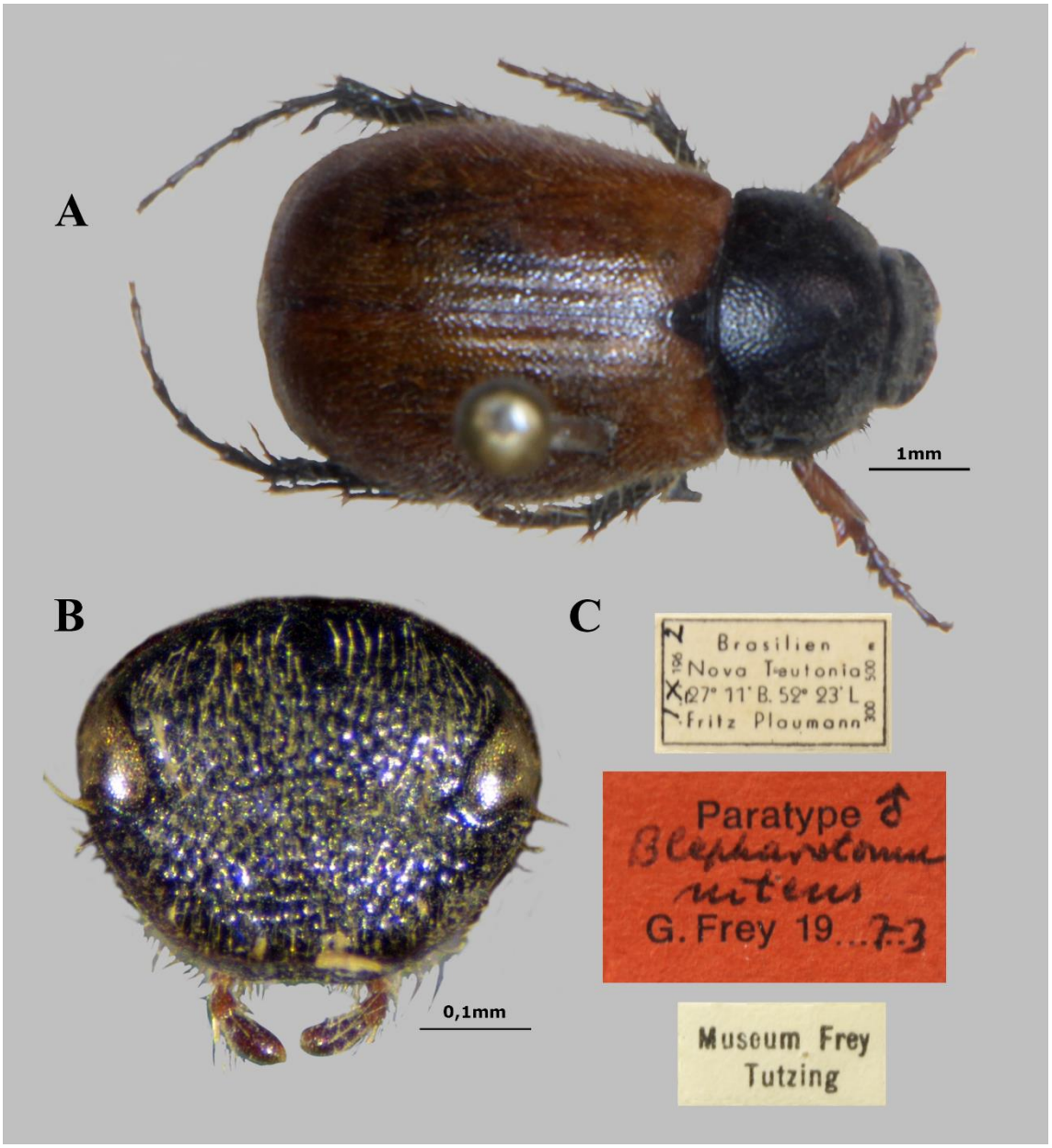


Fig 2. *Blepharotoma nitidula* Frey, 1973: (A) Habitus; (B) Head, front view; (C) Labels.

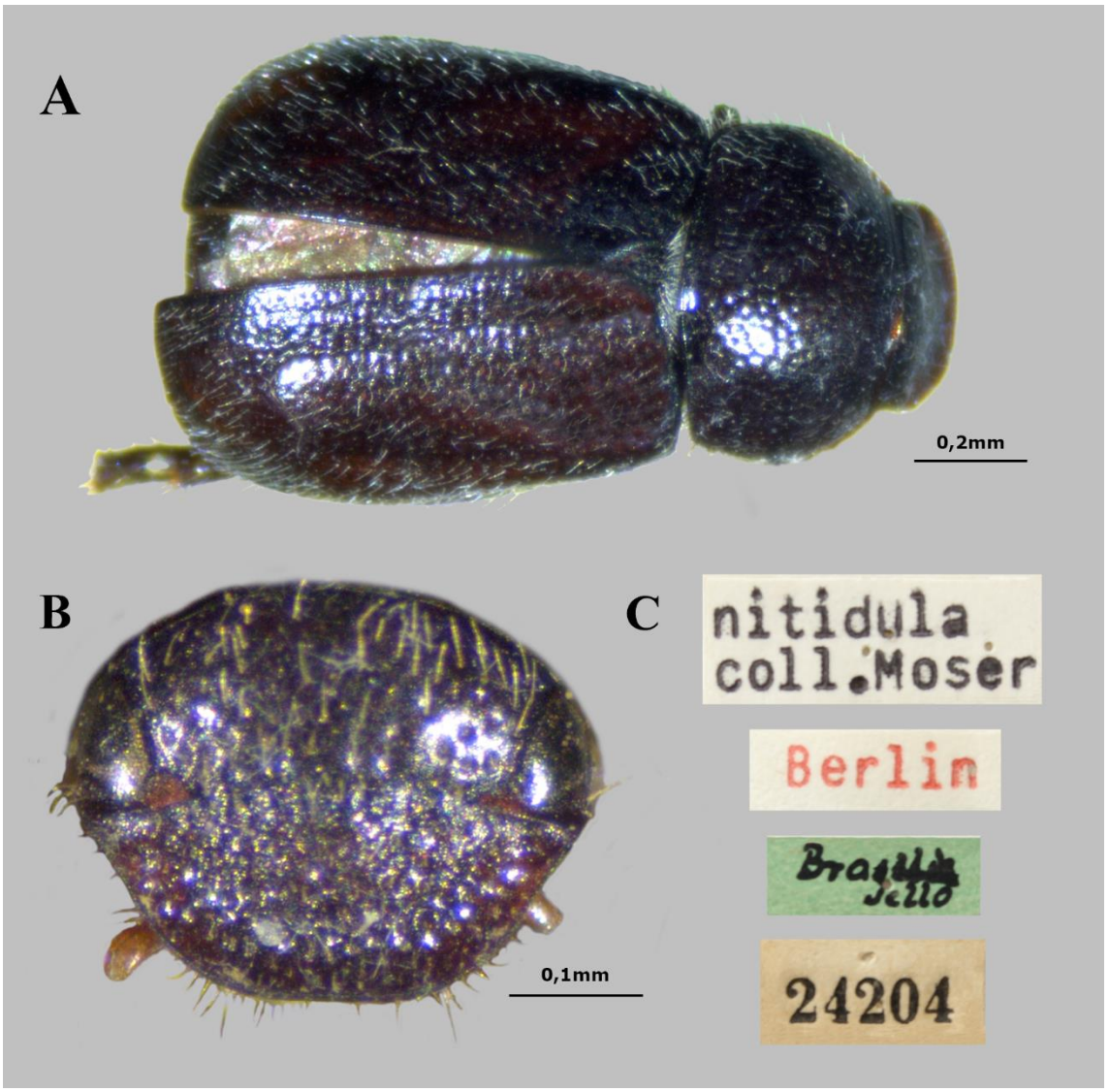


Fig 3. *Blepharotoma ohausiana* (Saylor, 1938)*:* (A) Habitus*;* (B) Head, front view.

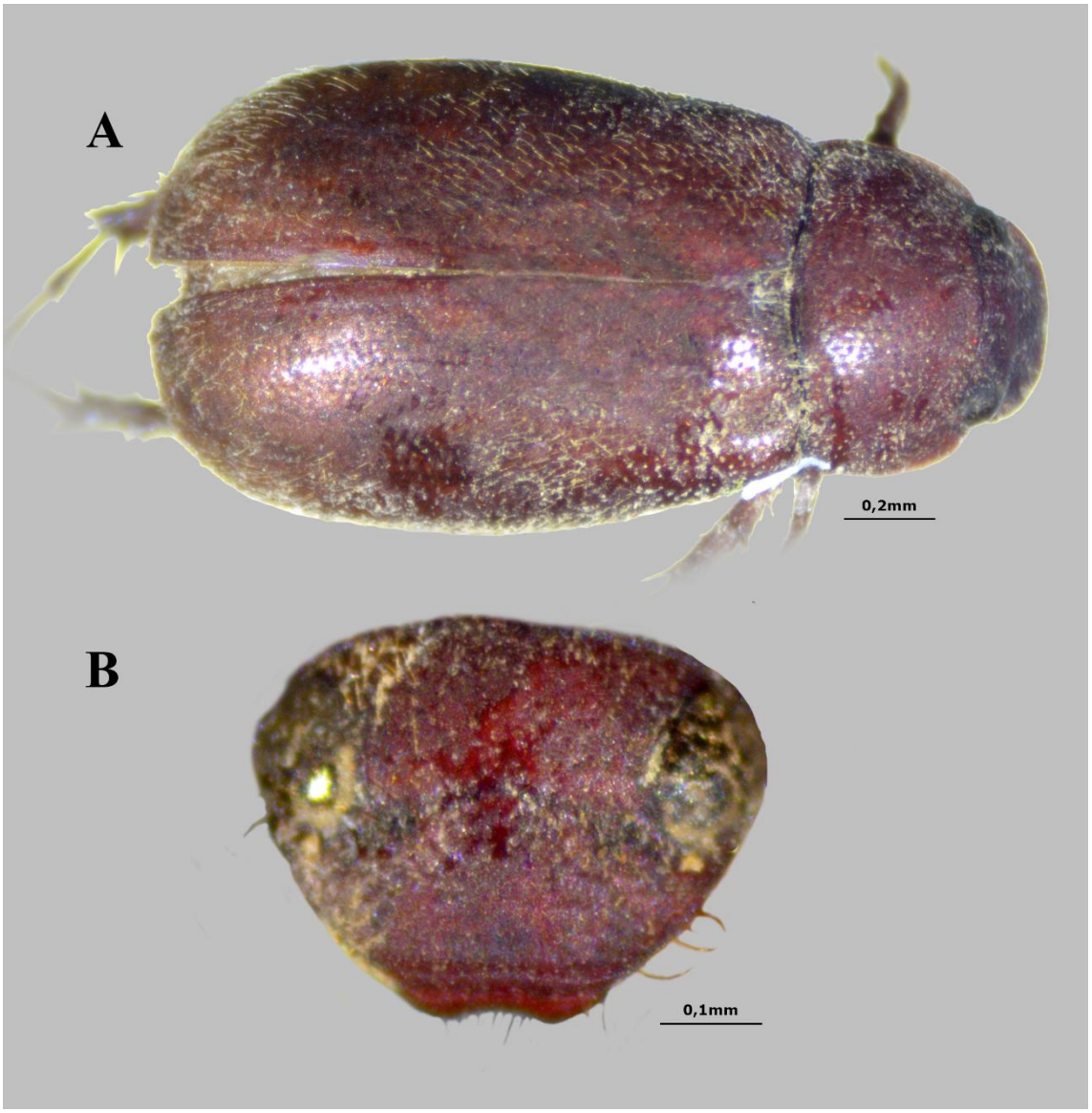


Fig 4. *Blepharotoma petropolisana* Frey, 1973*:* (A) Habitus*;* (B) Head, front view; (C) Labels.

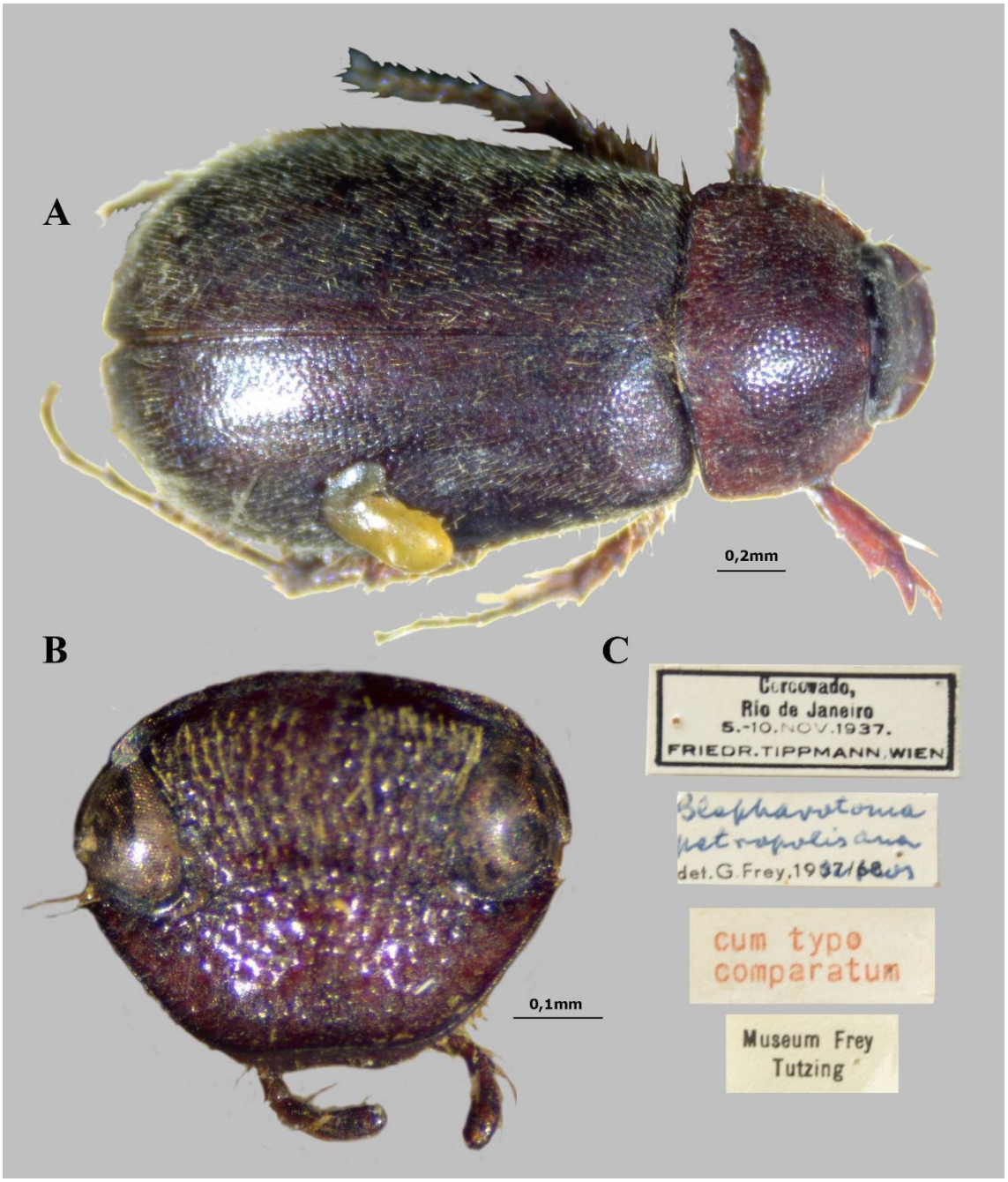


Fig 5. *Blepharotoma martinezi* Frey, 1973: (A) Habitus*;* (B) Head, front view; (C) Labels.

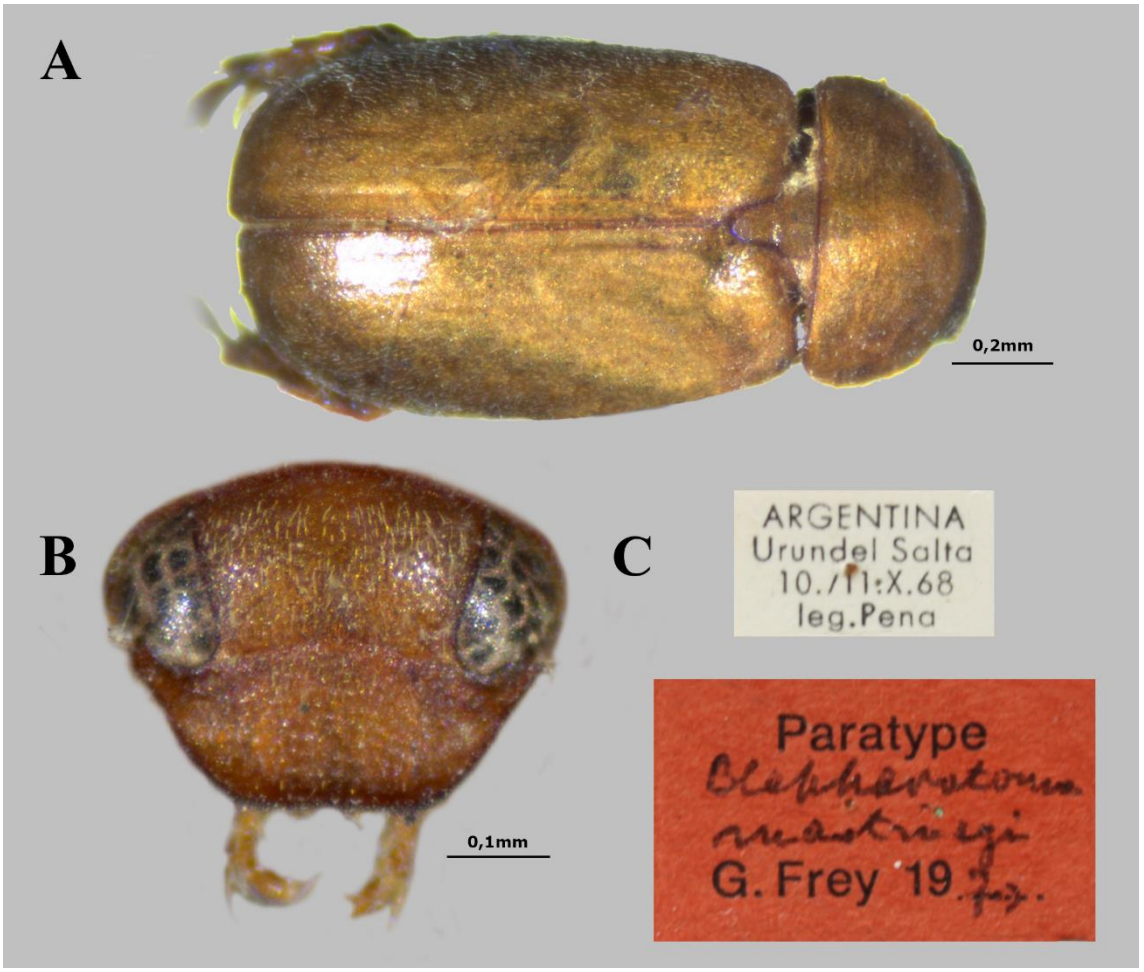


Fig 6. *Blepharotoma schenklingi* (Moser, 1919): (A) Habitus*;* (B) Head, front view.

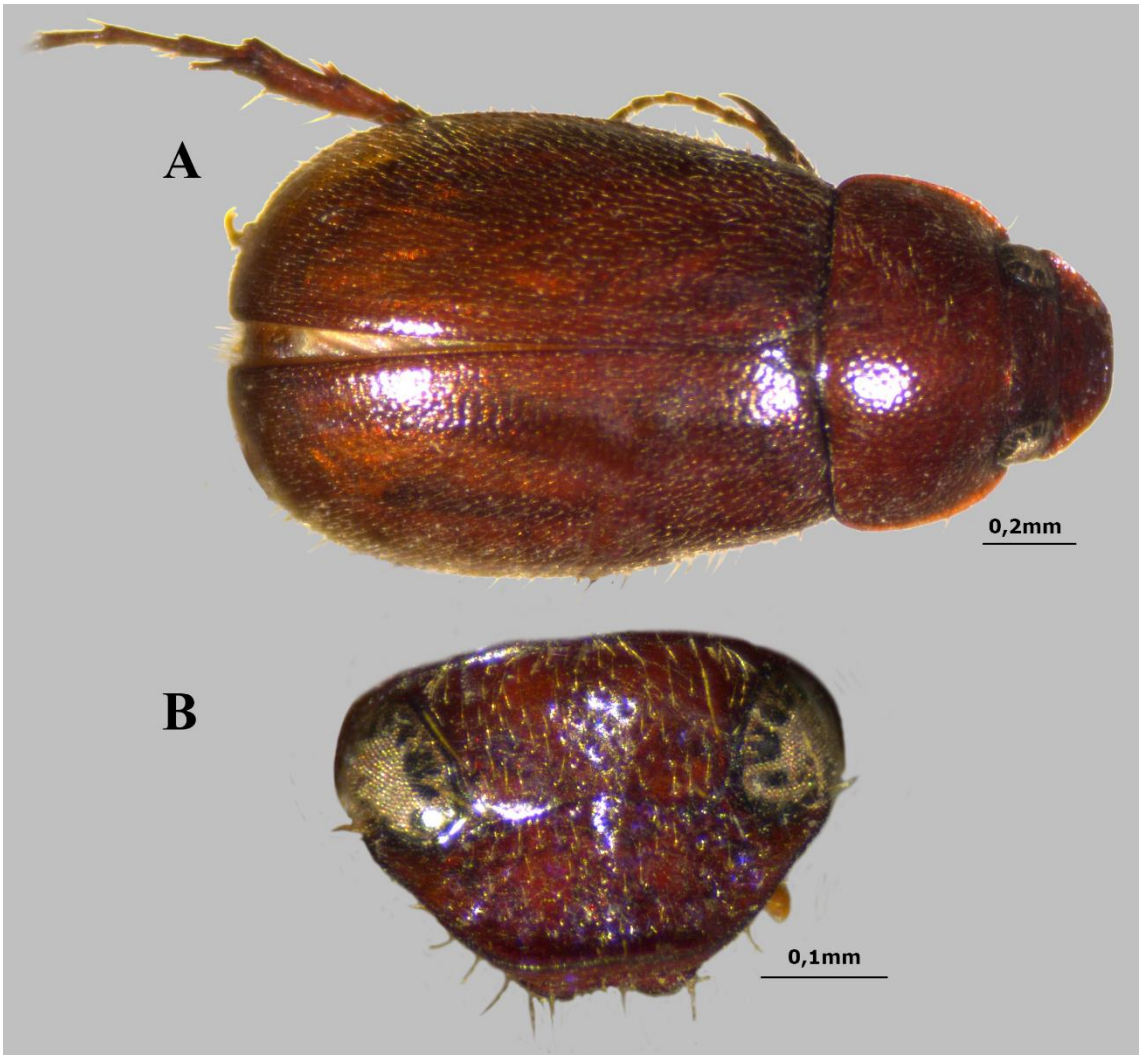


Fig 7. *Blepharotoma calvicolis* Frey, 1973: (A) Habitus*;* (B) Head, front view; (C) Labels.

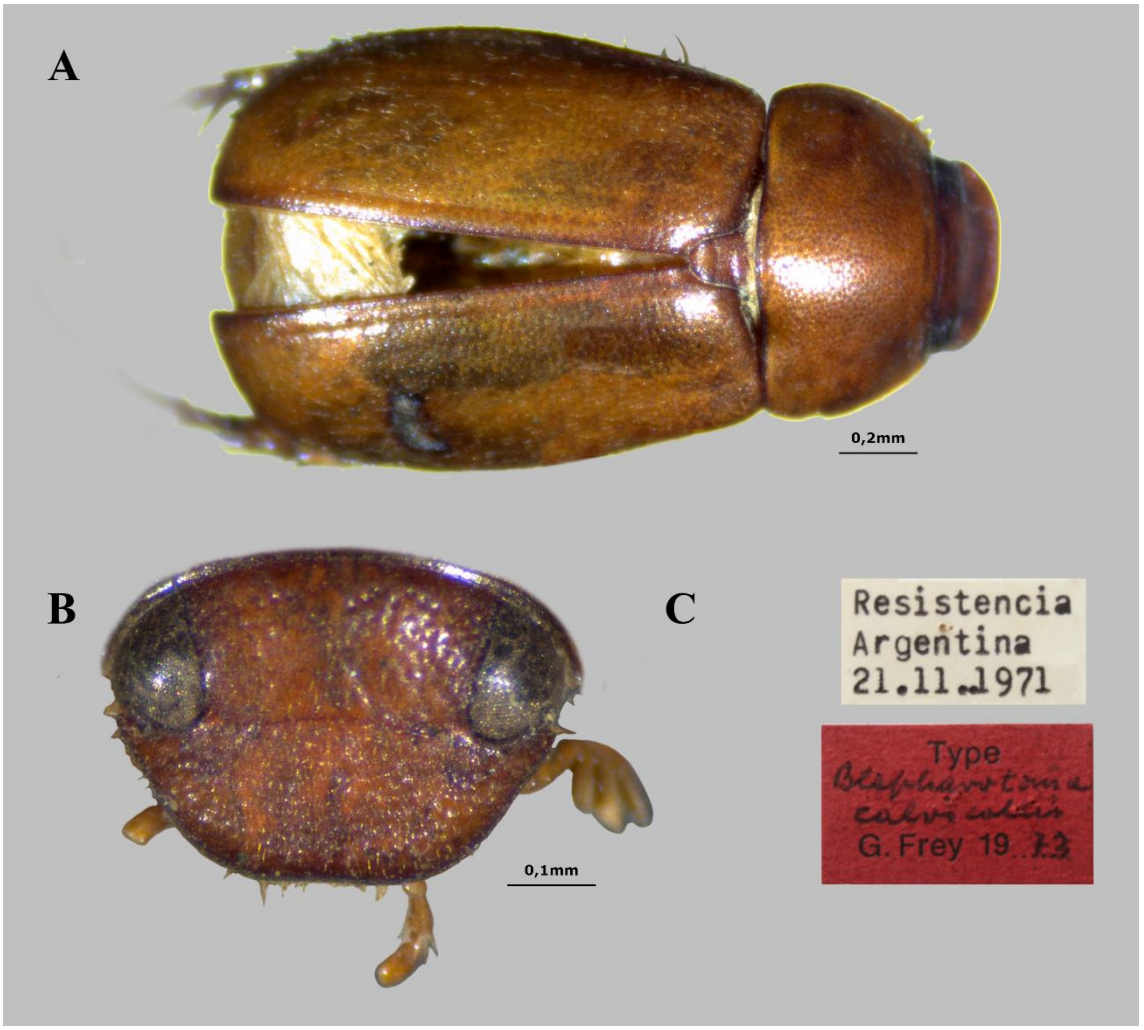


Fig 8. *Blepharotoma tarsalis* Blachard, 1850: (A) Habitus; (B) Lateral view; (C) Labels.

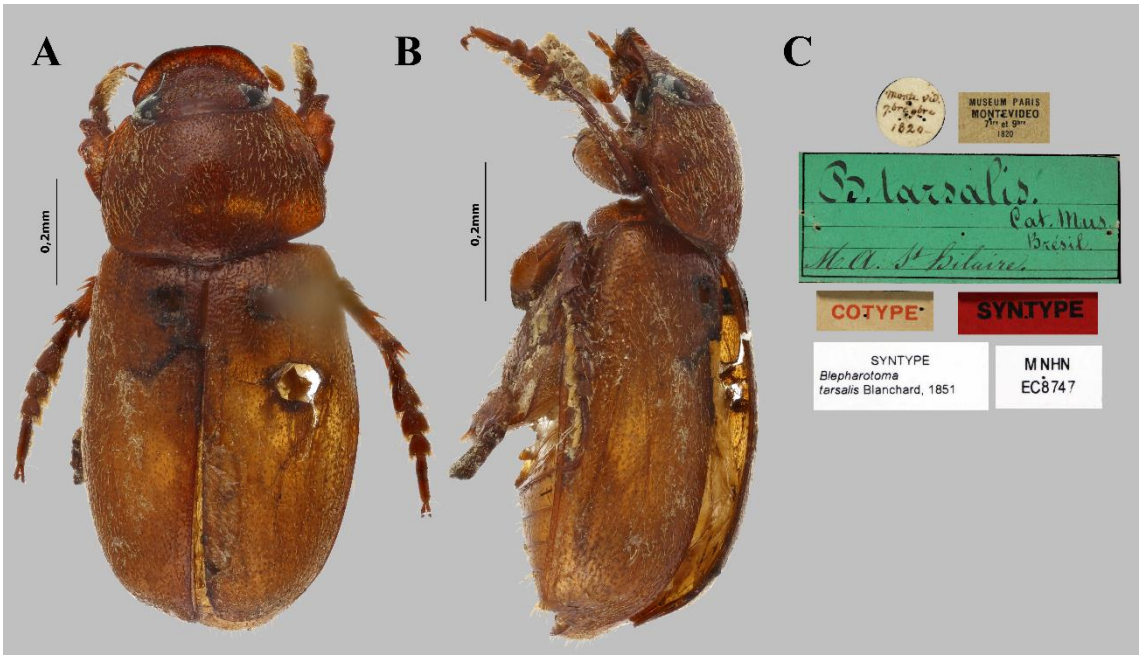


Fig 9. *Blepharotoma plaumanni*: (A) Habitus*;* (B) Head, front view; (C) Labels.

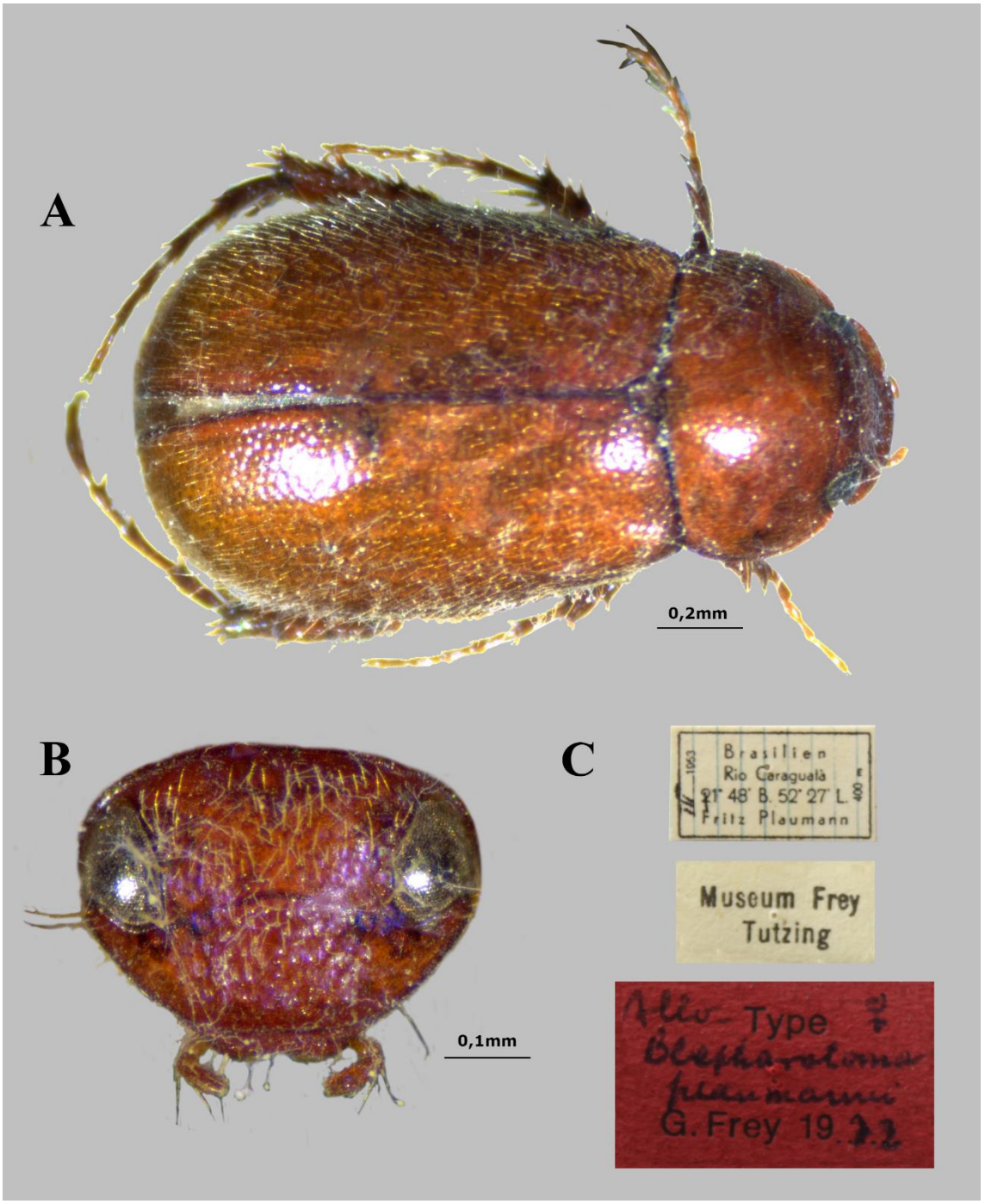


Fig 10. *Blepharotoma suboblonga* Frey, 1973: (A) Habitus; (B) Head, front view; (C) Labels.

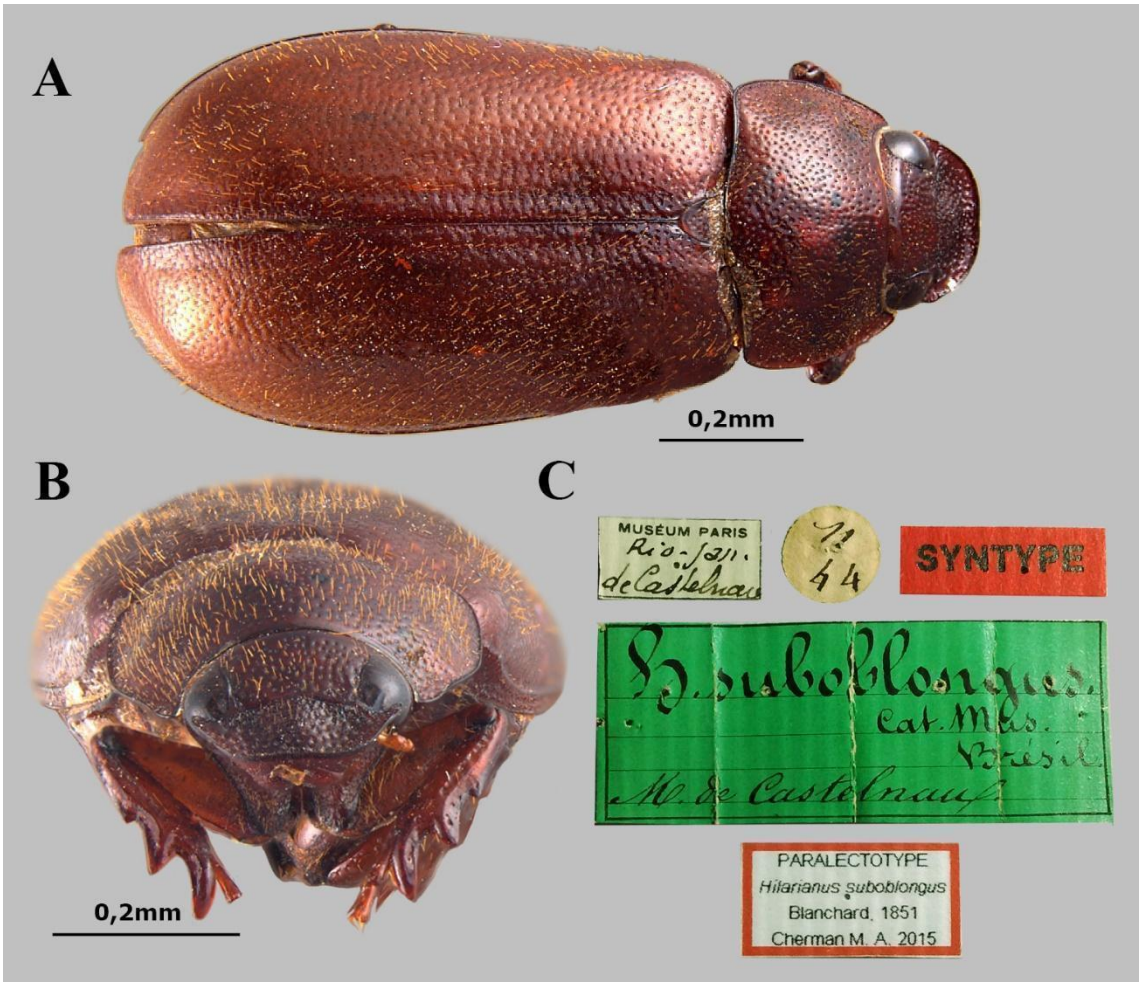


Fig 11. *Blepharotoma boccaine* Frey, 1973: (A) Habitus*;* (B) Head, front view; (C) Labels.

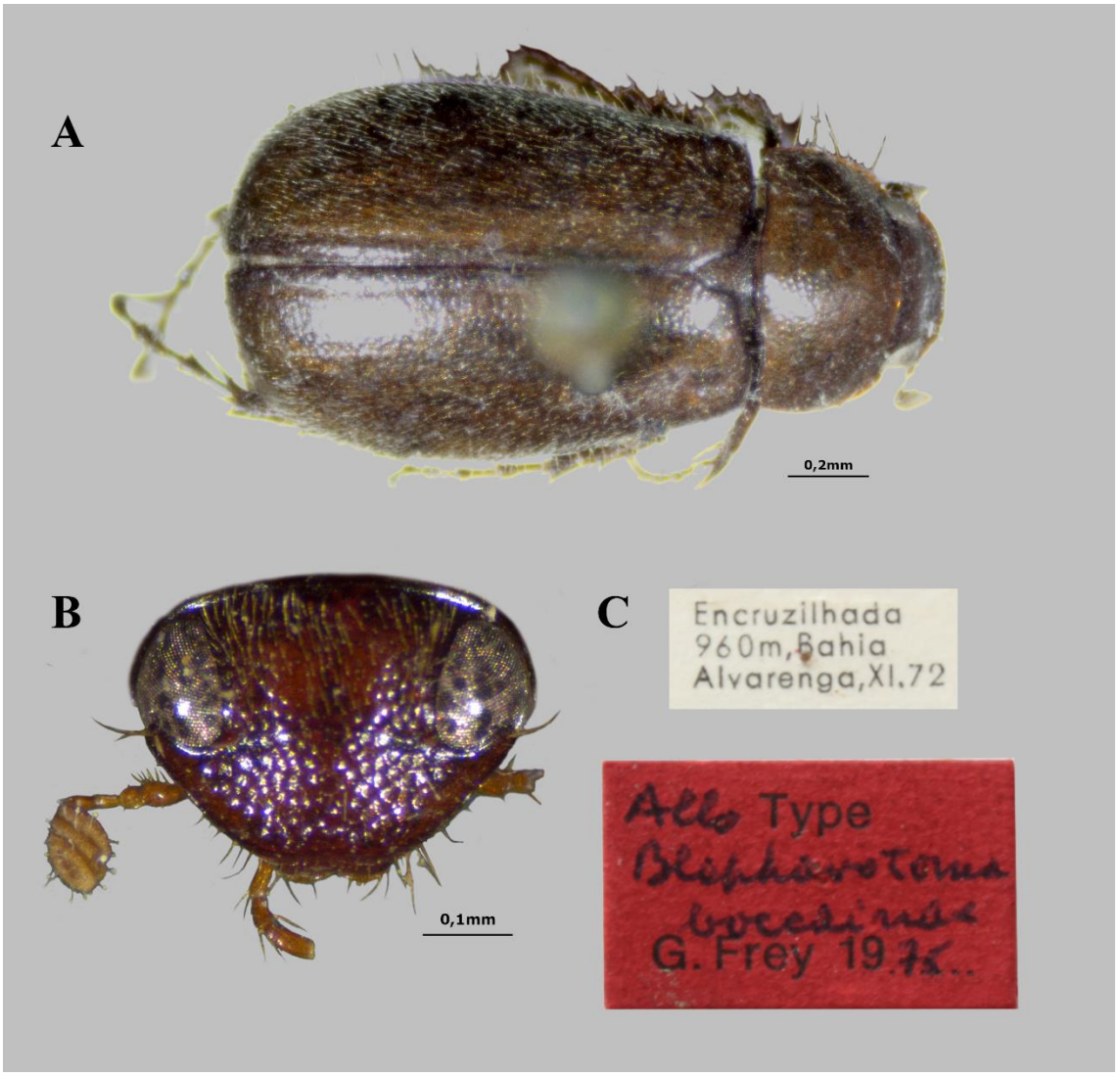


Fig 12. *Blepharotoma boliviana* (Moser, 1919): (A) Habitus*;* (B) Head, front view; (C) Labels.

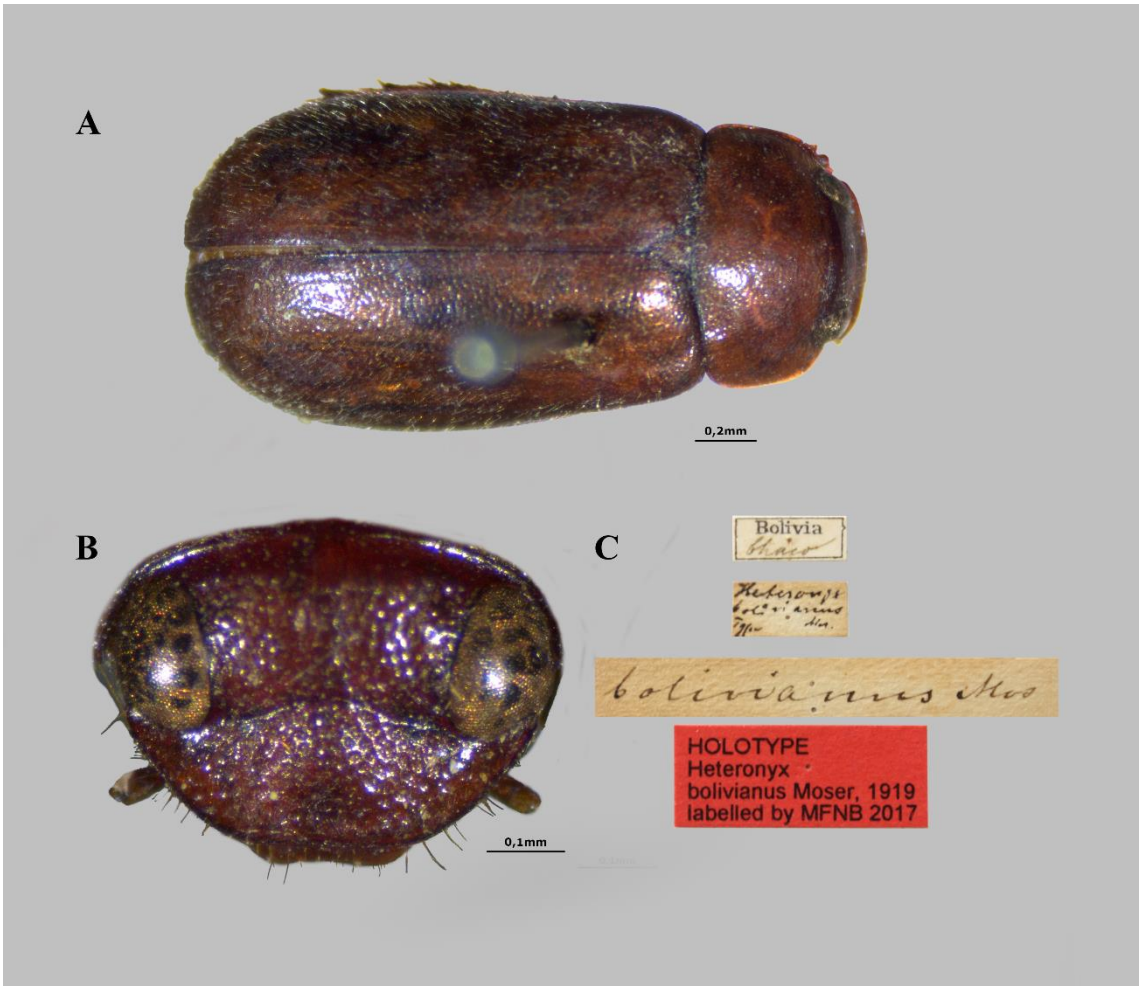


Fig 13. *Blepharotoma heynei*: (A) Habitus*;* (B) Head; (C) Labels.

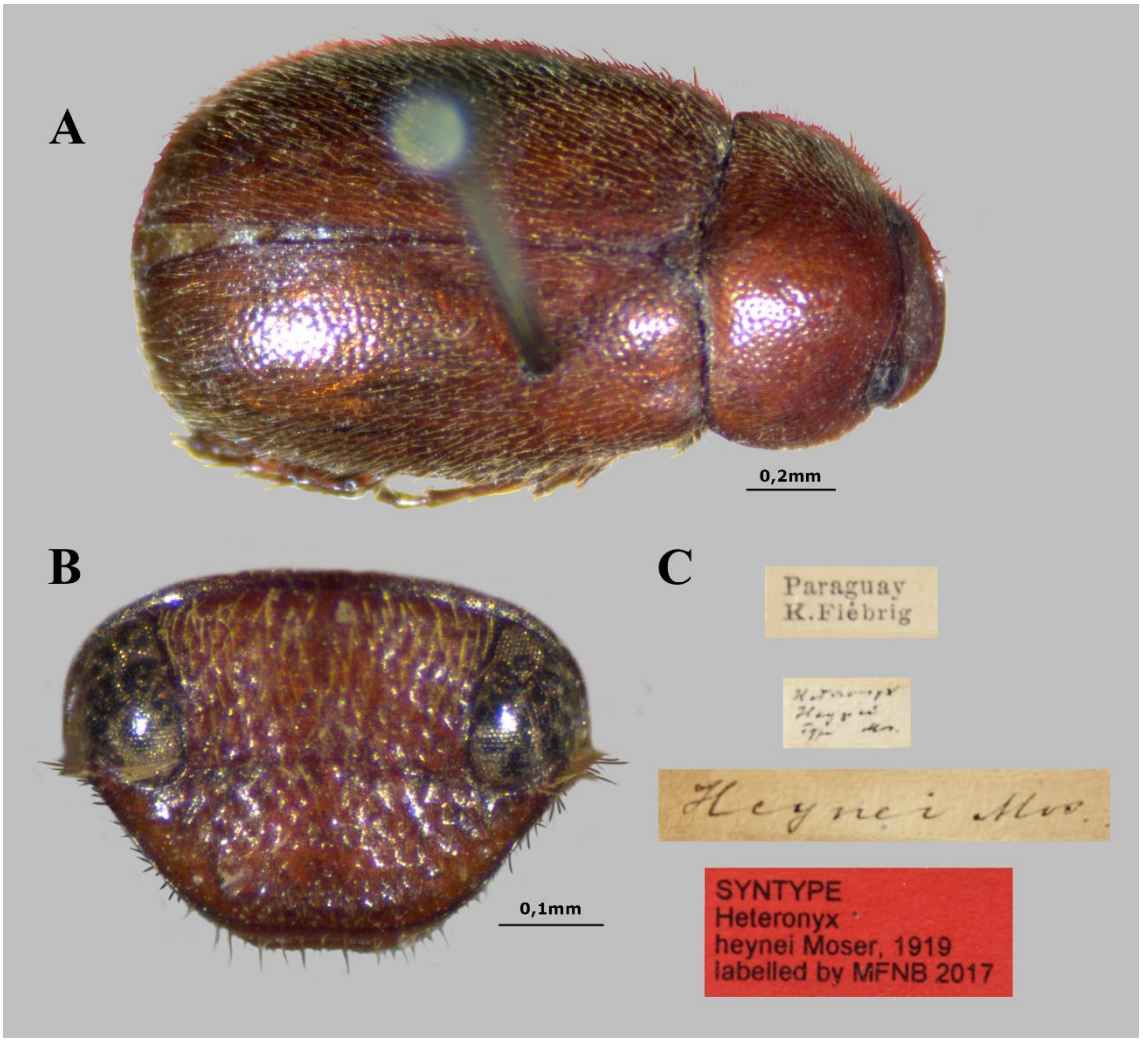


Fig 14. *Blepharotoma nitida* (Mannerheim, 1829): (A) Habitus; (B) Head, front view; (C) Labels (Images from Pacheco and Ahrens, 2024).

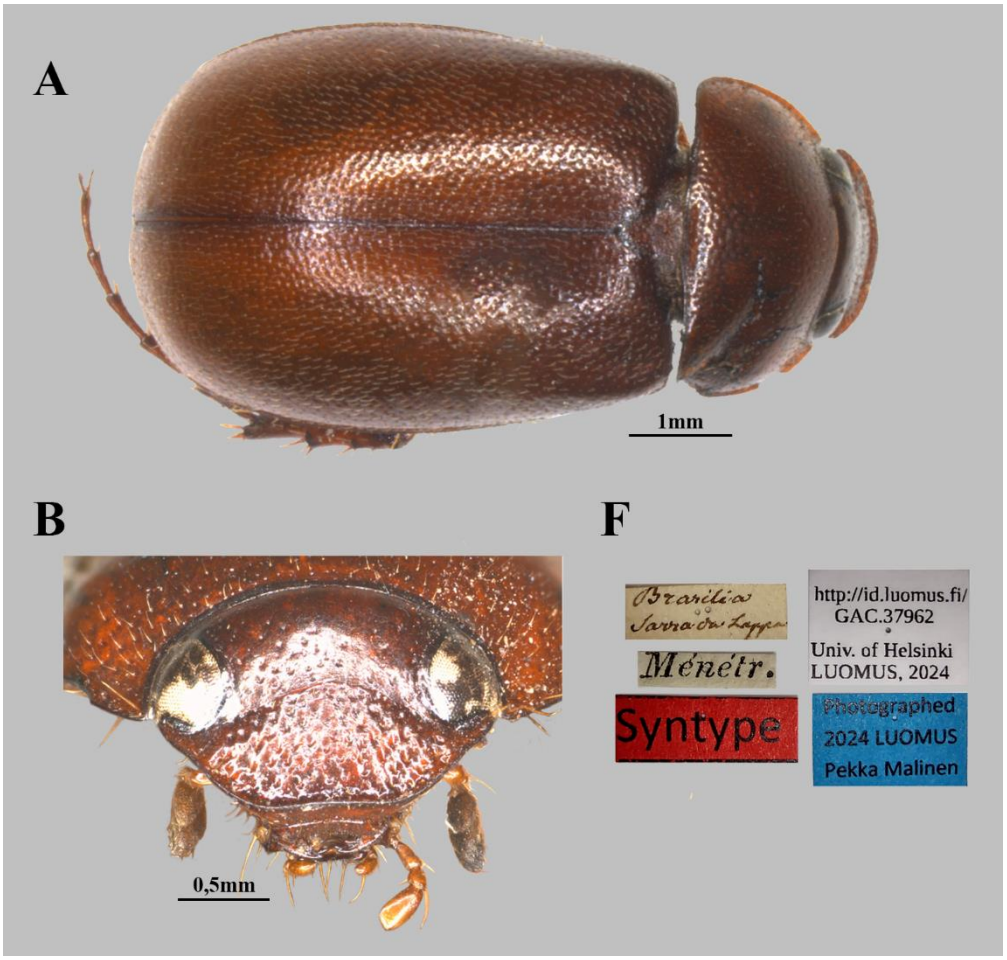


Fig 15 *Blepharotoma argentina* Frey, 1973: (A) Habitus; (B) Head, front view; (C) Labels.

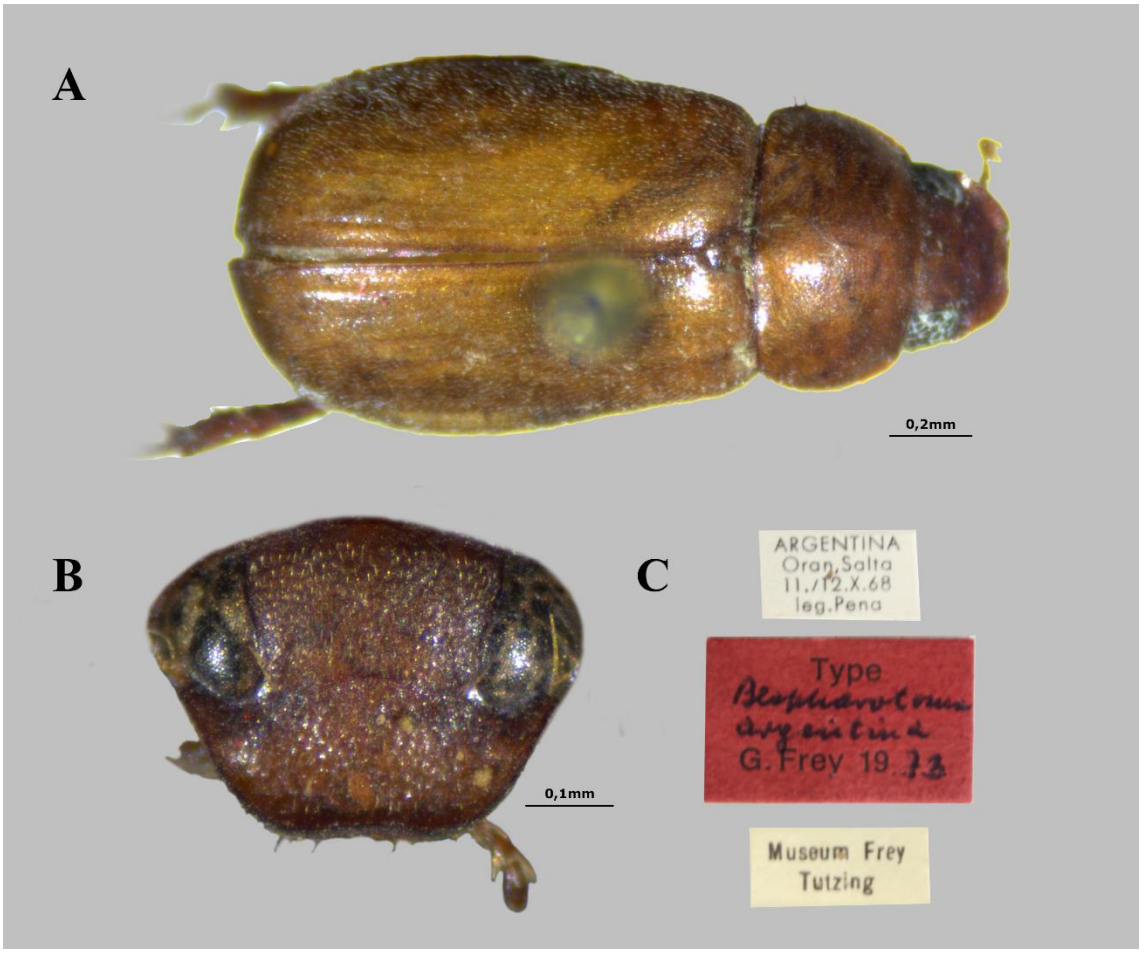


Fig 16. *Blepharotoma confusa* Martínez, 1959: (A) Habitus; (B) Head, front view; (C) Labels.

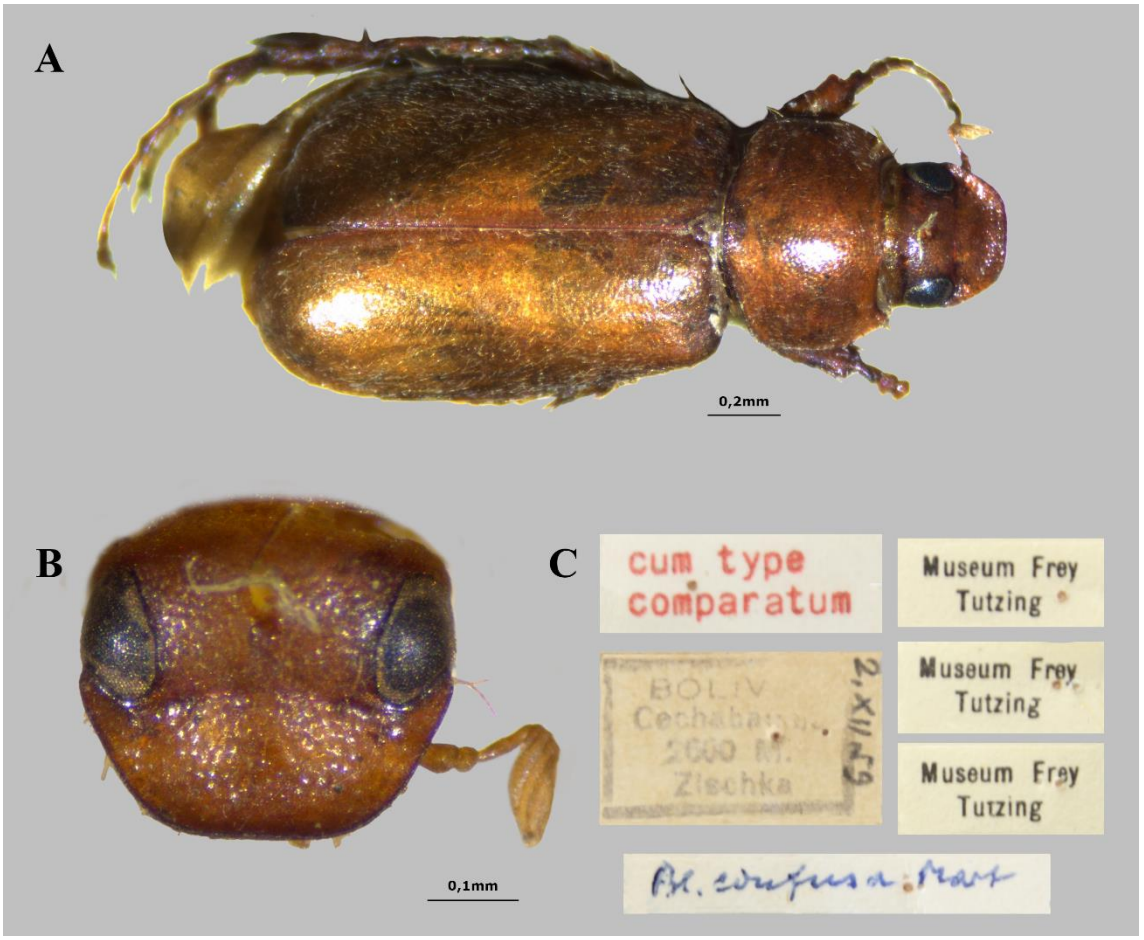


Fig 17. *Blepharotoma cuyabana* (Moser, 1919): (A) Habitus*;* (B) Head, front view; (C) Labels.

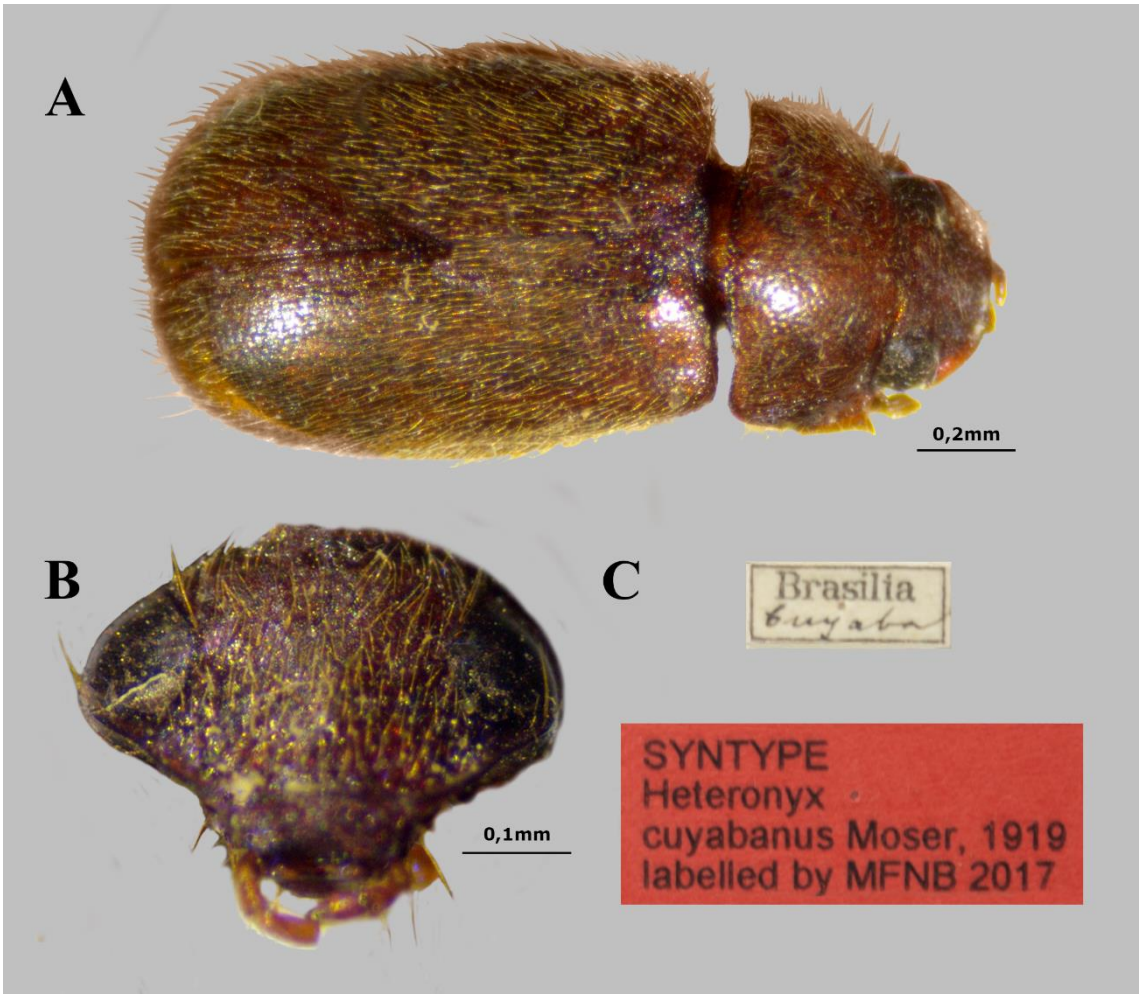


Fig 18. *Blepharotoma corumbana* (Moser, 1921): (A) Habitus; (B) Head, front view; (C) Labels.

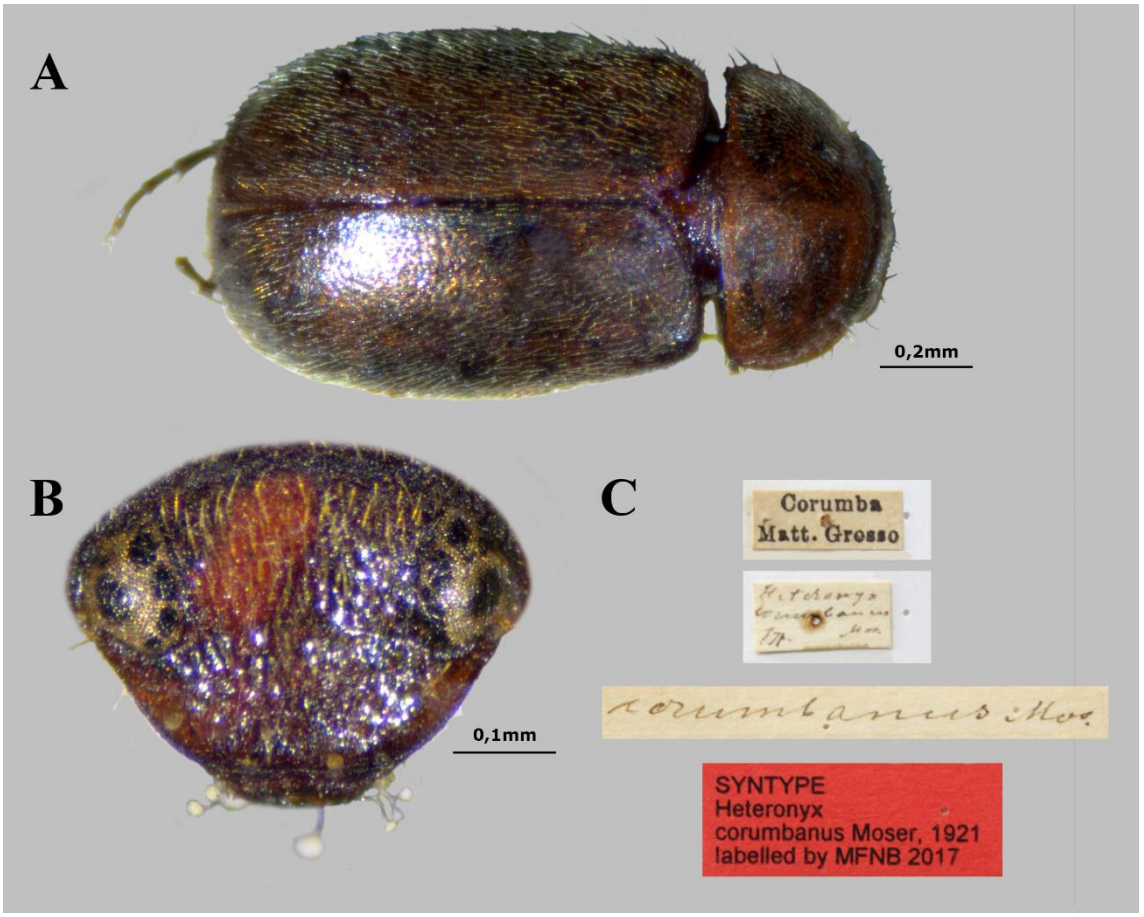


Fig 19. *Blepharotoma uniformis* (Blanchard, 1851)*:* (A) Habitus*;* (B) Head, front view; (C) Labels.

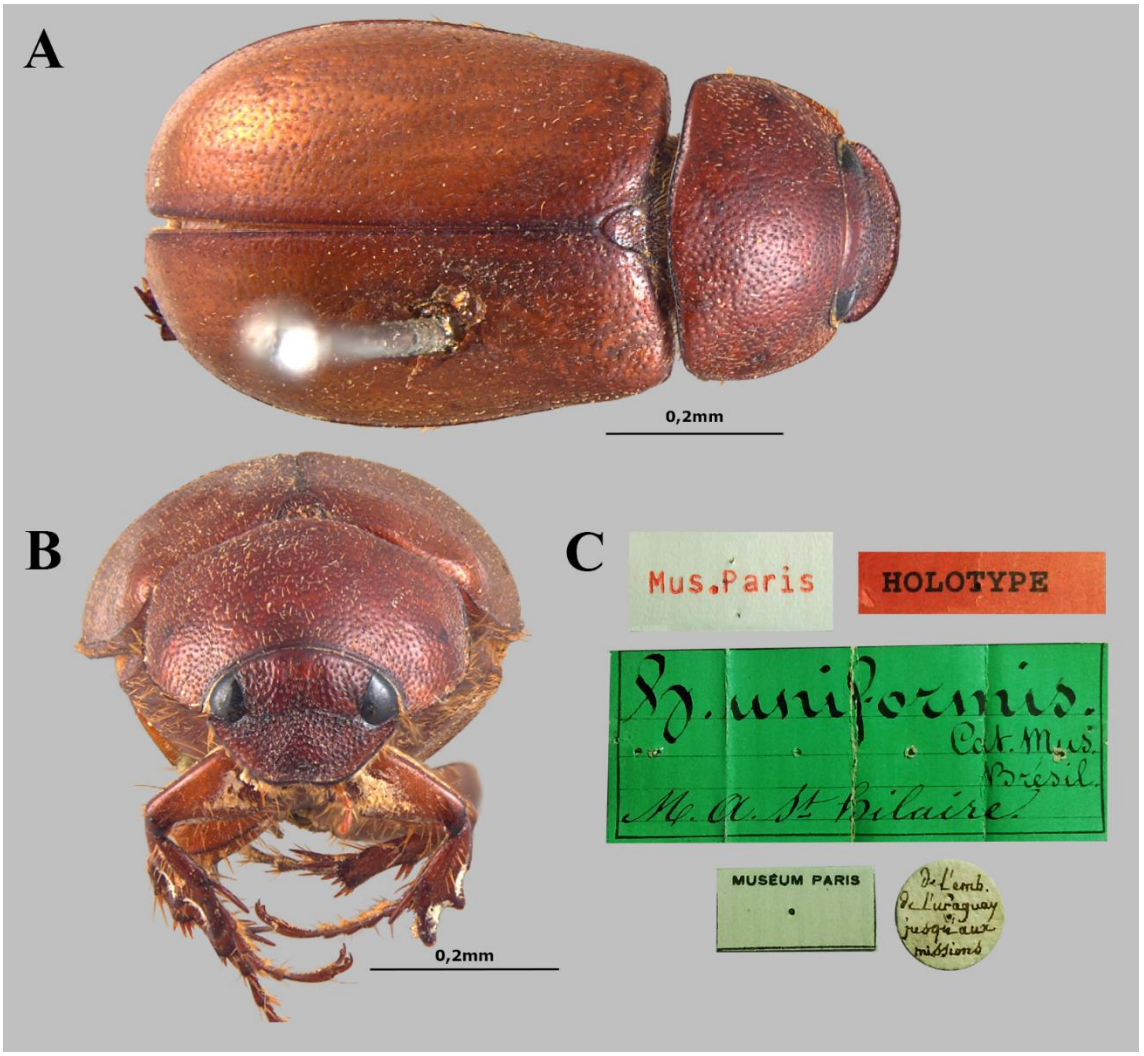


Fig 20: *Aedeagus* from type material of *Blepharotoma* species. Lines: (A) *B. argentina*; (B) *B. boccaine*; (C) *B. calvicolis*; (D) *B. confusa*. Columns: (1) Frontal view; (2) Lateral view; (3) Dorsal view.

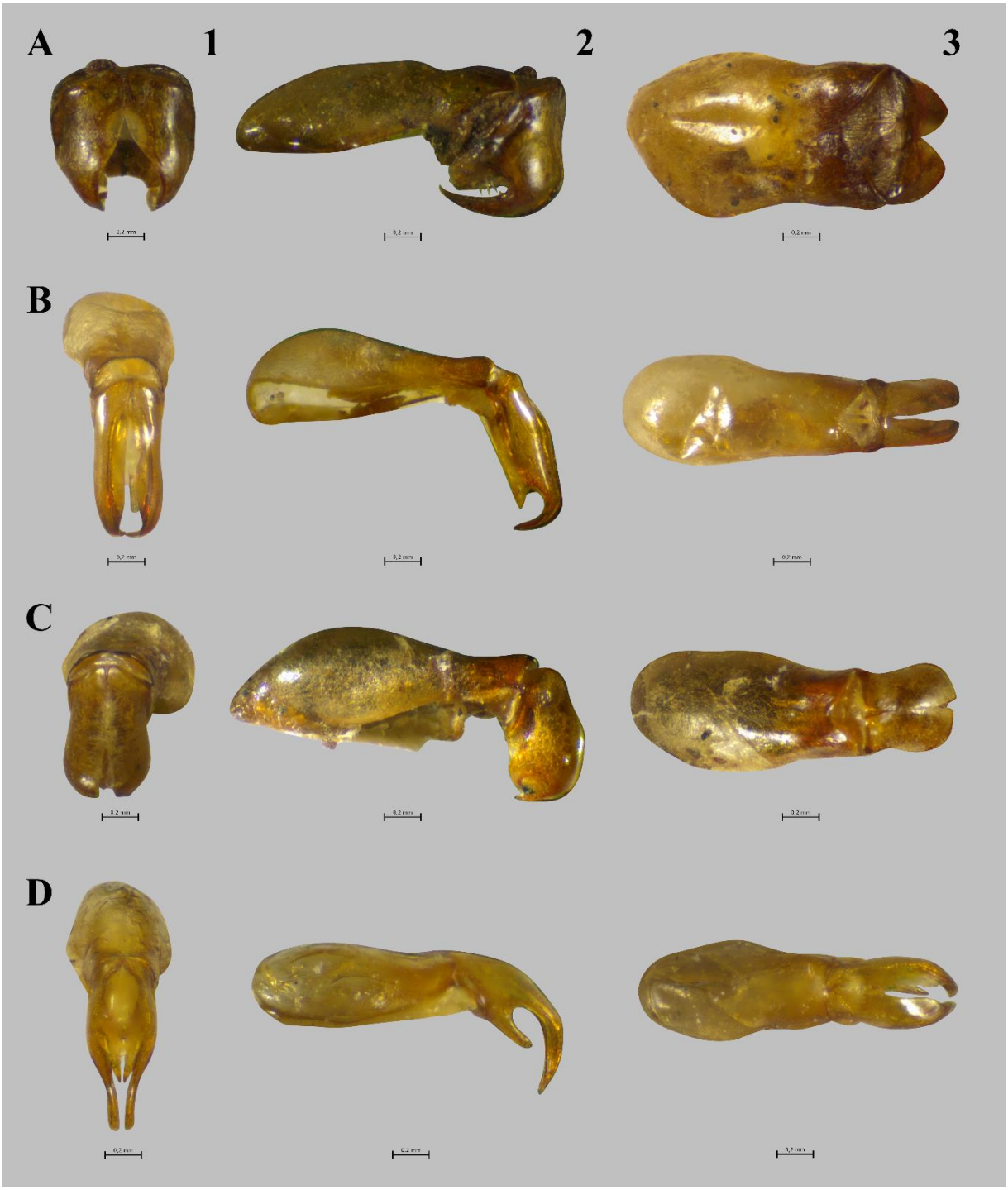


Fig. 21: South America map with distribution *Blepharotoma argentina* (circle blue), *B. boccaine* (circle green), *B. boliviana* (circle red), *B. calvicolis* (circle yellow), *B. confusa* (circle pink).

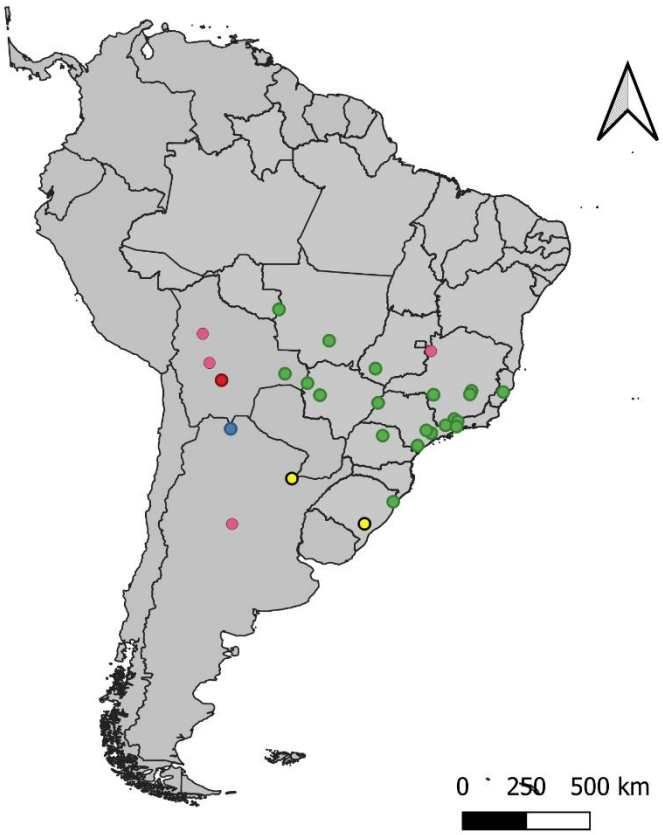


Fig 22: *Aedeagus* from type material of *Blepharotoma* species. Lines: (A) *B. corumbana*; (B) *B. cuyabana*; (C) *B. heynei*; (D) *B. martinezi*; (E) *B. tarsalis*. Columns: (1) Frontal view; (2) Lateral view; (3) Dorsal view.

Fig. 23: South America map with distribution *Blepharotoma corumbana* (circle blue), *B. cuyabana* (circle green), *B. heynei* (circle red), *B. matinezi* (circle yellow), *B. nitens* (circle pink).

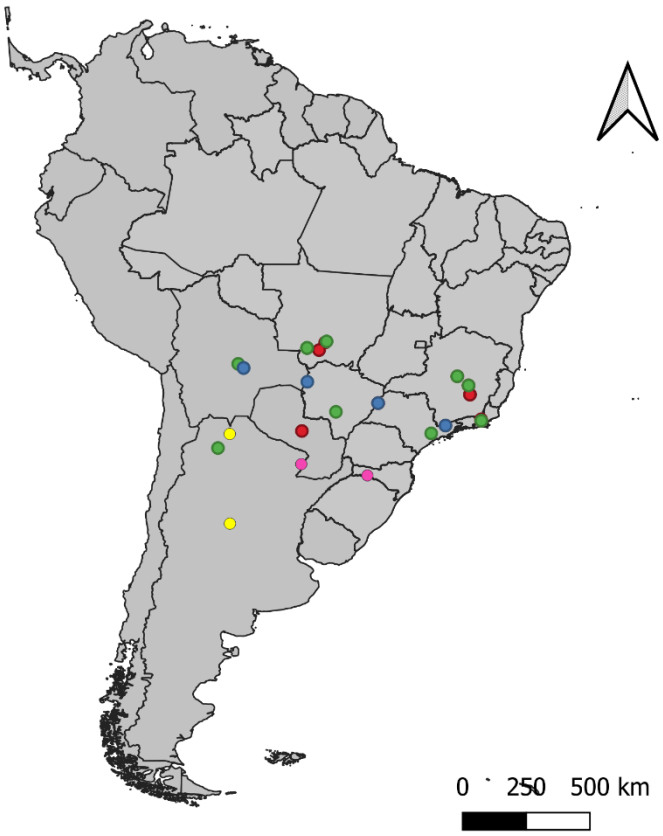


Fig. 24: South America map with distribution *Blepharotoma nitida* (blue), *B. nitidula* (circle green), *B. ohausiana* (circle red), *B. petropolisana* (circle yellow), *B. plaumanni* (circle pink).

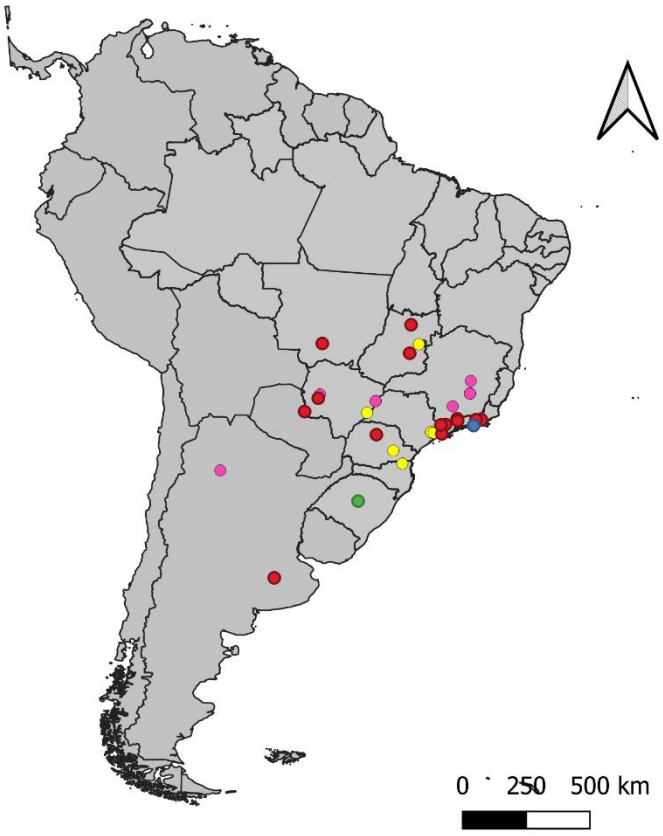
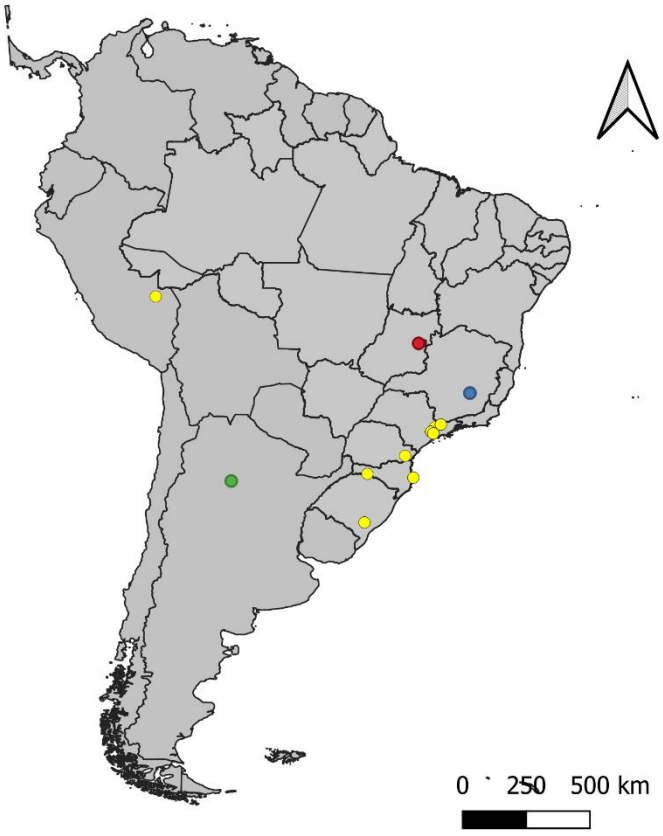


Fig. 25 South America map with distribution *Blepharotoma schenklingi* (circle blue), *B. suboblonga* (circle green), *B. tarsalis* (circle red), *B. uniformis* (circle yellow).



5. CONSIDERAÇÕES FINAIS

Neste trabalho realizamos a revisão sistemática do gênero *Blepharotoma* Blanchard, 1850 através de uma abordagem integrativa. Como resultado, produzimos a redescrição de 19 espécies do gênero com riqueza de detalhes e incluindo caracteres de estruturas pouco utilizadas até então para esse táxon, como aparelho bucal e genitália masculina. A partir disso, atualizamos a chave de identificação do grupo incluindo todas as espécies do gênero exceto *B. angustata*. A partir dos dados de localidades disponíveis nas etiquetas dos espécimes analisados, foi possível ampliar o conhecimento acerca da distribuição do grupo e detalhar a distribuição geográfica de cada espécie, produzindo mapas georreferenciados. A análise filogenética resulto na recuperação da monofilia do gênero e corroborou seu posicionamento pertencente a tribo Sericoidini. Esta análise também nos permitiu levantar uma hipótese da situação em relação ao posicionamento da tribo Sericoidini em relação aos seus clados próximos, e também apontou a tribo como monofilético. Quanto à análise morfométrica, apesar de seus resultados mostrarem nenhum padrão de forma entre os gêneros, *Blepharotoma* se mostrou um gênero conservado do ponto de vista morfométrico, não apresentando grande variação morfológica entre suas espécies. Entretanto, comparações realizadas par-a-par mostram-se úteis na diferenciação de algumas delas (e.g., *B. heynei* and *B. heynei*). Os resultados da morfometria reforçam aqueles da análise filogenética quanto ao posicionamento e monofilia de *Blepharotoma* visto que comparado a outros gêneros, apesar de apresentarem similaridades, todos os representantes de Sericoidini se agrupam com seus congêneres. Por fim, podemos concluir que devido a todos os pontos levantados neste tópico que este trabalho oferece uma melhor compreensão e delimitação do gênero *Blepharotoma* e suas espécies auxiliando assim a identificação dos mesmos.

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APÊNDICE - SHAPE VARIATION IN SERICOIDINI (COLEOPTERA: MELOLONTHIDAE: SERICOIDINAE) WITH EMPHASIS ON BLEPHAROTOMA BLANCHARD, 1850 USING GEOMETRIC MORPHOMETRICS

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Research paper

Shape variation in Sericoidini (Coleoptera: Melolonthidae: Sericoidinae) with emphasis on *Blepharotoma* Blanchard, 1850 using geometric morphometrics

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ABSTRACT

Sericoidini is a tribe of Melolonthinae (Sericoidinae) with five genera (*Apterodemidea*, *Blepharotoma*, *Manonychus*, *Ovomanonychus* and *Sericoides*) distributed throughout the neotropical region. All these genera, with the exception of *Ovomanonychus*, are in need of taxonomic reassessment. *Blepharotoma* Blanchard is the second largest genus of the tribe, and due to undergoing several new descriptions and transferences over the years has its intern limits become uncertain. Geometric morphometrics has been helping identify patterns among groups of organisms with uncertain limits. This method enables the identification of variations in shape among specimens through comparisons of landmarks coordinates. The aim of the present study was to test the existence of significant morphometric variation among the genera of Sericoidini and species of *Blepharotoma* that could enable identifying taxa. We analyzed the clypeus, pronotum and elytra of species of each genus of Sericoidini and 18 valid species of *Blepharotoma*. A photographic matrix was created with images of the structures and a set of landmarks was plotted in each image. Procrustes superimposition was performed, and the data were analyzed using principal component analysis (PCA), Procrustes ANOVA and canonical variate analysis (CVA). Groups for CVA were classified by genera, species and collection site. The results showed that genera of Sericoidini have a shape pattern. In contrast, species of *Blepharotoma* do not have any specific pattern, except for the population from Buenos Aires (unidentified species). In conclusion, geometric morphometrics seems to be a good support tool for the taxonomic classification of genera of Sericoidini.

1. Introduction

Sericoidini Erichson, 1847 is a tribe of phytophagous beetles (Melolonthidae, Sericoidinae) with five genera distributed throughout the neotropical region. The tribe is composed of the genera *Manonychus* Moser (eight valid species), *Apterodemidea* Arrow (one species), *Sericoides* Guérin-Méneville (51 species), *Blepharotoma* Blanchard (19 species) and the recently described *Ovomanonychus* Costa, Cherman & Iannuzzi (three species) (Costa et al., 2020; Smith, 2008). All these genera, except for *Ovomanonychus*, are in need of taxonomic reassessment.

Blepharotoma Blanchard is one the largest genera of the tribe and was originally proposed as monotypic based on *Blepharotoma tarsalis* Blanchard, 1850; Blanchard, 1850). Throughout its existence, nine additional species have been described for the genus and nine more have been transferred from other genera (*Aplodema, Heteronyx* and *Hilarianus*), leading to a current total of 19 species with neotropical distribution. Ten species occur in Brazil, five in Argentina, three in Bolivia and one in Paraguay (Evans and Smith, 2009). The genus has a confusing tribal history and has been assigned to four different tribes: Melolonthini, Macrodactylini, Sericini and Liparetrini (Blanchard, 1850; Dalla-Torre, 2008; Evans, 2003; Frey, 1973; Smith, 2008). Internally, limits among species are very uncertain and large part of this problem is due to the lack of detail in older descriptions and new combinations in the genus (Cherman et al., 2016; Frey, 1973; Martínez, 1959; Moser, 1918; 1924; Smith, 2008). Indeed, Cherman et al. (2016) pointed out the need for a reassessment of this genus precisely due to these uncertainties.

Geometric morphometrics constitutes a useful tool for the analysis of variations among groups of individuals. This method consists of shape analysis (morphological factors that are independent of scale, size and positioning) based on landmarks (Bookstein, 1997). Landmarks are

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Table 1
Blepharotoma Blanchard, 1850 specimens analyzed by structure of body. Columns refer to the number of specimens used for each structure.

TAXA	Clypeus	Pronotum	Elytra
Blepharotoma argentina	2	2	2
Blepharotoma boccainae	39	39	38
Blepharotoma boliviana	1	1	1
Blepharotoma calvicolis	2	2	2
Blepharotoma confusa	8	8	9
Blepharotoma corumbana	6	6	7
Blepharotoma cuyabana	14	13	13
Blepharotoma heynei	15	16	15
Blepharotoma martinezi	2	3	2
Blepharotoma nitens	3	3	3
Blepharotoma nitidula	1	1	1
Blepharotoma ohausiana	13	15	15
Blepharotoma petroposilana	12	12	10
Blepharotoma plaumanni	23	22	19
Blepharotoma schenkelingi	1	1	2
Blepharotoma suboblongus	2	2	–
Blepharotoma tarsalis	2	2	2
Blepharotoma uniformis	32	32	30
Blepharotoma sp.	62	72	54
Total	240	252	225

plotted in such a way that is easy to view and identify areas that represent key locations for the specimens. These landmarks form a polygon that represents the shape of the organism studied (Adams et al., 2004; Webster and Sheets, 2010). These coordinates can be analyzed for variations and possible patterns among groups of organisms. Thus, morphological factors can be investigated and distinguished statistically through multivariate analysis, enabling greater reliability (Klingenberg, 2011). Geometric morphometrics has proved to be highly useful in various types of studies, including taxonomic investigations (Li et al., 2016; Qubaiová et al., 2015).

The aim of the present study was to determine whether genera of Sericoidini and *Blepharotoma* species (Sericoidini) have significant differences in the shape of the taxa. Our hypothesis is that genera of Sericoidini and species of *Blepharotoma* exhibit significant intergeneric and interspecific variation, respectively.

2. Methods

2.1. Material examined

We examined randomly selected specimens from each genus of the tribe (Table 1) and 258 specimens from 18 species (Table 1) of *Blepharotoma* (Fig. 1). *Blepharotoma angustata* (Blanchard, 1850) was not included in the analyses due to a lack of access to specimens. The material examined is hosted in the following collections:

CEMT - Coleção Entomológica da Coleção de Zoologia da UFMT, Cuiabá, Mato Grosso, Brazil. **CERPE -** Coleção Entomológica da Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brazil. **CEUFPE -** Coleção Entomológica da Universidade Federal de Pernambuco, Recife, Pernambuco, Brazil. **DZUP -** Coleção Entomológica Pe. J.S. Moure, Universidade Federal do Paraná, Curitiba, Brazil. **MNRJ -** Museu Nacional do Rio de Janeiro, Universidade Federal do Rio Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil. **MNHN -** Muséum national d'Histoire naturelle, Paris, France. **MZSP -** Museu de Zoologia, Universidade de São Paulo, São Paulo, São Paulo, Brazil. **ZMHB -** Museum für Naturkunde der Humboldt-Universität, Berlin, Germany.

2.2. Geometric morphometrics

Images of adult specimens of both sexes were captured using an Axiocam 105 Color camera coupled to a Zeiss Stemi 305 stereomicroscope. Images were captured of the clypeus, pronotum and elytra. These structures were chosen based on the literature (Li et al., 2016) and the observation of available specimens.

All available individuals of species of *Blepharotoma* and genera of Sericoidini were analyzed, but only structures that could be clearly visualized were photographed (Table 1; Table 2; Table 3). To ensure the absence of bias due to groups with small samples, we tested the other major groups (with more than five species) separately to determine whether our results had any type of interference, like variation in the results caused by these small groups.

The images were used to create a photographic matrix with the aid of the TPSUtil 1.74 software program (Rohlf, 2017). The matrix was accessed through the TPSDig2, v.2.30 software, in which we plotted all landmarks (Fig. 2). The number of landmarks varied among the structures: ten for the clypeus, eight for the pronotum and six for the elytra (Table 4).

Analyses were performed with Morphoj 1.07. The symmetrical component was used for the clypeus and pronotum, and the asymmetrical component was chosen for the elytra, since the first two are morphologically symmetrical, on the contrary of the elytra, which without its pair is morphologically asymmetrical. Procrustes superimposition was performed to line up all landmark coordinates, thus avoiding problems related to rotation, translation, and scaling. A covariance matrix was generated, allowing to perform the following analysis. Principal component analysis (PCA) was conducted to identify variations in the shape of the specimens. Procrustes ANOVA was performed to test whether the variation among individuals was significant. The specimens were grouped on the generic level for the analysis of the tribe Sericoidini and on the specific level and geographical distribution for the analysis of the genus *Blepharotoma*. Specimens not identified were denominated *Blepharotoma* sp. And those with no information on the procedure were labeled "no location (NL)". Thus, we could determine whether the analysis could solve their taxonomic position and give a hint of their origin. The groups were then submitted to canonical variate analysis (CVA). This important method was used as a tool to differentiate and determine the groups where these predetermined groups (such as species and localities) belong, since maybe they could not present a natural grouping through the PCA.

3. Results

3.1. Sericoidini analysis

3.1.1. Clypeus

PCA revealed no grouping among the genera of Sericoidini for this structure and Procrustes ANOVA revealed significant variation among the genera (Table 5). With a total of seven principal components, PC1 explained 41.89 % of the variation and PC2 explained 29 %. PC1 represented the 'lower ocular canthus related to the base of the clypeus' and the 'higher apex and the depth increase' of landmark #4, whereas PC2 represented the opposite. CVA distinguished the genera of Sericoidini, despite some overlap between *Manonychus* and *Blepharothoma* and between *Manonychus* and *Sericoides* (Fig. 3).

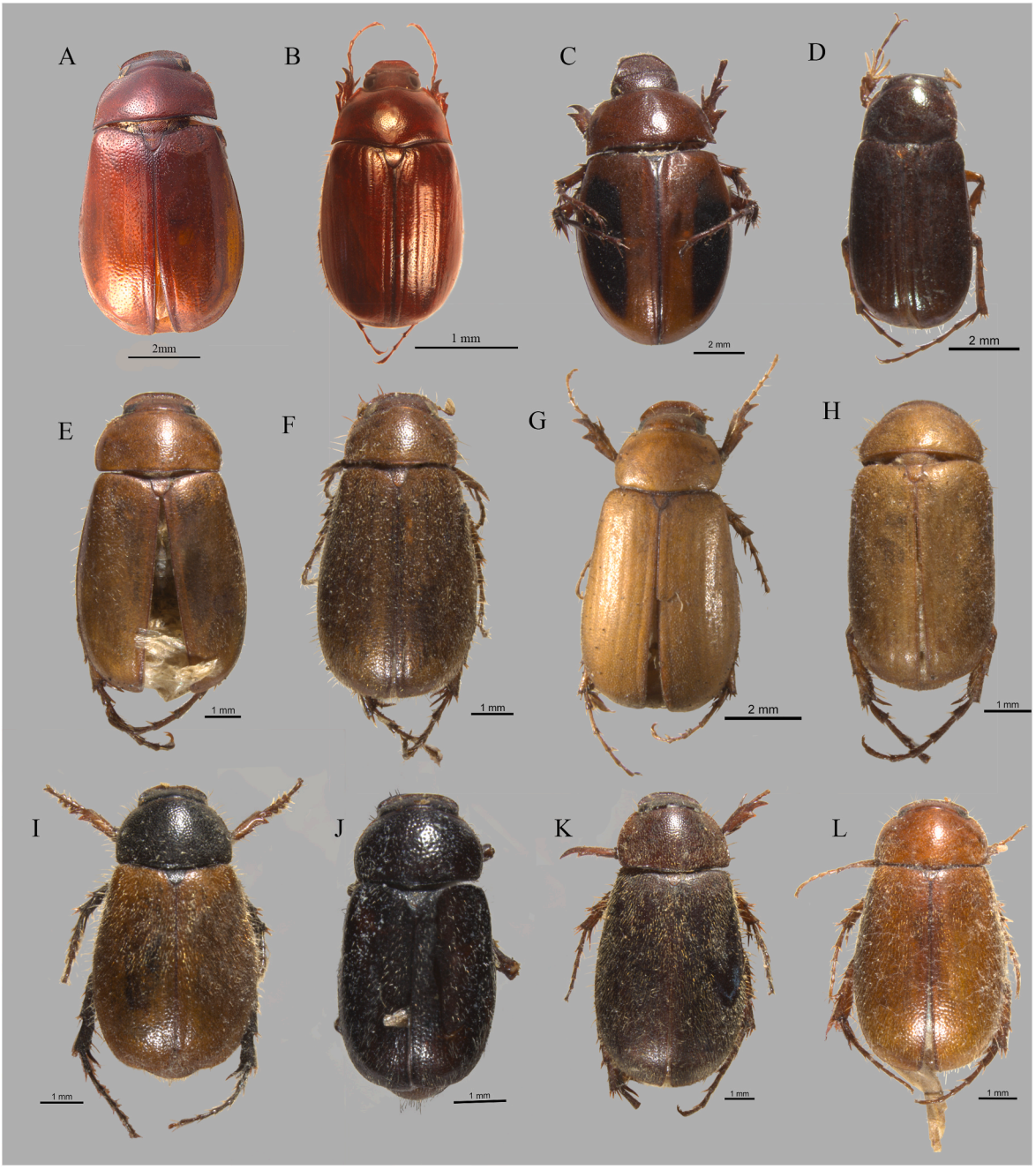

Fig. 1. Representation of variation among specimens of Sericoidini. (A) - *Manonychus* sp.; (B) - *Ovomanonychus* sp.; (C) - *Apterodemidea paraguayensis*; (D) - *Sericoides* sp.; (E) - *Blepharotoma calvicolis*; (F) - *B. boccainae*; (G) - *B. confusa*; (H) - *B. martinezzi*; (I) - *B. nitens*; (J) - *B. nitidula*; (K) - *B. petroposilana*; (L) - *B. plaumanni*.

Table 2
Specimens per structure and per taxon of Sericoidini used for the morphometric analysis. Columns refer to the number of specimens used for each structure.

TAXA	Clypeus	Pronotum	Elytra
Apterodemidea paraguayensis	10	10	10
Blepharotoma spp.	20	20	20
Manonychus spp.	20	20	20
Ovomanonychus spp.	15	15	15
Sericoides spp.	20	20	20

Table 3
Specimens of *Blepharotoma* analyzed per structure and country of origin of the analyzed material. The numbers refer to the amount of specimens analyzed by body structure.

Country	Clypeus	Pronotum	Elytra
Argentina	10	14	11
Bolivia	6	6	6
Brazil	196	204	177
Peru	1	1	–
No location	27	27	31
Total	240	252	225

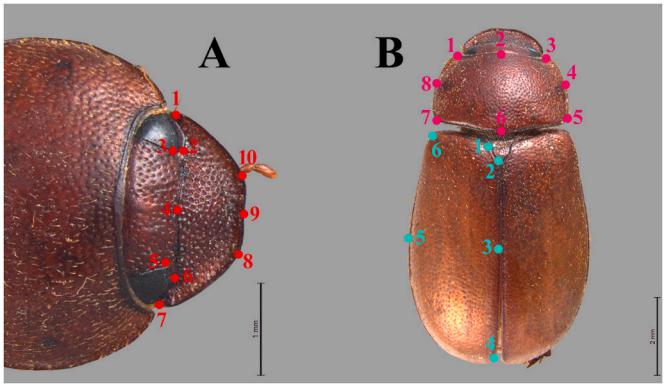

Fig. 2. Habitus of *Bepharotoma suboblongus* (A) Clypeus; (B) Pronotum (pink) and elytra (blue). Circles - landmarks.

Table 4
Landmarks and its respective descriptions per body part.

Landmark	Body part		
	Clypeus	Pronotum	Elytra
1	Left cantus ocular	Apex left corner	Basis left corner (contact area with the scutelum basis right corner)
2	Lower region of the left eye	Apex center	Elytral suture basis (contact area with the scutelum apex)
3	Left tip of the fronto-clypeal suture	Apex right corner	Elytral suture center
4	Central area of the fronto-clypeal suture	Right margin center	Elytral suture apex
5	Right tip of fronto-clypeal suture	Basis right corner	Elytra external margin (area with higher distance between margin and elytral suture);
6	Right cantus ocular	Basis center	Elytral humera
7	Lower region of the right eye	Basis left corner	
8	Basis right tip	Left margin center	
9	Basis central region		
10	Basis left tip		

Table 5
Procrustes ANOVA values to Sericoidini genera clypeus shape. SS – Sum of Squares; MS – Mean Squares; df – degrees of freedom; F – F test; P. (param.) – Parametric *p*-value.

Shape, Procrustes ANOVA for species:					
Effect	SS	MS	df	F	P (param.)
Extra1	0.18858943	0.0058934197	32	23.99	<0.0001
Individual	0.15721855	0.0002456540	640	4.73	<0.0001
Side	0.01091879	0.0013648491	8	26.28	<0.0001
Ind * Side	0.03489379	0.0000519253	672		

3.1.2. Pronotum

PCA revealed six principal components for the pronotum, with PC1 explaining 43.36 % of the variation and PC2 explaining 26.27 %. PC1 represented the widening of the apex and the narrowing of the base. PC2 represented the depth increases of landmarks #2 and #6. Pronotum variation was found in all Sericoidini genera, except *Blepharotoma*, which appears separated from the other genera (Fig. 4). Procrustes ANOVA revealed significant variation among the genera (Table 6). In contrast, CVA revealed significant grouping of the genera *Ovomanonychus* and *Blepharotoma*, despites some overlap forming a type of variation scale (Fig. 5).

3.1.3. Elytra

For the elytra, PC1 explained 70.13 % of the variation, whereas PC2 had only 13.27 % of the eight principal components. Considerable variation was over the PC1 axis (Fig. 6), with the genera distributed sequentially in the following order: *Sericoides*, *Blepharotoma*, *Manonychus*, *Ovomanonychus* and *Apterodemidea*. Apparently, the determinant factor was the width of the elytra (PC1) and part of the elytral humera position (PC2) (Fig. 6), with Procrustes ANOVA revealing significant variation (Table 7). Given the PCA result, as expected, CVA showed the same distribution pattern for *Apterodemidea,* which was the most isolated from the other genera (Fig. 7).

3.2. Analysis of Blepharotoma

3.2.1. Clypeus

PCA identified a total of eight principal components. PC1 explained 36.95 % of the variation, whereas PC2 explained 18.06 %. PC1 corresponded to the variation in clypeus length and narrowing of the *canthus ocular*, whereas PC2 corresponded to the shape variation of the fronto-clypeal suture. However, no grouping of individuals occurred in the same species (Fig. 8). Procrustes ANOVA indicated significant variation among species (Table 8). CVA revealed a high number of overlaps among the groups (Fig. 9). However, some groups could be distinguished by a pair-to-pair comparison of its shapes and supported by its Mahalanobis and Procrustes distance values (Appendix A, B). For instance, *B. boccaine* differed from *Blepharotoma confusa* (Mahalanobis = 2.0884; $P < 0.05$); *Blepharotoma boccainae* differed from *Blepharotoma uniformis* (Mahalanobis = 1.8150; $P < 0.0001$) and *B. uniformis* differed from *Blepharotoma heynei* (Mahalanobis = 2.1876; $P < 0.0001$).

3.2.2. Pronotum

A total of six principal components were found for the pronotum, but PCA did not identify any grouping (Fig. 10). PC1 explained 53.45 % of the variation and corresponded to the depth of the central region of the pronotum apex. PC2 explained 19.66 % of the variation and

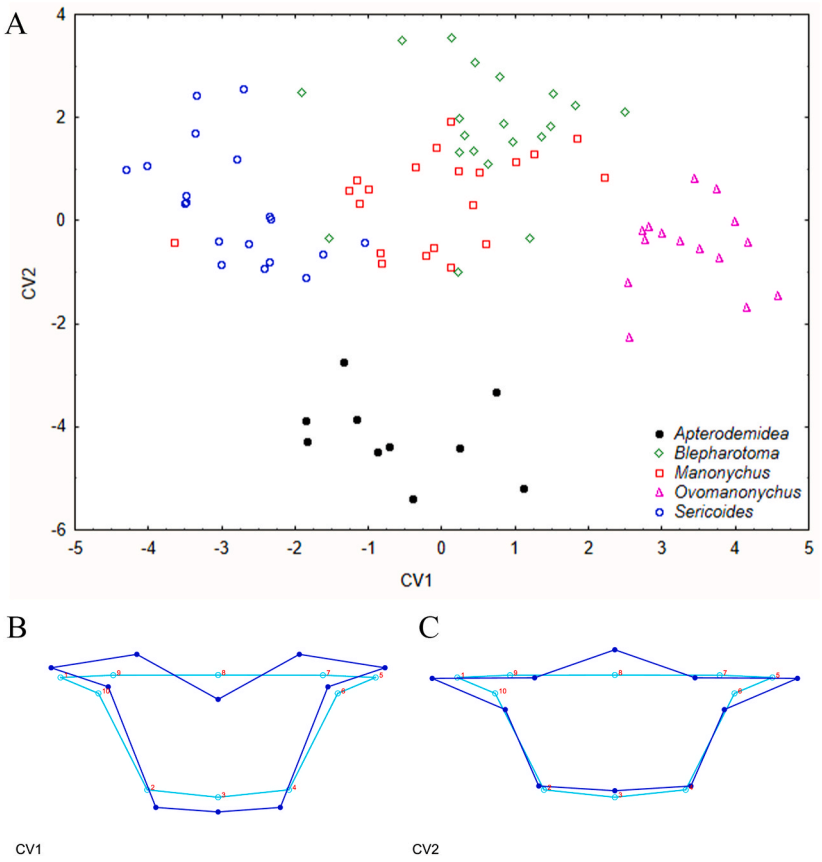

Fig. 3. Graphic representation of CVA results for the clypeus shape of Sericoidini genera. (A) - Graphic representation; (B) - CV1; (C) - CV2. Light and dark blue line represents the variation along the axis.

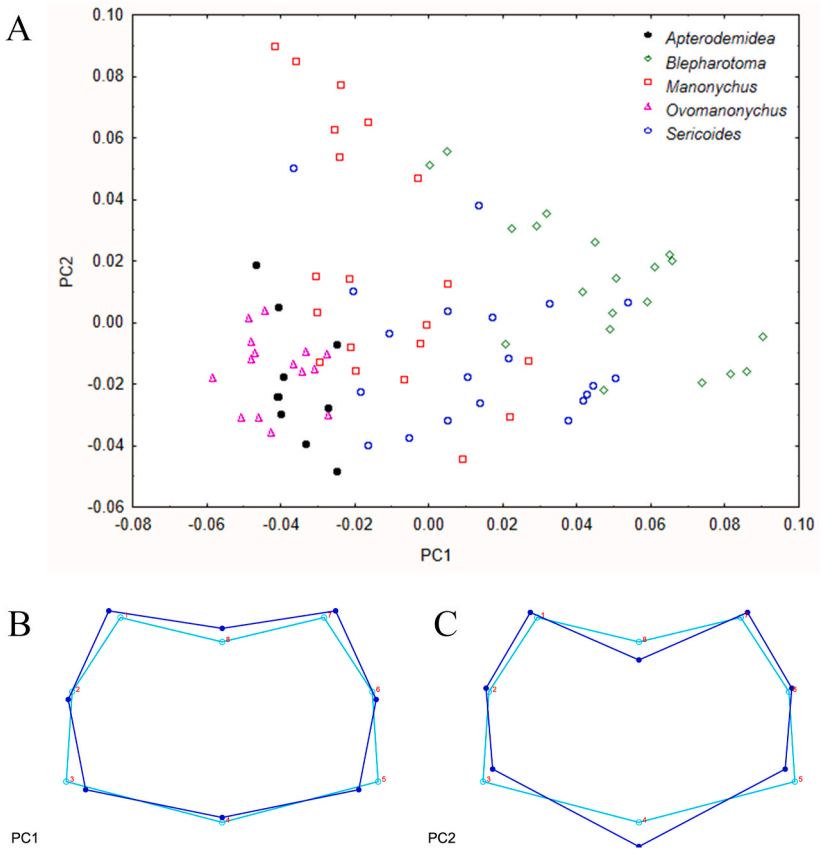

Fig. 4. Graphic representation of PCA results for the pronotum shape of Sericoidini genera. (A) - Graphic representation; (B) - PC1; (C) - PC2. Light and dark blue line represents the variation along the axis.

Table 6
Procrustes ANOVA values to Sericoidini genera pronotum shape. SS – Sum of Squares; MS – Mean Squares; df – degrees of freedom; F – F test; P. (param.) – Parametric *p*-value.

Shape, Procrustes ANOVA for species:					
Effect	SS	MS	df	F	P (param.)
Extra1	0.15567930	0.0064866374	24	22.31	<0.0001
Individual	0.13955197	0.0002907333	480	4.36	<0.0001
Side	0.01947513	0.0032458548	6	48.62	<0.0001
Ind * Side	0.03364348	0.0000667529	504		

corresponded to the variation in the height of the lateral tips of the apex and width of the pronotum. Procrustes ANOVA revealed significant variation in the groups for this structure (Table 9). CVA found no clear grouping by species (Fig. 11). When compared by locality, however, some specimens from Argentina were separated from the others.

3.2.3. *Elytra*

Eight principal components were found for the elytra. PC1 explained 69.65 % of the variation, whereas PC2 explained only 17.74 %. For this structure, PC1 and PC2 vary among landmarks #4, #5 and #6, but PC2 showed considerable variation between landmarks #1 and #2. Procrustes ANOVA revealed significant shape variations (Table 10). CVA showed a cluster of specimens from Brazil in the center of the graphs, while the other specimens seem to be in regions closer to zero on both axis (Fig. 12). Moreover, one group was comprised only of Argentine specimens.

4. Discussion

Our results show that Sericoidini genera present specific shape patterns, but *Blepharotoma* species have similar shape, with the exception of some individuals whose pronotum is different.

Along with the analysis for the Sericoidini tribe we found segregation of the genera, highlighting the shape patterns for each one. This result confirms the most recent phylogeny for Sericoidini, which recovers the monophyly of the tribe (Costa et al., 2021). One of the most interesting results was the segregation of *Apterodemidea* by the clypeus and elytra shapes. Specimens of this genus are wingless and have adaptations of the body and consequent lifestyle, which explains the particular shape pattern. Some beetles have undergone changes due to their habits, like species of Trechiini (Carabidae). These beetles underwent changes as a response to their cave-dwelling habits, enabling the easy identification of the shape of aphaenopsian, semi-aphaenopisan, and anophthalmic species. The same occurs in Scarabaeinae, whose mouthparts developed a specific shape due to the characteristic feeding habit (coprophilia) throughout evolution of the taxa, which differentiates these organisms

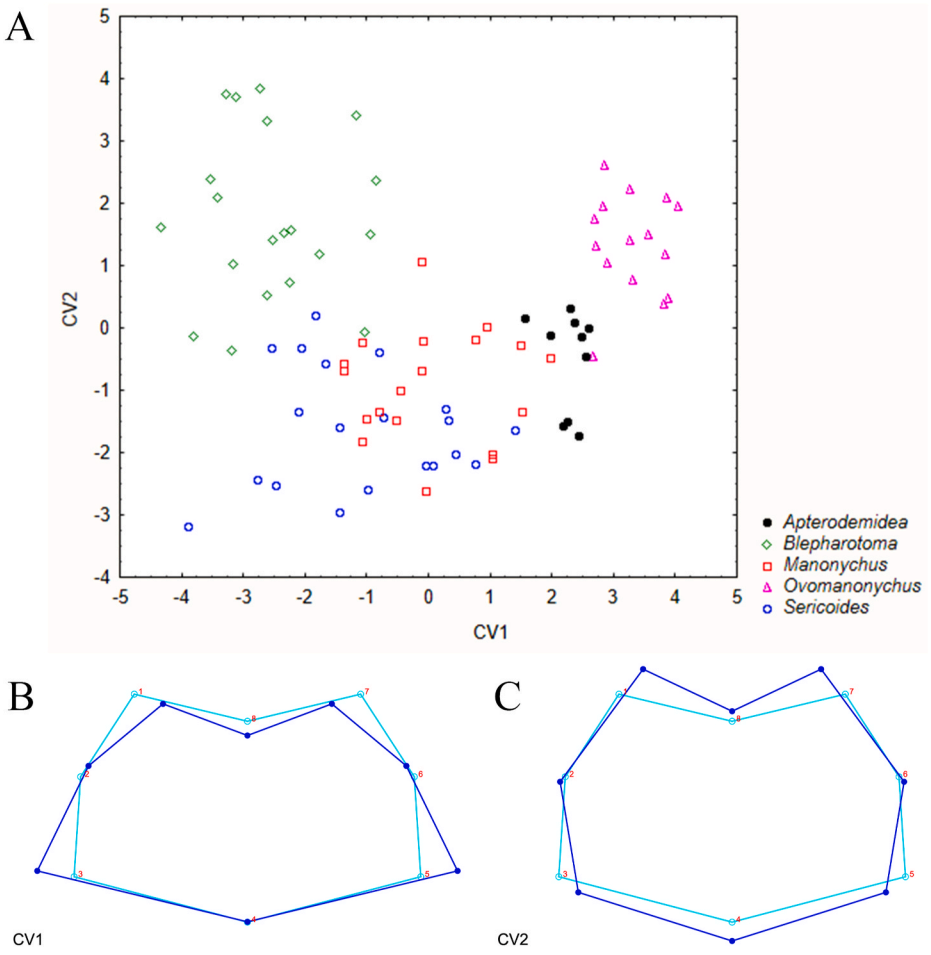

Fig. 5. Graphic representation of CVA results for the pronotum shape of Sericoidini genera. (A) - Graphic representation; (B) - CV1; (C) - CV2. Light and dark blue line represents the variation along the axis.

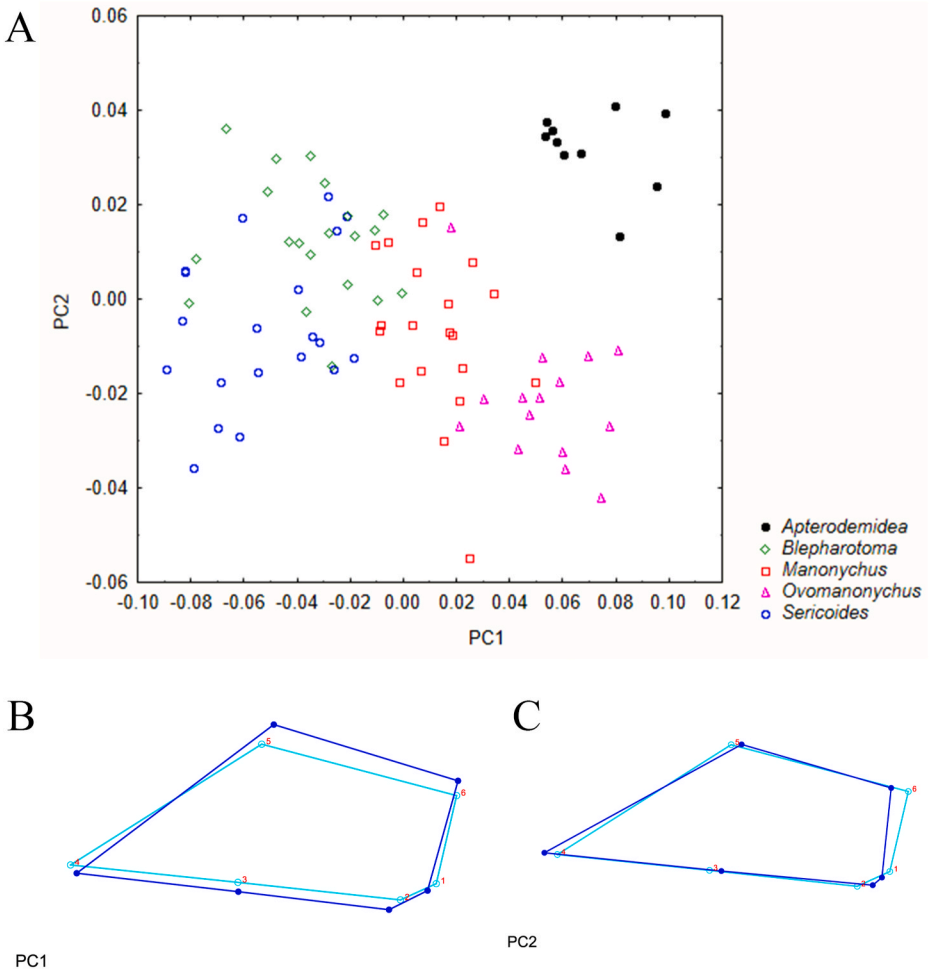

Fig. 6. Graphic representation of PCA results in elytra shape of Sericoidini genera. (A) - Graphic representation; (B) - PC1; (C) - PC2. Light and dark blue line represents the variation along the axis.

Table 7
Procrustes ANOVA values to Sericoidini genera elytra shape. SS – Sum of Squares; MS – Mean Squares; df – degrees of freedom; F – F test; P. (param.) – Parametric *p*-value.

Shape, Procrustes ANOVA for species:					
Effect	SS	MS	df	F	P (param.)
Extra1	0.18858943	0.0058934197	32	23,99	<0.0001
Individual	0.15721855	0.0002456540	640	4,73	<0.0001
Side	0.01091879	0.0013648491	8	26,28	<0.0001
Ind * Side	0.03489379	0,0000519,253	672		

from other Scarabaeoidea (Bai et al., 2015; Chen et al., 2021; Gutiérrez, 1952). *Ovomanonychus* was another genera of Sericoidini segregated from the others. Species from these genera have a large and ovoid body shape, which may be the cause for the segregation from the other genera. On the other hand, *Blepharotoma*, *Manonychus* and *Sericoides* formed separate groups, but with some superimposition among them. The three genera resemble by sub- or oblongous body shape in most of its species. This is particularly noticeable between *Blepharotoma* and *Manonychus*, which are the most similar from all the species of Sericoidini (Blanchard, 1850; Moser, 1924). As for *Sericoides,* which is a big and very diverse genera with more than 50 species (Evans and Smith, 2009), that shares a lot of similarities with the previous two genera (Smith, 2008), which justifies some superimpositions. These results corroborated the importance of geometric morphometrics in higher taxa segregation, and shows the potential of the structure's shape variation to taxonomy. This can be seen in similar analysis performed to cantharid beetles (Pretorius and Scholtz, 2001; Su et al., 2015).

As for the analysis for the *Blepharotoma* genera, the internal limits of species do not point out based on geometric morphometric, which refutes our hypothesis. This method was applied, because it is used to identify variation and find patterns in predetermined groups and find patterns (Webster and Sheets, 2010), which should help to find a better definition for the genera species. We believe that the species of this genus may occupy similar niches and therefore have little shape variation, like we can see in some bee species. Panmictic populations of *Apis dorsata* (Rattanawannee et al., 2012) and other species of bees that occupy the same niche and have little variation and no specific morphometric patterns. On the other hand, during the analysis by geographical groups, we found the segregation of four of the five representative specimens from Buenos Aires (Argentina) by the pronotum and elytra in geographical groups. This result enables us to consider that the specimens from Buenos Aires are possibly from a heretofore unknown species of *Blepharotoma*. In this sense, we believe that the environment may be considered a major driver of shape in *Blepharotoma*. Indeed, morphometrics is used to identify ecological patterns that are effective at segregating groups among guilds or populations from different environments, possibly due to adaptation to the variation among environments, such as soil, plant cover or chemical components (Armendáriz-Toledano et al., 2014; Hernández et al., 2011; Regueira et al., 2020).

Although geometrics is not able to distinguish species, this method can serve as support in an integrative study when used together with other methods. Integrative taxonomy using geometric morphometrics assists in solving taxonomic problems, such as species complexes (see Mitrovski-Bogdanović et al., 2014 for *Praon dorsale–yomenae* - Hymenoptera), cryptic species, among others.

Among the structures analyzed for Sericoidini, the CVA shows that

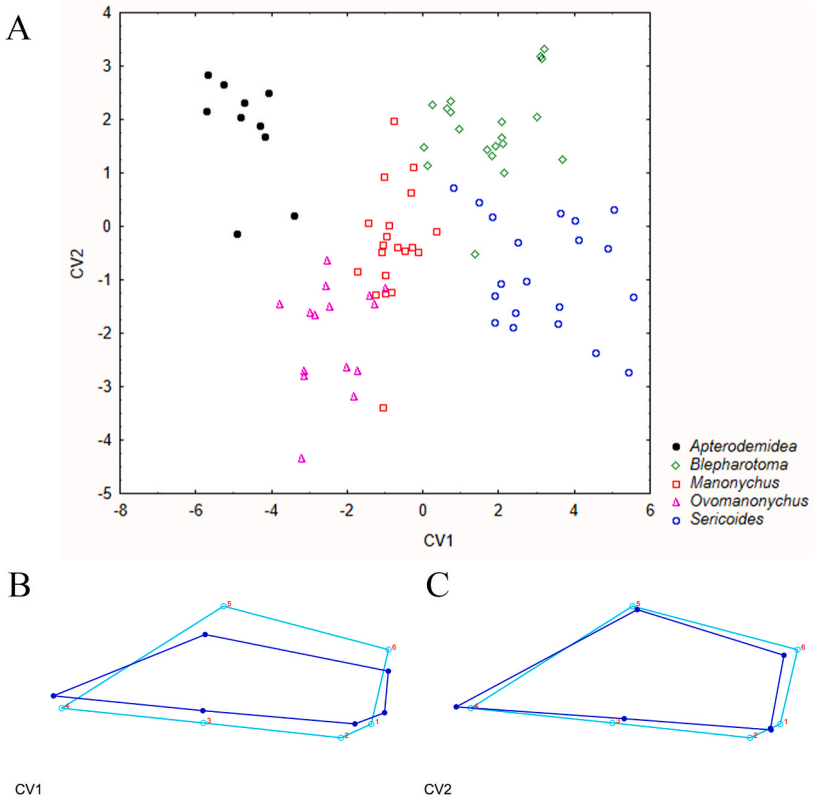

Fig. 7. Graphic representation of CVA results for the elytra shape of Sericoidini genera. (A) - Graphic representation; (B) - CV1; (C) - CV2. Light and dark blue line represents the variation along the axis.

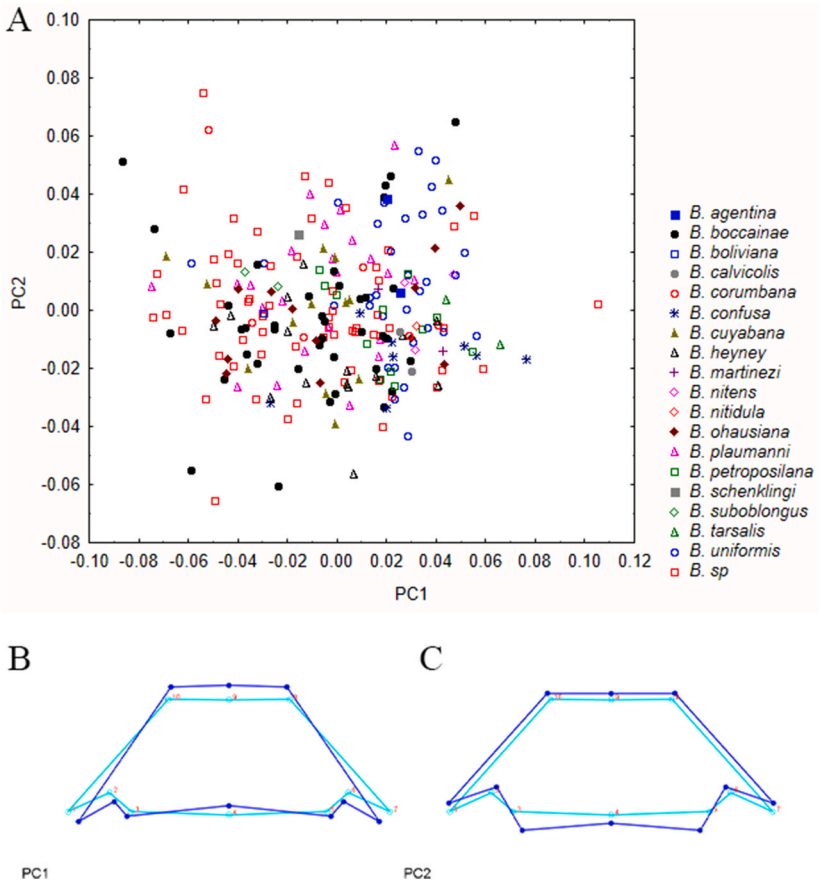

Fig. 8. Graphic representation of PCA results for *Blepharotoma* Blanchard, 1850 species clypeus shape. (A) - Graphic representation; (B) - PC1; (C) - PC2. Light and dark blue line represents the variation along the axis.

Table 8
Procrustes ANOVA values to *Blepharotoma* Blanchard, 1850 specimens clypeus shape. SS – Sum of Squares; MS – Mean Squares; df – degrees of freedom; F – F test; P. (param.) – Parametric *p*-value.

Shape, Procrustes ANOVA for species:					
Effect	SS	MS	df	F	P (param.)
Extra1	0.12620128	0.0008763978	144	2.62	<0.0001
Individual	0.59036466	0.0003339167	1768	4.53	<0.0001
Side	0.01396800	0.0017459997	8	23.70	<0.0001
Ind * Side	0.14088731	0.0000736858	1912		
Shape, Procrustes ANOVA for country:					
Individual	0.71656595	0.0003747730	1912	4.58	<0.0001
Side	0.01396800	0.0017459997	8	21.36	<0.0001
Ind * Side	0.15628931	0.0000817413	1912		

all of them have distinct shapes in each genera. On the other hand, among species of *Blepharotoma*, the most variation was found in the elytra, pronotum and clypeus, respectively. The elytra and pronotum are linked directly to the locomotion of the beetles either for protection or to house the muscles responsible for the movement of the locomotor appendages. Therefore, these structures were expected to have a larger number of changes in shape as a reflection of adaptation of flight behavior in the presence of environmental differences (Hlavac, 1972; van de Kamp et al., 2015). It is possible that the clypeus, unlike the other characters, did not show any isolated grouping because of shared habits of digging the ground for oviposition, like other Melolonthidae (Morón 1997; 2004). But, since the biology of the genera is yet unknown this theory remains uncertain.

Morphometric geometrics is normally used as a support for the determination of taxa, as seen in other studies (Li et al., 2016b; Sasakawa, 2016). As mentioned above, morphometrics is a very useful tool to identify specific patterns of specimens from different environments (Carvajal-Rodríguez et al., 2005; Hernandez et al., 2022; Lycett and von Cramon-Taubadel, 2013). Thus, it is reasonable to presume that *Blepharotoma* is a well-preserved genus in terms of its shape. The main cause of this absence of variation may be genotypic stability, consequently resulting in phenotypic stability (see Balaško et al. (2022) for *Leptinotarsa decemlineata* (Say) - Coleoptera; Chrysomelidae). Another hypothesis would be that such stability is the result of the occupation of similar niches and the response to similar environmental pressures, as seen for *Onthophagus taurus* and *O. illyricus* (Coleoptera, Scarabaeidae), by which external stimuli are the determinants of one phenotype

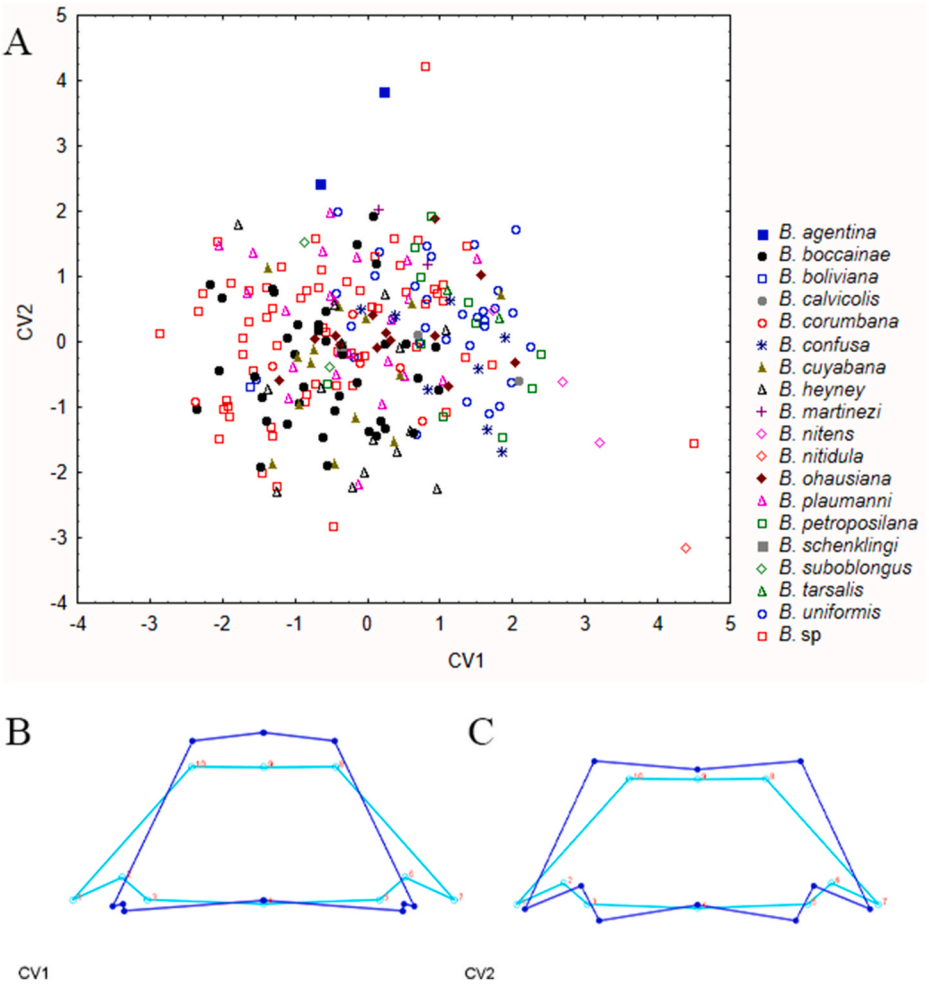

Fig. 9. Graphic representation of CVA results for *Blepharotoma* Blanchard, 1850 species clypeus shape. (A) - Graphic representation; (B) - CV1; (C) - CV2. Light and dark blue line represents the variation along the axis.

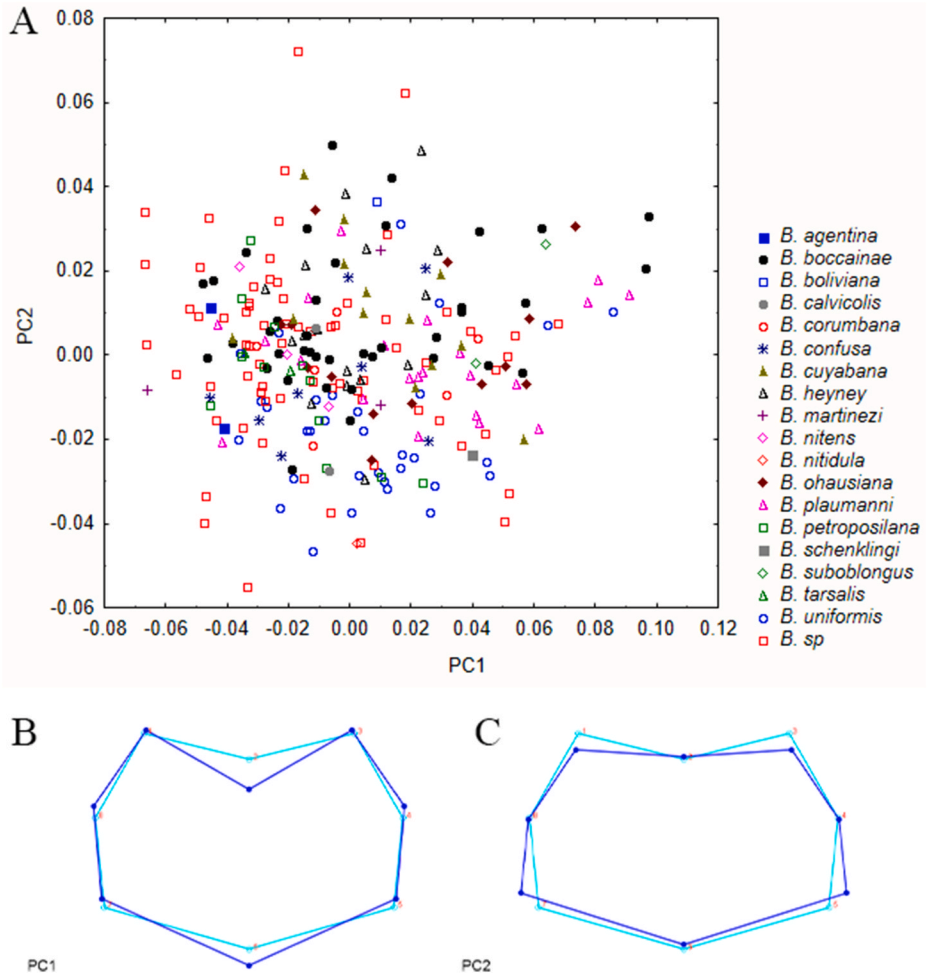

Fig. 10. Graphic representation of PCA results of the pronotum shape of *Blepharotoma* Blanchard, 1850 specimens. (A) - Graphic representation; (B) - PC1; (C) - PC2. Light and dark blue line represents the variation along the axis.

Table 9
Procrustes ANOVA values to *Blepharotoma* Blanchard, 1850 specimens' pronotum shape. SS – Sum of Squares; MS – Mean Squares; df – degrees of freedom; F – F test; P. (param.) – Parametric *p*-value.

Shape, Procrustes ANOVA for species:					
Effect	SS	MS	df	F	P (param.)
Extra1	0.09306228	0.0008616877	108	2.88	<0.0001
Individual	0.41824356	0.0002991728	1398	5.07	<0.0001
Side	0.00860867	0.0014347791	6	24.32	<0.0001
Ind * Side	0.08884060	0.0000589911	1506		
Shape, Procrustes ANOVA for country:					
Extra 1	0.02938003	0.0012241679	24	3.76	
Individual	0.48192580	0.0003251861	1482	5.18	<0.0001
Side	0.00860867	0.0014347791	6	22.84	<0.0001
Ind * Side	0.09460571	0.0000628192	1506		

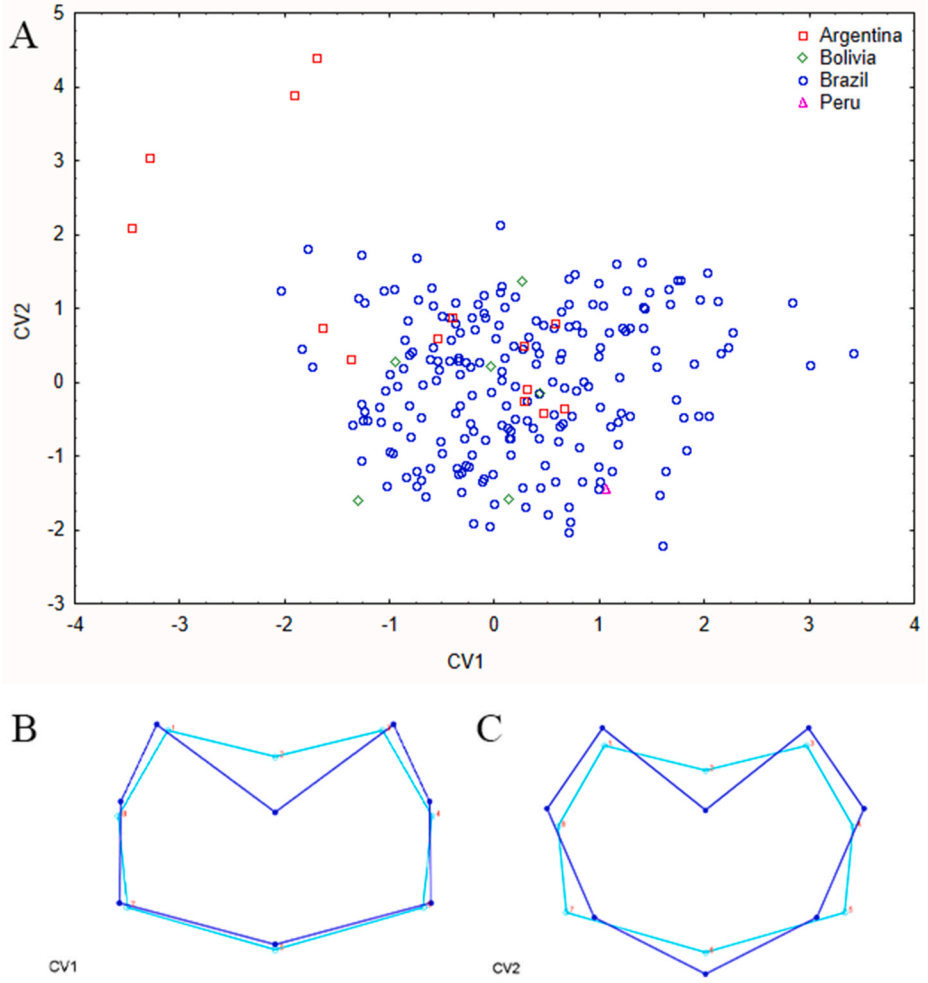

Fig. 11. Graphic representation of CVA results for *Blepharotoma* Blanchard, 1850 species pronotum shape. (A) - Graphic representation; (B) - CV1; (C) - CV2. Light and dark blue line represents the variation along the axis.

Table 10
Procrustes ANOVA values to *Blepharotoma* Blanchard, 1850 specimens' elytra shape. SS – Sum of Squares; MS – Mean Squares; df – degrees of freedom; F – F test; P. (param.) – Parametric *p*-value.

Shape, Procrustes ANOVA for species:					
Effect	SS	MS	df	F	P (param.)
Extra1	0.12352973	0.0009083069	136	2.81	<0.0001
Individual	0.49892201	0.0003231360	1544	1.30	<0.0001
Residual	0.02778961	0.0002481215	112		
Shape, Procrustes ANOVA for country:					
Extra 1	0.02864244	0.0011934348	24	3.33	<0.0001
Individual	0.59380931	0.0003585805	1656	1.45	0.0064
Residual	0.02778961	0.0002481215	112		

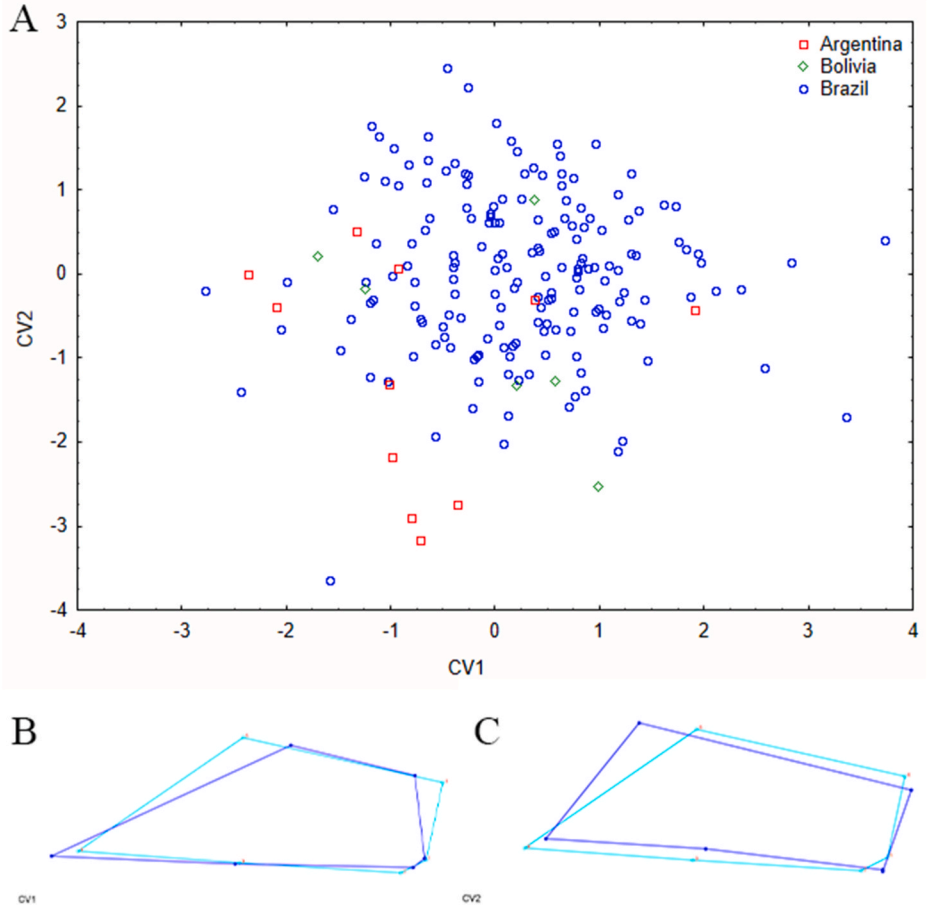

Fig. 12. Graphic representation of CVA results for the elytra shape of *Blepharotoma* Blanchard, 1850 by specimens' country. (A) - Graphic representation; (B) - CV1; (C) - CV2. Light and dark blue line represents the variation along the axis.

predominating over another (Pizzo et al., 2006; Moczek, 2009).

5. Conclusion

We concluded that Sericoidini presents different shapes and that the geometric morphometrics represents an important tool to accurate definition of genera. Also, it is evident that all structures analyzed here for the investigation of variability in the genus *Blepharotoma* had significant variation, but this variation seems not to be sufficient to segregate species naturally. Finally, clypeus seems not to be the most suitable character to identify variation patterns in these taxa, being pronotum and elytra clearly more informative in this aspect.

CRediT authorship contribution statement

J.C.S. Regueira: Writing – review & editing, Writing – original draft, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **F.C. Costa:** Writing – review & editing, Writing – original draft, Supervision, Resources, Methodology, Data curation, Conceptualization. **L. Iannuzzi:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Regueira, J.C.S. reports financial support was provided by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Table of Mahalanobis values resulting from CVA for *Blepharotoma* shape grouped for species. B. arg – *B. argentina*; B. boc – *B. boccainae*; B. bol – *B. boliviana*; B. cal – *B. calvicollis*; B. con – *B. confusa*; B. cor – *B. corumbana*; B. cuy – *B. cuyabana*; B. hey – *B. heynei*; B. mar – *B. martinezi*; B. nis – *B. nitens*; B. nit – *B. nitidula*; B. oha – *B. ohausiana*; B. pet – *B. petroposilana*; B. pla – *B. plaummani*; B. sch – *B. schenklingi*; B. sub – *B. suboblongus*; B. tar – *B. tarsalis*; B. uni – *B. uniformis*; B. sp – non-identified; *p < 0,05; **p < 0,01

	B. arg	B. boc	B. bol	B. cal	B. con	B. cor	B. cuy	B. hey	B. mar	B. nis	B, nit	B. oha	B. pet	B. pla	B. sch	B. sub	B. tar	B. uni
B. boc	3,9442**																	
B. bol	4,5077	1,7226																
B. cal	3,9267	2,6624	3,8048**															
B. con	4,1341**	2,0884**	3,3522	2,0842														
B. cor	4014*	1148	2,1886	2,9313	2194**													
B. cuy	3,8376**	0,6594	1,7539	2,4919	1,8193**	1,1191												
B. hey	4143*	1,1215	1,7888	2,3735	1,7444*	1,5887	0,8025											
B. mar	2,9674**	3372*	3,7099**	3,2855**	2996	3,8238*	3,1396*	3,1706*										
B. nis	4,9014**	3,3105**	4,3697	2,4272	2,0573	3,1998*	2,8817**	2905*	4,0076									
B. nit	8,2605	6,4752**	7,1495	4,8121**	5,6922	6,4991	6,1682**	6005*	7,0698	4,2939								
B. oha	3,6592**	1,6357**	2,7069	2,6835	1,5499	1,7766	1,2021	1,5493*	3,0957*	2432	6,2741							
B. pet	3,5835**	2,0961**	3,3291**	1877	1206	2,0513*	1,7021**	1,7954**	3174**	1,7637	5,6283*	1149						
B. pla	3,6446**	1,0375	2,0477	2,7916	2,3184**	1,8475*	1,1389	1,6796**	3,0057*	3,2217**	6,5225*	1,5934**	2,1674**					
B. sch	3,9473	2,0325**	3,1795	2,9754	3,0066	1,5978	2,0972	2,7164	4,3192	3,54	6,3507	2,5636	2,6139	2,3565				
B. sub	3,4501	1,4538	2,4961	3,1383	2,6759	1,9105	1,4872	2174	3,4151	3,5817	6921	1,5955	2,3248	1,2145	1,9643			
B. tar	4,0637	3,39*	4,7662	2,6967	2,2785	3,2863	3,3598**	3,5283**	3,4439	3,3969	6,3083	3,3036**	2,7987**	3,5816**	3,3046**	3,6806		
B. uni	3,6584**	1815**	3,0529	2,1876	1,7219*	2,0753**	1,6448**	1,9684**	3,0827*	2,0896	5,7675**	1,5053**	1,3595*	1,4092**	2,5224	2,0877	3,0289*	
B. sp.	3,2537	0,9073*	1,9682	2,5074	2,0728**	1,2042	0,739	1,2373*	3,0579	3,2141**	6,5721*	1,3145*	1,7324**	1,3027**	1,9231	1,2459	3,2988*	1,8434**

Appendix B. Table of Procrustes distance values resulting from CVA for *Blepharotoma* shape grouped for species. B. arg – *B. argentina*; B. boc – *B. boccainae*; B. bol – *B. boliviana*; B. cal – *B. calvicollis*; B. con – *B. confusa*; B. cor – *B. corumbana*; B. cuy – *B. cuyabana*; B. hey – *B. heynei*; B. mar – *B. martinezi*; B. nis – *B. nitens*; B. nit – *B. nitidula*; B. oha – *B. ohausiana*; B. pet – *B. petroposilana*; B. pla – *B. plaummani*; B. sch – *B. schenklingi*; B. sub – *B. suboblongus*; B. tar – *B. tarsalis*; B. uni – *B. uniformis*; B. sp – non-identified; *p < 0,05; **p < 0,01

	B. arg	B. boc	B. bol	B. cal	B. con	B. cor	B. cuy	B. hey	B. mar	B. nis	B, nit	B. oha	B. pet	B. pla	B. sch	B. sub	B. tar	B. uni
B. boc	0,0569																	
B. bol	0,0771	0,0295																
B. cal	0,0551	0,0464	0,0672															
B. con	0,0532	0,0454**	0,0687	0,0186														
B. cor	0,0529	0,0198	0,0334	0,0472	0,0479**													
B. cuy	0,0568*	0,0109	0,0286	0,043	0,0434**	0,0193												
B. hey	0,0652*	0,0221	0,0345	0,0362	0,0373*	0,0293	0,0178*											
B. mar	0,0378	0,0581	0,0769	0,0414	0,0355	0,0593*	0,0555*	0,0558*										
B. nis	0,0667	0,0631**	0,0809**	0,0342**	0,0388	0,0606*	0,0567**	0,0545*	0,0557									
B. nit	0,1143	0,0998	0,1056	0,0729	0,0839	0,0968	0,0915**	0,0851*	0,0994	0,0553								
B. oha	0,0532	0,0238	0,0453	0,0395**	0,037	0,0326	0,0188	0,0269*	0,0499*	0,0478	0,0885							
B. pet	0,05*	0,0381**	0,0608**	0,019	0,0194**	0,0391*	0,0336**	0,0321**	0,0419**	0,0292	0,076	0,025						
B. pla	0,0514	0,0187	0,0406	0,0493	0,0479	0,0297*	0,0203	0,0343**	0,0556*	0,0589**	0,0995*	0,0198*	0,0373**					
B. sch	0,0535	0,0339	0,0425	0,0639	0,0661	0,0258	0,034	0,0498	0,0706	0,073	0,1075**	0,0426	0,0544	0,0341				
B. sub	0,0625	0,0322	0,043	0,0691	0,0676	0,0428	0,0338	0,0493	0,0714	0,0787	0,1148*	0,0342	0,0571	0,0257	0,0346			
B. tar	0,0477	0,0754	0,0991	0,0511	0,0445	0,0719	0,0759**	0,075**	0,0411	0,0669	0,1121	0,0716**	0,0559**	0,0761**	0,0834**	0,0927		
B. uni	0,0458	0,0414**	0,0649	0,0328	0,0324*	0,0413**	0,0394**	0,0436**	0,0459*	0,0329	0,0831*	0,0315**	0,0211*	0,0335**	0,052	0,0565	0,0578*	
B. sp.	0,0523	0,01	0,0302	0,0455	0,0455**	0,0187	0,0087	0,0233	0,0549*	0,0615**	0,098	0,021*	0,0365**	0,02**	0,0301	0,0299	0,0743*	0,0417**

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