ISSN 2755-3531

Vol. 45, no. 2 **Journal of Conchology** 27 November 2024

Published by the Conchological Society of Great Britain and Ireland, established 1874

Taxonomic synopsis of land snails (Mollusca: Gastropoda) from the Brazilian Midwest deposited in the Coleção Malacológica de Ribeirão Preto, University of São Paulo, Brazil

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Abstract. Land-snail inventory suffers many gaps in knowledge, especially in countries of the Global South such as Brazil. Studying undersampled regions and providing data on species distributions are among the most pressing matters in Brazilian malacology. Here, we study a sample of land snails collected in the Central-West region of Brazil ("Midwest") housed in the Coleção Malacológica, Departamento de Biologia, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto (University of São Paulo). Ten species from seven families were identified in the material: *Alterorhinus constrictus*, *Anostoma rossi*, *Aperostoma redfieldi*, *Bulimulus corumbaensis*, *Cyclodontina gemellata, Cyclodontina sectilabris*, *Drymaeus poecilus*, *Megalobulimus* aff. *elongatus*, *Solaropsis fairchildi,* and *Solaropsis rosarium*. The geographic range of four species and one family (Bothriembryontidae) are expanded. We reassess the taxonomic status of two species and consider *Anostoma luetzelburgi* Weber, 1925 to be a junior synonym of *A. rossi* Weber, 1925.

Key words. *Anostoma*, Bothriembryontidae, Cyclophoroidea, new records, Stylommatophora

ZooBank identifier. urn:lsid:zoobank.org:pub:73F4B271-3266-4DFD-B3E1-F4CDBB88BD30

DOI. https://doi.org/10.61733/jconch/4531

Introduction

Land snails are the most diverse non-marine molluscs, with over 24,000 species described from phylogenetically disparate lineages (Rosenberg 2014). Despite their striking diversity, there are still many gaps in our knowledge about the inventory, taxonomy, and biology of land snails, especially concerning species from the Global South (e.g., Raheem *et al.* 2014; Salvador 2019b; von Oheimb *et al.* 2019; Eguakhide *et al.* 2023; Machado *et al.* 2023). This scenario is particularly worrying considering the high extinction rates among land snails in the face of the current biodiversity crisis (Lydeard *et al.* 2004; Cowie *et al.* 2022; Miyahira *et al.* 2022). A comprehensive understanding of the taxonomy and distribution of land snail species is required to better inform conservation efforts, with the study of undersampled regions being among the most pressing matters in Brazilian malacology (Lydeard *et al.* 2004; Miyahira *et al.* 2022; Salvador 2019b; Machado *et al.* 2023).

The Brazilian Midwest (or, more specifically, the Central-West region of Brazil) comprises the states of Goiás, Mato Grosso, and Mato Grosso do Sul, as well as the Distrito Federal. It is the least populated and second largest region of Brazil, encompassing an area of over 1,600 km^2 that includes four of the country's main ecoregions: Cerrado, Pantanal, Amazon rainforest and Atlantic Forest (Parras *et al.* 2024). Nonetheless, the Brazilian Midwest suffers from a severe scarcity of information regarding its land-snail fauna. Despite its large area, only *ca* 8% of all land snail species recorded in Brazil have records from the Midwest, which is likely an underestimation due to the lack of studies in the region (Salvador 2019b).

In recent years, the Brazilian Midwest has faced severe habitat loss due to land use and occupation (Alho *et al.* 2019). This has been aggravated by deforestation (Parras *et al.* 2024), large-scale fires (Berlinck *et al.* 2022), heat waves and droughts (Marengo *et al.* 2021), mining (Gallão & Bichuette 2018), and catastrophic governmental policies (Nature Editorials 2018; Leal *et al.* 2023). Although habitat destruction is considered the main threat to land snails and responsible for most of their recorded extinctions (Miyahira *et al.* 2022), the impacts of recent events on the land snails in this region are still unknown. In this context, taxonomic studies can help by providing new data on the species and serve as testimony to their existence and distribution at the time of their collection.

In this paper, we study the land snail specimens from the Brazilian Midwest deposited in the Coleção Malacológica de Ribeirão Preto at the Departamento de Biologia, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, University of São Paulo, Brazil. The specimens studied herein are sourced from various distinct localities across mid-western Brazil. Notes on their taxonomy, distribution and habitat are presented and discussed below.

Materials and Methods

Specimens analysed in this study are deposited in the Coleção Malacológica de Ribeirão Preto (CMRP) at the Departamento de Biologia, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto (FFCLRP), University of São Paulo (USP), Ribeirão Preto, Brazil. This material was collected from 2017 to 2023 in the states of Goiás and Mato Grosso do Sul, as well as the Distrito Federal (the Federal District of Brazil) (Fig. 1).

Species identifications were based on shell morphology, using the catalogue of Simone (2006), original descriptions (as well as type specimens or photographs when available), further taxonomic literature (cited below when applicable), and voucher specimens deposited in the CMRP and MZUSP collections (Museu de Zoologia da Universidade de São Paulo, Brazil). Species are presented below in systematic order following the classification of Bouchet *et al.*

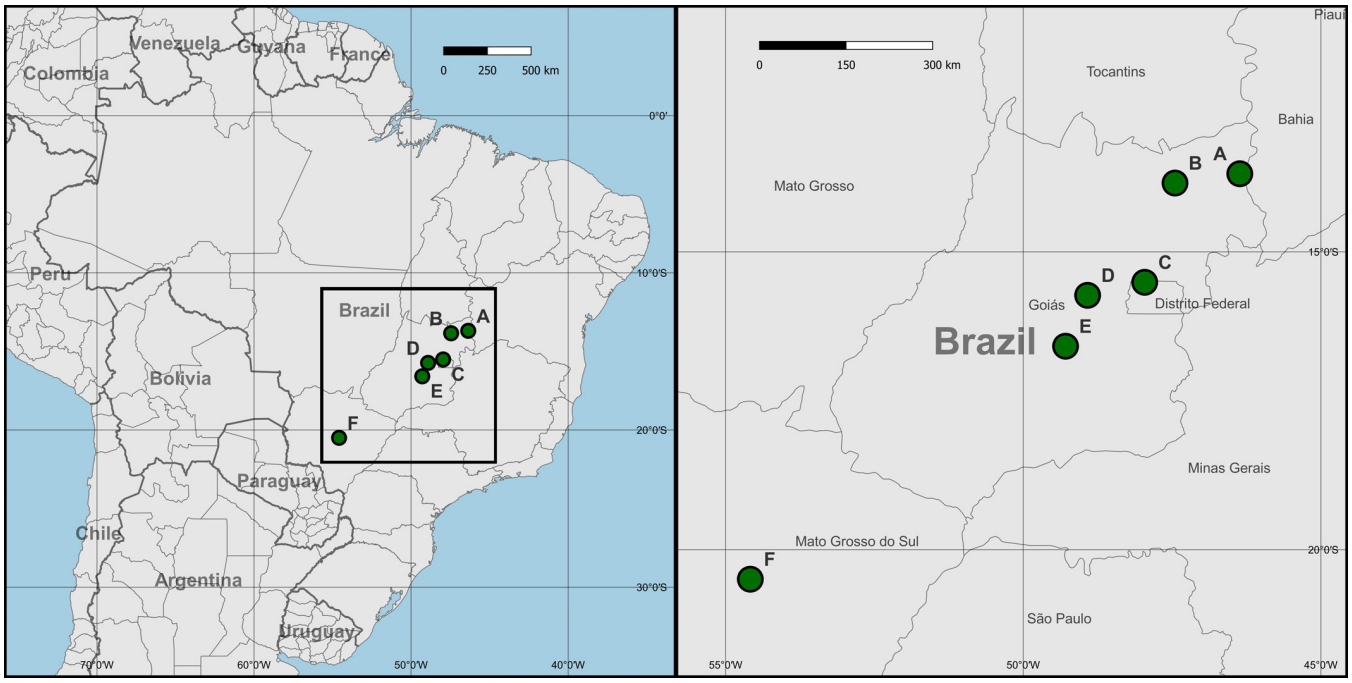

Figure 1. Map of the collection localities. A = São Domingos, Goiás. B = Cavalcante, Goiás. C = Brasília, Distrito Federal. D = Pirenópolis, Goiás. E = Goiânia, Goiás. F = Campo Grande, Mato Grosso do Sul.

(2017), with the addition of more recent revisions on Neotropical Helicoidea/Sagdoidea and Orthalicoidea (Sei *et al.* 2017; Calcutt *et al.* 2020; Salvador *et al.* 2023b). Information on the specimen collection dates, coordinates, habitat and additional ecological data are also included in the taxonomic entries below.

Specimens were photographed at the Centro para Documentação da Biodiversidade (CDB), FFCLRP-USP. Specimens larger than 20 mm were photographed with a Sony digital camera and smaller specimens were photographed with a Leica M205C stereomicroscope equipped with a digital camera. Measurements were obtained with digital callipers or, for microgastropods, using the Leica Application Suite X 4.12 software.

To improve the information available for future studies, we also provide sequence data of some commonly used genetic markers, including the barcode, for species with ethanol-preserved specimens. Tissue clips were obtained from selected specimens for DNA extraction (QIAGEN DNEasy® Blood & Tissue Kit, standard protocol with repetition of the final step to increase yield). The following markers were targeted for this study: the barcoding fragment of the mitochondrial COI gene (Folmer *et al.* 1994: primers LCO/HCO); the mitochondrial 16S rRNA gene (Simon *et al.* 1994: primers 16SarL/16SbrH); a fragment of the nuclear H3 (histone 3) gene (Uit de Weerd & Gittenberger 2013: primers H3pulF/H3pul3); a fragment of nuclear DNA including the 3′ end of the 5.8S rRNA gene, the ITS2 region, and the 5′ end of the 28S rRNA gene (Wade & Mordan 2000; Wade *et al.* 2006: primers LSU-1/LSU-3 and LSU-2/LSU-5).

The PCR protocols used are as follows: COI and 16S: 96 °C (3 min); 35 cycles of 95 °C (30 s), 48 °C (1 min), 72 °C (2 min); 72 °C (5 min). H3: 95 °C (3 min); 40 cycles of 95 °C (30 s), 57°C (30 s), 72 °C (40 s); 72 °C (5 min). ITS2+28S: 95 °C (3 min); 40 cycles of 95 °C (30 s), either 50 °C (ITS2 section) or 45 °C (28S section) (1 min), 72 °C (5 min for ITS2 section or 2 min for 28S section 72 °C (4 min). The success of the PCR procedure was assessed visually via agarose gel electrophoresis. PCR products were cleaned with ExoSAP-IT™ (Affymetrix Inc.) and samples were sent to Macrogen Europe (Amsterdam, The Netherlands) for Sanger sequencing. The resulting sequences were quality-checked and assembled in Geneious Prime (v. 2023.2.1, Biomatters Ltd). The consensus sequence of each marker was extracted and uploaded to GenBank (accession numbers of the genetic sequences are noted below, under each species' entry).

The following abbreviations are used throughout the text:

Collections: CMRP, Coleção Malacológica de Ribeirão Preto, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo (Ribeirão Preto, SP, Brazil); MCZ, Museum of Comparative Zoology (Cambridge, MA, USA); NMW, National Museum Cardiff (Cardiff, Wales, United Kingdom); ZSM, Zoologische Staatssammlung München (Munich, Germany).

Locations: DF, Distrito Federal; GO, Goiás; MS, Mato Grosso do Sul; MT, Mato Grosso.

Shell measurements: H, shell height (parallel to the columellar axis); h, aperture height (parallel to the columellar axis); D, greatest "diameter"/width of shell (perpendicular to H); d, aperture width (perpendicular to h).

Specimens: sh, shell(s); spm, whole animal(s).

Systematics

Caenogastropoda

Superfamily Cyclophoroidea

Family Megalomastomidae

Genus *Aperostoma* Troschel, 1847

Aperostoma redfieldi Bartsch & J. P. E. Morrison, 1942

Figure 2A

Aperostoma (*Aperostoma*) *redfieldi* Bartsch & Morrison 1942: 261 (pl. 38 figs 10–12).

Neocyclotus redfieldi—Salgado & Coelho 2003: 152.

Aperostoma redfieldi—Simone 2006: 44 (fig. 48); Salvador *et al.* 2024: 150.

Type locality. Brazil.

Previously known records. Known generically from "Brazil", with no specific locality.

New records. Goiás state, São Domingos municipality; Distrito Federal, Brasília.

Habitat. In a section of deciduous dry forest growing in rocky soil surrounding calcareous outcrops. Living snails were found amidst dry leaves in the leaf litter near the rock face.

Material examined. BRAZIL: Goiás: São Domingos, between caves Terra Ronca 1 and Terra Ronca 2, 13°44′16.9″S 046°22′30.7″W, iv/2022, CMRP 1014, 4 sh; Distrito Federal: Brasília, 15°30′41.5″S 047°57′34.0″W, A. de Luca coll., 30/ix/2017, CMRP 870, 10 spm.

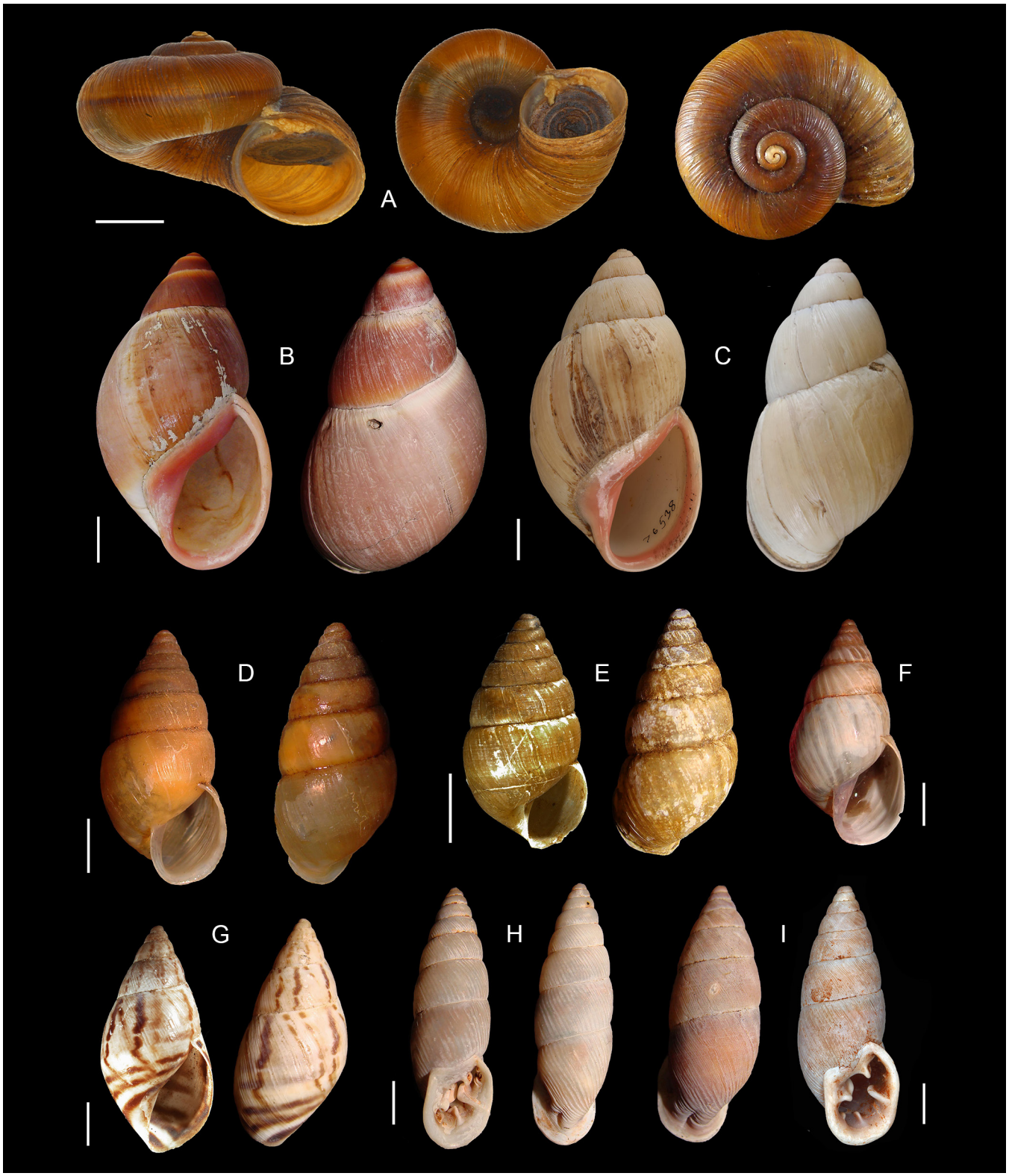

Figure 2. Shells. **A**, *Aperostoma redfieldi* Bartsch & J. P. E. Morrison, 1942, CMRP 870. Scale bars = 10 mm. **B**, *Megalobulimus* aff. *elongatus* (Bequaert, 1948), CMRP 1000A. **C**, *Megalobulimus elongatus* (Bequaert, 1948), MCZ holotype 76538. **D**, *Alterorhinus constrictus* (L. Pfeiffer, 1841), CMRP 885. **E**, *Alterorhinus constrictus* (L. Pfeiffer, 1841), CMRP 937. **F**, *Bulimulus corumbaensis* Pilsbry, 1897, CMRP 1208. **G**, *Drymaeus poecilus* (d'Orbigny, 1835), CMRP 1013. **H**, *Cyclodontina gemellata* (Ancey in Pilsbry, 1901), CMRP 1009. **I**, *Cyclodontina sectilabris* (L. Pfeiffer, 1850), CMRP 1010. Scale bars: A–C, 10 mm; D–H, 5 mm.

Remarks. The present specimens can be identified by their relatively more prominent spire (compared to congeners), the more rounded (i.e., less elongated) aperture, and the dark brown spiral band running on the median portion of the whorl with a light whitish band running immediately above it. The operculum can also be observed in the present material, consisting of a round structure with marked concentric circles, as usual in the genus.

Considering that the previously known distribution for *A. redfieldi* was vague, the present records allow us to pinpoint a more specific distribution for this species in the Brazilian Midwest, encompassing Goiás state and the Distrito Federal.

Eupulmonata

Order Stylommatophora

Superfamily Rhytidoidea *sensu lato*

Family Strophocheilidae

Genus *Megalobulimus* K. Miller, 1878

***Megalobulimus* aff. *elongatus* (Bequaert, 1948)**
Figure 2B, C

New record. Goiás state, São Domingos municipality.

Material examined. BRAZIL: Goiás: São Domingos, Sítio Daniel, 13°41′21.5″S 046°21′42.0″W, iv/2022, CMRP 1000, 5 sh; between caves Terra Ronca 1 and Terra Ronca 2, 13°44′16.9″S 046°22′30.7″W, iv/2022, CMRP 1011, 1 sh.

Remarks. The present specimens were identified as *Megalobulimus* aff. *elongatus*, since their size and protoconch are congruent with the holotype of *M. elongatus*, MCZ 76538 (Fig. 2C) (type locality Nueva Palmira, Uruguay). However, the penultimate whorl of the examined specimen differs from the holotype in being less convex and having a prominent lighter-coloured subsutural band. Furthermore, the distribution of *M. elongatus* is currently restricted to southern Brazil, Paraguay, and Uruguay (Bequaert 1948; Simone 2006; Teles *et al.* 2022), which may indicate that the specimens examined here belong to a possible new species. Other conclusions, however, depend on acquiring new data (i.e., anatomical and/or genetic).

Superfamily Orthalicoidea

Family Bothriembryontidae

Genus *Alterorhinus* Salvador, Silva & Cavallari, 2023

***Alterorhinus constrictus* (L. Pfeiffer, 1841)**
Figure 2D

Synonymy see Breure (1974a). Complement:

Bulimulus (*Rhinus*) *constrictus*—Breure 1974a: 49 (pl. 5 figs 8, 9, pl. 6 fig. 1, pl. 7 fig. 6).

Rhinus constrictus—Breure 1978: 232; Breure 1979: pl. 3 fig.4; Simone 2006: 121 (fig. 403); Köhler 2007: 154 (fig. 142); Breure & Ablett 2015: 33 (fig. 23iii, iv); Bello-Pulido & Agudo-Padrón 2019: 33 (table 1); Agudo-Padrón 2021: 307; Agudo-Padrón 2023: 2389.

Alterorhinus constrictus—Salvador *et al.* 2023: 15; Salvador *et al.* 2024: 156.

Type locality. Venezuela, Angostura (presently Ciudad Bolívar).

Previously known records. Colombia, Venezuela, and the Brazilian states of Roraima, Rio Grande do Norte, Paraíba, Pernambuco (Fernando de Noronha Archipelago), and Bahia (Pilsbry 1897; Breure 1974a, 1978; Simone 2006). Pilsbry (1897) noted that localities in Colombia were based on Cumming's labels and were doubtful. A report from Ceará state, Brazil, was likewise considered uncertain (Martens 1873), although it would not be a contradictory record given the remaining distribution.

New record. Goiás state, Pirenópolis municipality.

Habitat. This species was found in a small section of humid semideciduous forest growing alongside small water courses, in a steep terrain near a rock face with grottos. The surrounding vegetation consisted of rocky savannah dominated by patches of native grasslands and pasture areas. Living snails were found among dry leaves in leaf litter.

Material examined. BRAZIL, Goiás, Pirenópolis, 15°43′48.8″S 48°55′06.1″W, A. de Luca coll., 16/xii/2017, CMRP 885, 7 spm; CMRP 937, 20 sh.

GeneBank accession nrs: H3 (TBD), ITS2+28S (TBD).

Remarks. The present specimens can be assigned to *Alterorhinus constrictus* based on the bulimoid multi-whorled shell with a well-marked suture and reflected peristome (including the columellar region over the umbilicus). The species has two other species and one subspecies presently considered its junior synonyms (Pilsbry 1897; Breure 1974a, 1978): *Bulimus angosturensis* Gruner, 1841 (type locality: Orinoco Department, Venezuela), *Bulimus hyaloideus* L. Pfeiffer, 1855 (type locality: Mendez, Andes of New Granada, presently in Tolima Department, Colombia), *Bulimus constrictus tateanus* Guppy, 1875 (type locality: Venezuelan Guiana).

Despite its extensive range, *A. constrictus* is conchologically conservative, as already remarked by Breure (1974a), with some specimens having shorter and slightly more rotund shells, but within a continuous spectrum of shell shapes and sizes (cf. Pilsbry 1897). The new record from

Goiás state presented here expand this species' distribution to the south, towards central Brazil. Despite the similar conchological features, the latest records represent a considerable discrepancy in geographic distribution and an occurrence in a different biome (i.e., the Cerrado).

Alterorhinus is the sole representative of the family Bothriembryontidae in Brazil, being distributed from Colombia, along Venezuela, Guyana, and the northern and northeastern Brazilian states, down to Bahia (Salvador *et al.* 2023). Thus, the present record also represents a significant increase in geographic distribution in the country.

Family Bulimulidae

Genus *Bulimulus* Leach, 1814

***Bulimulus corumbaensis* Pilsbry, 1897**

Figure 2E

Synonymy see Salvador *et al.* (2018). Complement:

Bulimulus corumbaensis—Oliveira *et al.* 1981: 345; Salvador *et al.* 2018: 74 (figs 18–23); Salvador *et al.* 2021: 72; Salvador *et al.* 2023a: 61; Salvador *et al.* 2024: 157.

Type locality. Corumbá, MS, Brazil.

Previously known records. Mato Grosso and Mato Grosso do Sul states, Brazil; Paraguay; Santa Cruz province, Bolivia (Simone 2006; Salvador *et al.* 2018, 2021).

New record. Mato Grosso do Sul state, Campo Grande municipality.

Habitat. This species was found in an urban area, living in walls near a parking lot.

Material examined. BRAZIL: Mato Grosso do Sul: Campo Grande, 20°29′44.8″S 054°35′07.2″W, 30/xii/2022, CMRP 1039, 1 spm; 21/xii/2023, CMRP 1208, 3 spm.

GeneBank accession nrs: COI (PP916640), H3 (TBD), ITS2+28S (TBD).

Remarks. This species is identifiable by its tall, narrow (often trapezoid) aperture and colour pattern, which typically consists of a light background with fine, brown axial stripes (Salvador *et al.* 2018). The parietal wall of the current specimens is particularly developed, which is akin to the syntypes illustrated by Simone (2006).

Genus *Drymaeus* Albers, 1850

***Drymaeus poecilus* (d'Orbigny, 1835)**

Figure 2F

Synonymy see Salvador *et al.* (2018). Complement:

Drymaeus (*Leiostracus*) *poecilus*—Oliveira *et al.* 1981: 347.

Drymaeus poecilus—Salvador *et al.* 2018: 76 (figs 24–42); Salvador 2019a: 86; Silva *et al.* 2019: 182 (fig. 3K, L); Breure 2020: 79 (fig. 53); Martín *et al.* 2021: 5 (fig. 3E); Rosa *et al.* 2022: 6 (table 1); Miranda *et al.* 2022: 915 (table 1); Salvador *et al.* 2023a: 61; Salvador *et al.* 2024: 158.

Drymaeus (*Mesembrinus*) *lynchi*: Macedo *et al.* 2023: 19 (fig. 8C).

Type locality. Chiquitos province, Bolivia.

Previously known records. States of Tocantins, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais and São Paulo, Brazil; Bolivia; Paraguay; Argentina (Cuezzo *et al.* 2013; Birckolz *et al.* 2016; Salvador *et al.* 2018; Rosa *et al.* 2022).

New record. Goiás, São Domingos municipality.

Material examined. BRAZIL: Goiás: São Domingos, Sítio Daniel, 13°41′21.5″S 046°21′42.0″W, iv/2022, CMRP 1013, 1 sh.

Remarks. This is a widespread species with ample conchological variation; see Salvador *et al.* (2018) for an overview of shell morphology and colouration patterns. The present specimen (CMRP 1013) fits the variation originally described as *Drymaeus lynchi* Parodiz, 1946, from Bolivia. This variation is recognizable by its distinct colour pattern, with spiral bands on the abapical area of the whorls and the adapical dark axial markings, which are also present in our specimen. Salvador *et al.* (2018) interpreted the characteristic colour pattern of *D. lynchi* as part of the variation continuum of *D. poecilus*, designating the former as a junior synonym of the latter.

This designation was later contested by Macedo *et al.* (2023), who claimed that additional anatomical data were needed to support the synonymy, but they did not provide any further evidence either way. While we agree that additional studies, including genetic data, are essential to provide a stronger basis for the taxonomy of *Drymaeus sensu lato* (see e.g., Breure *et al.* 2024), we find the arguments of Salvador *et al.* (2018) sufficient for the interpretation of *D. lynchi* as a junior synonym of *D. poecilus*. As argued by those authors, extreme forms (like the present specimens) can be readily assigned to *D. lynchi*, but intermediate forms cannot. Even the original description of *D. lynchi* by Parodiz (1946) recognized that it could simply represent a colour morph of *D. poecilus*. Thus, considering the evidence presently available, the more likely scenario is that *D. lynchi* represents a subspecies or population of *D. poecilus*, although genetic data is necessary to fully ascertain that.

Drymaeus poecilus was already reported in São Domingos based on photographic records published on the iNaturalist platform, as reported by Rosa *et al.* (2022). Nonetheless, the present record represents the first voucher specimen from

this locality, supporting the occurrence of this species in São Domingos.

Family Cyclodontinidae

Genus *Cyclodontina* H. Beck, 1837

Cyclodontina gemellata (Ancey *in* Pilsbry, 1901)

Figure 2G

Odontostomus gemellatus Ancey *in* Pilsbry 1901: 170; Ancey 1904: 104; Breure 1974b: 116; Salgado & Coelho 2003: 167; Wood & Gallichan 2008: 47 (pl. 10 figs 5, v).

Odontostomus (*Cyclodontina*) *gemellatus*—Lange de Morretes 1949: 156.

Cyclodontina gemellata—Simone 2006: 166 (fig. 573); Salvador *et al.* 2024: 159.

Cyclodontina cf. *gemellata*—Salvador *et al.* 2015: 70 (fig. 13).

Type locality. Goiás state ("Goyaz"), Brazil (the old Goyaz state was split into Goiás and Tocantins states in 1988.)

Previously known records. States of Tocantins and Goiás, Brazil (Simone 2006; Salvador *et al.* 2015).

New record. Goiás state, São Domingos municipality.

Material examined. BRAZIL: Goiás: São Domingos, between caves Terra Ronca 1 and Terra Ronca 2, 13°44′16.9″S 046°22′30.7″W, iv/2022, CMRP 1009, 1 sh.

Remarks. The narrow shell, marked teleoconch sculpture (axial ribs), more centrally positioned aperture, and the number, position and strength of the apertural barriers, together allow the identification of the present material as *C. gemellata*. The shell of the present specimen is slightly narrower than the syntypes (NMW.1955.158.12858); likewise, the ribs of the teleoconch sculpture are finer and more closely spaced. These features closely resemble the specimens reported by Salvador *et al.* (2015) as *Cyclodontina* cf. *gemellata*. We consider that this discrepancy in shell features represents intraspecific morphological variation. The present record is within the currently known distribution of *C. gemellata* in Goiás state.

Cyclodontina sectilabris (L. Pfeiffer, 1850)

Figure 2H

Synonymy see Salvador *et al.* (2015). Complement:

Cyclodontina sectilabris—Salvador *et al.* 2015: 71 (fig. 14); Birckolz *et al.* 2016: 149; Salvador *et al.* 2024: 159.

Type locality. Bahia state, Brazil.

Previously known records. States of Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Bahia, and Tocantins, Brazil (Salvador *et al.* 2015).

New record. Goiás state, São Domingos municipality.

Material examined. BRAZIL: Goiás: São Domingos, Sítio Daniel, 13°41′21.5″S 046°21′42.0″W, iv/2022, CMRP 1010, 9 sh.

Remarks. The acuminated spire and the number and position of the apertural barriers are consistent with what has been called *Cyclodontina sectilabris* in the literature. It has been noted that *C. sectilabris* and *C. inflata* (Wagner, 1827), of which it is sometimes considered a synonym, could be a species complex (Pilsbry 1901; Solem 1956; Salvador *et al.* 2015). This is the first record of *C. sectilabris* from Goiás state, although from an area very close to the border with Bahia and Tocantins, where the species was previously recorded (Salvador *et al.* 2015).

Family Tomogeridae

Genus *Anostoma* Fischer von Waldheim, 1807

Anostoma rossi Weber, 1925

Figure 3A–C

Anostoma lützelburgi Weber 1925: 274 (pl. 5 fig. 5). **New synonym**.

Anostoma rossi Weber 1925: 276 (pl. 5 fig. 6)—Breure 1974b: 123; Breure & Schouten 1985: 25 (fig. 15; pl. 4 fig. 2); Verdcourt 1992: 184; Salgado & Coelho 2003: 169; Simone 2006: 175 (fig. 621); Salvador *et al.* 2015: 70 (figs. 10–12); Birckolz *et al.* 2016: 149; Salvador *et al.* 2024: 161.

Anostoma (*Anostoma*) *luetzelburgi*—Lange de Morretes 1949: 159.

Anostoma (*Anostoma*) *rossi*—Lange de Morretes 1949: 159.

Anostoma luetzelburgi—Breure 1974b: 117; Breure & Schouten 1985: 24 (text fig. 14, pl. 4 fig. 1); Verdcourt 1992: 184; Salvador *et al.* 2024: 161.

Ringincella luetzelburgi—Salgado & Coelho 2003: 169; Simone 2006: 175 (fig. 623).

Type locality. Inside a calcareous grotto (70 m deep) in São Desidério municipality, Bahia state, Brazil.

Previously known records. Bahia, Goiás, and Tocantins states, Brazil (Salvador *et al.* 2015).

New record. Goiás state, São Domingos municipality.

Habitat. This species was found near caves surrounded by semideciduous forests. Living snails were found among leaf litter and on boulders and rock outcrops.

Material examined. BRAZIL: Goiás: São Domingos, between caves Terra Ronca 1 and Terra Ronca 2, 13°44′16.9″S 046°22′30.7″W, iv/2022, CMRP 1006, 7 sh; Sítio Daniel, 13°41′21.5″S 046°21′42.0″W, iv/2022, CMRP 1007, 1 sh.

Remarks. There are two species of *Anostoma* described from this region, *A. rossi* and *A. luetzelburgi*, both named by Weber (1925). *Anostoma rossi* was originally described

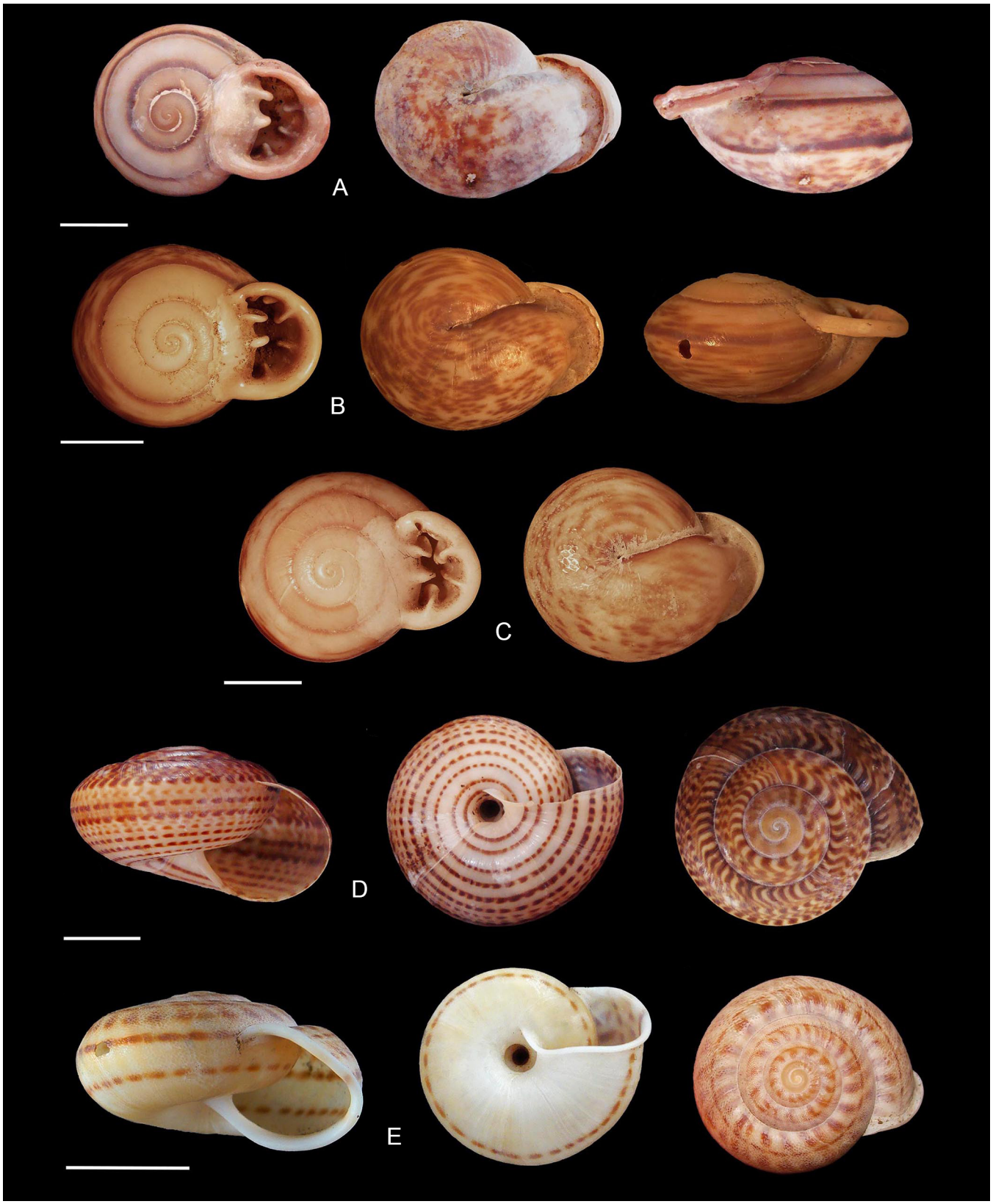

Figure 3. Shells. **A**, *Anostoma rossi* Weber, 1925 CMRP 1006. **B**, *A. rossi* lectotype ZSM 20020169. **C**, *Anostoma luetzelburgi* Weber, 1925 paralectotype ZSM 20020163. **D**, *Solaropsis fairchildi* Bequaert & Clench, 1938, CMRP 1003. **E**, *Solaropsis rosarium* (L. Pfeiffer, 1850), CMRP 1008. Scale bars = 10 mm.

from a cave in the municipality of São Desidério, Bahia state, while *A. luetzelburgi* was described with a dual type locality, a cave in São Desidério, Bahia, and a cave in Serra Geral ("General Mountains", in English), "Goyaz" state. It should be noted that back then, "Goyaz" state encompassed the territories of present-day Goiás and Tocantins states (Tocantins was split from Goiás in 1988). The locality in Serral Geral mentioned by Weber (1925) could refer to either the present-day south-eastern Tocantins state or north-eastern Goiás state.

We analysed the type specimens of both species: ZSM 20020169 (lectotype of *A. rossi*), ZSM 20020168 (paralectotype? of *A. rossi*), ZSM 20020165 (lectotype of *A. luetzelburgi*), ZSM 20020162 (paralectotype of *A. luetzelburgi*), ZSM 20020163 (paralectotype of *A. luetzelburgi*), ZSM 20020164 (paralectotype? of *A. luetzelburgi*). There are no conchological characters that separate both forms, be it general shell shape, size (both are around 30 mm in width), colour, or aperture dentition. The differences in peristome thickness and size of the apertural barriers mentioned as diagnostic features by Breure & Schouten (1985) are dependent on the age of individuals, since the peristome and dentition enlarge and thicken with age. Therefore, we consider these two purported forms to represent a single species, which is supported by their co-occurrence in the same locality (São Desidério, BA). As First Revisers (ICZN 1999: Article 24.2 of the Code), we consider the name *Anostoma rossi* Weber, 1925 to have precedence. Thus, *Anostoma luetzelburgi* Weber, 1925 is its junior subjective synonym.

The present specimens can be assigned to *A. rossi* based on the more rounded shell profile, with a gentler angulation than its congeners; the uniformly coloured spire, along with the brushstroke-like brown markings over the whole body whorl; and the number, size and position of the main apertural teeth. Some of the present specimens were collected outside caves (CMRP 1007), while others (CMRP 1006) were found near caves. Live specimens were observed and photographed at both localities but not collected. The soft body of the specimens is light-yellow and with a somewhat rugose appearance.

Superfamily Sagdoidea

Family Solaropsidae

Genus *Solaropsis* H. Beck, 1837

Solaropsis fairchildi Bequaert & Clench, 1938

Figures 3D, 4

Synonymy see Salvador *et al.* (2015). Complement:

Solaropsis fairchildi—Salvador *et al.* 2015: 68 (figs 4–6); Birckolz *et al.* 2016: 149; Salvador 2019: 95; Salvador *et al.* 2024: 162.

Type locality. Anápolis, Goiás state, Brazil.

Previously known records. States of Goiás, Minas Gerais and southeastern Tocantins, Brazil (Salvador *et al.* 2015; Salvador 2019a).

New records. Goiás state, municipalities of Cavalcante, Goiânia, and São Domingos.

Habitat. This species was found in a fragment of semideciduous forest in an area under strong anthropogenic influence. Living snails and dry shells were found among leaf litter alongside dead tree trunks.

Material examined. BRAZIL: Goiás: São Domingos, Sítio Daniel, 13°41′21.5″S 046°21′42.0″W, iv/2022, CMRP 1005, 3 sh; between caves Terra Ronca 1 and Terra Ronca 2, 13°44′16.9″S 046°22′30.7″W, iv/2022, CMRP 1004, 1 sh; Cavalcante, 13°50′43.7″S 047°27′00.1″W, iv/2022, CMRP 1003, 1 sh; Goiânia, 16°35′04.8″S 049°17′18.7″W, A. de Luca coll., 8/i/2018, CMRP 871, 3 spm, 1 egg; CMRP 943, 3 sh.

GeneBank accession nrs. 16S (TBD), ITS2+28S (TBD).

Remarks. The specimens can be identified by their size, the very slight peripheral angulation of the whorls, and the colour pattern (remarkably similar to the holotype of *S. fairchildi*: MCZ 65208). All records fall within the previously known distribution for this species; Goiânia is relatively close to its type locality in Anápolis (~60 km), while São Domingos and Cavalcante are both relatively close to southern Tocantins, from where the species was previously reported (Salvador *et al.* 2015).

Figure 4. Live specimen of *Solaropsis fairchildi* Bequaert & Clench, 1938 *in situ* (Pirenópolis, Goiás state, Brazil).

***Solaropsis rosarium* (L. Pfeiffer, 1850)**

Figure 3E

Synonymy see Salvador *et al.* (2015). Complement:
Solaropsis rosarium—Salvador *et al.* 2015: 68 (figs 7–9); Salvador *et al.* 2024: 163.
Solaropsis rosaria—Calcutt *et al.* 2020: 188 (fig. 3B).

Type locality. Banks of the Amazon River (Pfeiffer 1853; Pilsbry 1933).

Previously known records. Suriname and the Brazilian states of Amazonas, Pará, Goiás, Mato Grosso do Sul, and Tocantins (Salvador 2015).

New record. Goiás state, São Domingos municipality.

Material examined. BRAZIL: Goiás: São Domingos, between caves Terra Ronca 1 and Terra Ronca 2, 13°44′16.9″S 046°22′30.7″W, iv/2022, CMRP 1008, 4 sh.

Remarks. The specimens can be identified by a flattened spire, strongly convex whorls, deep suture, granulated microsculpture, and colour pattern. The colour pattern of *S. rosarium* is reported to be consistent across specimens, with a constant number of spiral dotted lines showing only a slight variation in width (Salvador 2015). The specimens of this study match this reported colour pattern. The present record slightly extends the species distribution to the municipality of São Domingos, Goiás, which is close to the southern border of Tocantins, from where the species had been previously reported (Salvador 2015).

Discussion

Here we present a taxonomic study on land snail specimens from the Brazilian Midwest based on the material available in the CMRP collection. Ten species from seven families were identified, including important new geographical records for four species (*Aperostoma redfieldi*, *Alterorhinus constrictus*, *Cyclodontina sectilabris*, *Solaropsis rosarium*) and one family (Bothriembryontidae). The material also prompted the taxonomic revision of *Anostoma luetzelburgi*, which we consider a junior synonym of *Anostoma rossi*.

Improving our understanding of the distribution of land snail species in Brazil is an essential step for their conservation (Miyahira *et al.* 2022). Understanding the distributional patterns of land-snail species allows us to detect their decline and assess their conservation status, but the absence of temporal data precludes their evaluation according to Red List criteria (IUCN 2012; Miyahira *et al.* 2022). Surveys such as the one presented in this study are a fundamental step for providing distributional data, especially when containing dated and georeferenced data and in-depth taxonomic reviews (Miyahira *et al.* 2022). Sadly, this type of study seems to receive limited attention and is increasingly side-lined, despite the importance of such data (Miyahira *et al.* 2022).

Additional records are necessary for a more complete understanding of the distribution of the species presented in this study, as well as other species from the Brazilian Midwest. Very little is known about the terrestrial gastropod fauna in the region, particularly when compared to other regions in the country, and its biodiversity is likely grossly underestimated (Salvador 2019b). Thus, further observations and collection efforts in the Brazilian Midwest are extremely important, especially in light of the recent string of environmental disasters impacting the region (e.g., Gallão & Bichuette 2018; Nature Editorials 2018; Alho *et al.* 2019; Marengo *et al.* 2021; Berlinck *et al.* 2022; Leal *et al.* 2023; Parras *et al.* 2024).

Regardless of being relatively small and lesser-known in comparison to other malacological collections in Brazil and São Paulo state (see Percequillo *et al.* 2022), the CMRP provided invaluable material for our study, as well as other similar studies in the past (e.g., Troncon & Avelar 2011; Salvador *et al.* 2020). These examples demonstrate the relevance of smaller institutional collections in improving our understanding of biodiversity. Lastly, it serves as further testimony to the increasing urgency for funding and maintaining natural history collections in the face of the ongoing biodiversity crisis.

Funding

RBS was supported by an Early Career Research Grant from the Malacological Society of London (UK) to analyse type specimens in European collections. RMR was supported by a Programa Unificado de Bolsas de Estudos para Apoio à Formação de Estudantes (PUB-USP) grant (2023-2024). FBR was supported by Programa de Apoio aos Novos Docentes USP—2022/2023 (process no. 2022.1.1254.59.0).

Acknowledgements

We are grateful to all those who have collected and deposited specimens over the years in the CMRP. We are also grateful for the support from the Centro para Documentação da Biodiversidade (FFCLRP-USP, Brazil) and the Department of Arctic and Marine Biology (UiT, Norway). We thank Jennifer Trimble and Melissa Merkel (MCZ, Harvard) for providing images of the type specimen of *Megalobulimus elongatus*.

Author Contributions

Conceptualization, D.C.C., R.M.R., R.B.S.; methodology, investigation, data curation, D.C.C., R.M.R., A.C.D.L., F.S.S., F.B.R., R.B.S.; writing—original draft preparation, D.C.C., R.M.R., R.B.S.; writing—review and editing, D.C.C., R.M.R., A.C.D.L., F.S.S., F.B.R., R.B.S.; funding acquisition, F.B.R., R.B.S. All authors have read and agreed to the published version of the manuscript.

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Manuscript received: 2 September 2024
Revised manuscript accepted: 16 November 2024
Editor: Robert Forsyth