

RESEARCH ARTICLE

A new species of *Megaspira* (Stylommatophora: Megaspiridae) from Ilha Grande, Southeast Brazil

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ABSTRACT. Megaspiridae include land snails with a tall spire. They occur in Brazil, New Guinea and Australia. *Megaspira* Lea, 1839 is distributed through the central and southeast regions of Brazil. There is controversy regarding the number of species in the genus, and their taxonomic status. The characters used to identify *Megaspira* include a large cylindrical shell and internal armature in the columella. The goal of the present study is to describe a new species for the genus, based on shell morphology, microsculpture and the inner anatomy. These anatomic characters had not been described before for any of the included species. The material was collected at the Jararaca trail, Ilha Grande (Angra dos Reis, state of Rio de Janeiro). Seven linear measurements were taken from the shells. *Megaspira adenticulata* sp. nov. differs from the other species of the genus by not having apertural lamella in the shell aperture or in the columella in adult specimens. Also, the shell does not have light brown spots, as observed in other species of *Megaspira*. The shell has a mean of 16 whorls and height of 27 mm. It is smaller in average size than the shell of other described species. The new species was found under leaf litter, especially near rocks and in shallow soil.

KEY WORDS. Gastropoda, Jararaca trail, land snail, taxonomy.

INTRODUCTION

Megaspiridae Pilsbry, 1904 is a family of land snails characterized by a tall spire. The family includes four recent genera, which occur in Brazil, New Guinea and Australia (Pilsbry 1904): *Callionepion* Pilsbry & Vannatta, 1899 in southeast Brazil (Simone 2006, Salvador 2019), *Megaspira* Lea, 1839 in the central and southeastern Brazil (Pilsbry 1904), *Perrieria* Tapparone-Canefri, 1878 in western New Guinea and *Coelocion* Pilsbry, 1903 along the east coast of Queensland, Australia. Besides the genera mentioned above, Pilsbry included, in Megaspiridae, the fossil *Eomegaspira* Pilsbry, 1903. The fossil has been recorded from the Eocene in Europe (France and England).

The taxonomy of Megaspiridae has changed over time, and the relationships among the included genera and the phylogenetic relationships between Megaspiridae and the other families of Gastropoda have remained unclear. Pilsbry (1904) proposed the following diagnostic characters for the family: "...an elongated, acute spire, and cylindrical shell, with of a

high number of whorls. Aperture of the shell, with a thin outer margin of the peristome, with or without columellar lamellae in the aperture...".

Although no consensus has been reached about the supra-familiar classification of Megaspiridae, two main classifications have been generally accepted. The first, proposed by Thiele (1931), includes Megaspiridae (with *Callionepion*, *Perrieria* and *Coelocion*) within the "lineage" Achatinacea (= Achatinoidea), since it takes the radular characters and the conchilio-morphometric description into account. The second, based on distribution data and shell characters, was advanced by Nordsieck (1986), who proposed that Megaspiridae is a member of the Orthalicoidea. According to Nordsieck, the presence of inner lamellae, an elongated conical shell, and a thick fold at the base of the columellar side of the aperture are plesiomorphic characters that are also present in some genera of Orthalicoidea and also in *Megaspira*. Thiele's proposal was adopted by some (Salgado and Coelho 2003), while others (Bouchet et al. 2005, 2017, Breure et al. 2010) opted for Nordsieck's classification. Bouchet

et al. (2005) considered Megaspiridae as part of Orthalicoidea, following Nordsieck (1986). Both authors, however, questioned their own classification. Using molecular markers (ITS2 and 28S), Breure et al. (2010), found compelling evidence that Megaspiridae is a member of Orthalicoidea, with *Coelocion* grouped with *Megalobulimus* Miller, 1878 in a clade with low support. Subsequently, Breure and Romero (2012) reinforced the inclusion of Megaspiridae in the Orthalicoidea, considering the analyses of the species *Megaspira elatior* (Spix, 1820) as representative of *Megaspira*. In their results, *M. elatior* grouped with *Thaumastus largillierti* Philippi, 1845 and *T. achilles* Pfeiffer, 1852. They proposed that *Thaumastus* and *Megaspira* are sister-groups within the Bulimulidae. At present, some authors (Salgado and Coelho 2003, Simone 2006) consider only *Megaspira* and *Callionepion* as members of the Megaspiridae. A recent proposal (Breure and Romero 2012), based on molecular data, included other genera, such as *Thaumastus* Albers, 1860, in Megaspiridae. According to Bouchet et al. 2017, *Perrieria* and *Coelocion* are part of another family (Coelociontidae Iredale, 1937) and not Megaspiridae.

Megaspira Lea, 1839 is an interesting genus that includes terrestrial gastropods with elongated and cylindrical shell, large and plicate columella with internal armature (Lea 1839, Pilsbry and Vanatta 1899). According to Lea (1839) the shells of the adult of most species have an inner sculpture, which is usually confined to the last whorls, and consists of several lamellae. There is no consensus on the authorship of the genus, number of species in it, and the taxonomic status of the included species. Thiele 1931, Simone 2006, Breure and Ablett 2015, Breure and Araujo 2017 attributed the authorship of the genus to John C. Jay. Most likely, this attribution owes to the fact that, in the Catalogue on Recent Shells published in 1936, Jay mentioned (sic) "*Megaspira ruschenbergiana*, Lea. This is a new and interesting land shell from Brazil, for which Mr. Lea considers it necessary to form a new genus. His description of it will appear in the Transactions of American Philosophical Society of Philadelphia." (Jay 1836). The formal description of *Megaspira* was made by Lea (1839), when the author designated *M. ruschenbergiana* Lea, 1839 as the type species as Jay had previously indicated. The distribution of *Megaspira* is restricted to Brazil, with records mainly from the Atlantic Forest of the southeast region (Pilsbry 1904, Morretes 1949, Simone 2006). According to Pilsbry (1904), the distribution of *Megaspira* is Central-Southern Brazil, and information on the habitats of several species is scarce.

Pilsbry (1904) recognized only two species in *Megaspira* (*M. ruschenbergiana* and *M. elatior*). He established three subspecies (*M. elatior gracilis*, *M. elatior robusta* and *M. elatior elata*). Rehder (1945) increased the number of species to three with the description of *Megaspira pilsbryi* Rehder, 1945. Brazilian authors such as Salgado and Coelho (2003) considered four valid species. They did not mention the status of Pilsbry's subspecies. Simone (2006) considered a total of six species, after raising the two subspecies established by Pilsbry (1904) to species, and synonymizing *Megaspira elatior* with *M. ruschenbergiana*. The author failed to

provide a clear justification for their nomenclatural acts. All species are only known by their shell morphology, with the exception of the radula of *Megaspira elatior robusta* described by Pilsbry (1904).

The goal of the present study is to describe a new species of *Megaspira* based on shell morphology and microsculpture, and to describe the inner anatomy of main anatomy systems.

MATERIAL AND METHODS

The material was collected from the Jararaca trail, Ilha Grande State Park (PEIG), Angra dos Reis, in southwestern Rio de Janeiro state (Fig. 1). This protected area covers 62.5% of the island and is also part of the Tamoios Environmental Protection Area (Bastos et al. 2009).

The specimens were collected in 1995, using the hand collection method, where specimens are captured directly from the substrate. The material was deposited in the Malacological Collection of the Laboratório de Malacologia Límnic e Terrestre, Universidade do Estado do Rio de Janeiro. In 2015, the same methodology was used to collect additional material to obtain live specimens for studies of the inner anatomy. The collecting locality, however, was not in the exact same spot as in 1995.

The shells were measured using calipers (0.01 mm precision) and seven linear measurements were taken: major diameter (D), minor diameter (d), diameter of body whorl (dw), total shell height (h), teleoconch height (th), apertural height (ah) and apertural length (al) (Fig. 2). Due to the size of the shells, a 0.5 × reduction lens was used and the scales of all drawings were standardized. The number of whorls (NW) was obtained following the method of Diver (1931) (Fig. 3). Also, the shells were drawn with the help of a camera lucida (Nikon SMZ 800) in order to take the angular measurements according the methodology explained in Parodiz (1951): spiral angle (SpA), suture angle (SA), columellar angle (CA), growth angle (GA) and maximum angle (MA) (Fig. 4).

Five adult specimens were dissected and used to describe the pallial, digestive (jaw and radula) and reproductive systems. Due to the high number of whorls in the shell and the thick columellar muscle, it was necessary to remove the entire animal by dissolving the shell. To do this, the specimens were transferred from 70° alcohol to Raillet Henry solution (93% distilled water, 2% glacial acetic acid, 5% formaldehyde, and 6 g sodium chloride per liter). Five specimens remained in Raillet Henry solution for 24 hours to allow the shell to decalcify. After that, the soft parts were washed in distilled water to remove any remaining Raillet Henry and returned to 70° alcohol for dissections.

Dissections were carried out under a Leica MZ6 stereoscopic microscope, the pallial and reproductive systems were dissected following the methodology of Cuezco (1997) and anatomical systems were drawn with the help of a camera lucida. The material was compared with type material from the Malacology Collection of the Academy of Natural Sciences of

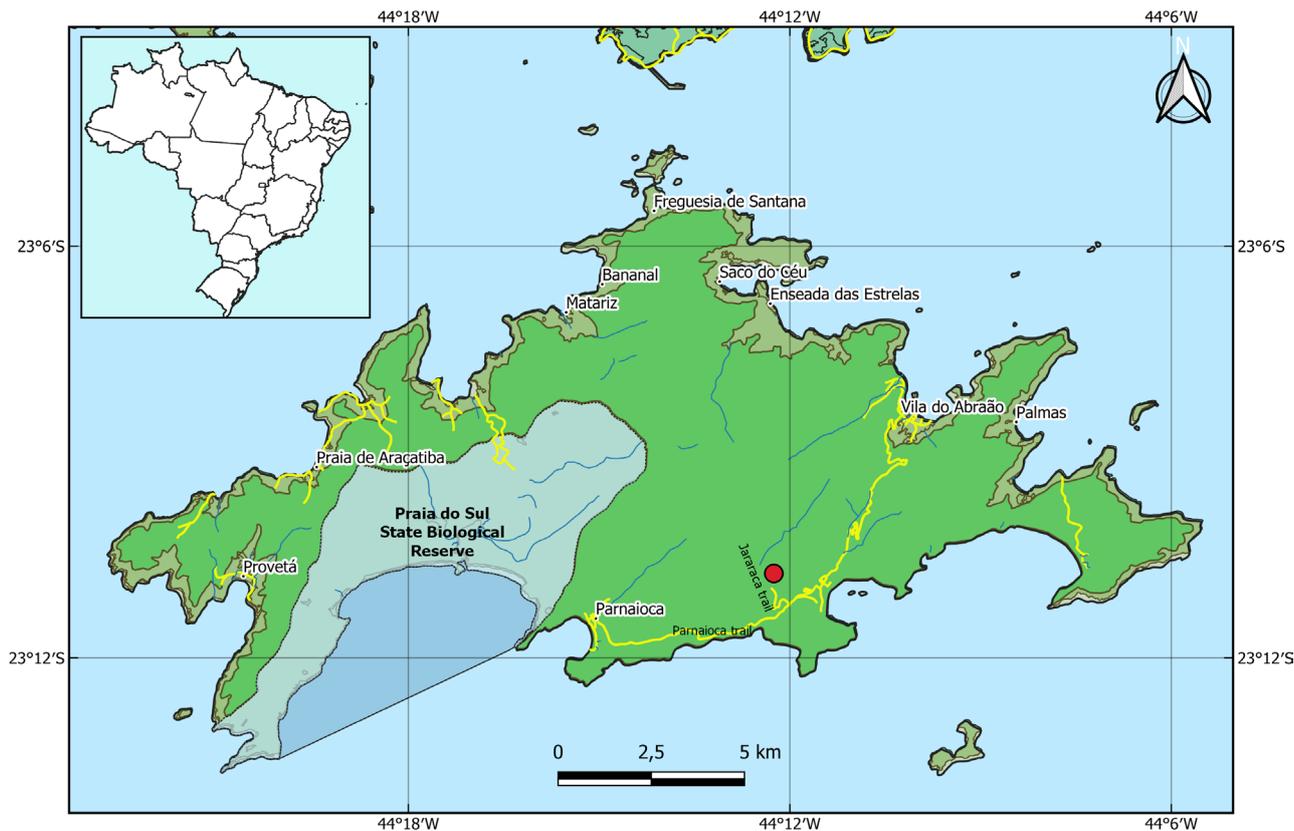


Figure 1. Map of the Ilha Grande showing the site (the Jararaca trail in red circle) where the material of *Megaspira adenticulata* sp. nov. was collected.

Philadelphia (ANSP) (Table 1): *Megaspira elatior gracilis* (lectotype: ANSP 25039), *Megaspira pilsbryi* (lectotype: ANSP 25041) (Figs 5, 6), *Megaspira iheringi* (lectotype: ANSP 100532) (Figs 7–9) and *Megaspira elatior robusta* (lectotype: ANSP 71925 and paralectotype ANSP 25040) (Figs 10–12).

Radulas, jaws (three) and a portion of the columellar axis were cleaned and placed on stubs to be analyzed in JSM-6510LV scanning microscopy following the methodology of Ploeger and Breure (1977) in the Scanning Electronic Microscopy Laboratory in the Department of Chemistry of UERJ (PPGQ).

TAXONOMY

Gastropoda Cuvier, 1795

Eupulmonata Haszprunar & Huber, 1990

Orthalcoidea Martens, 1860 in Albers & Martens, 1860

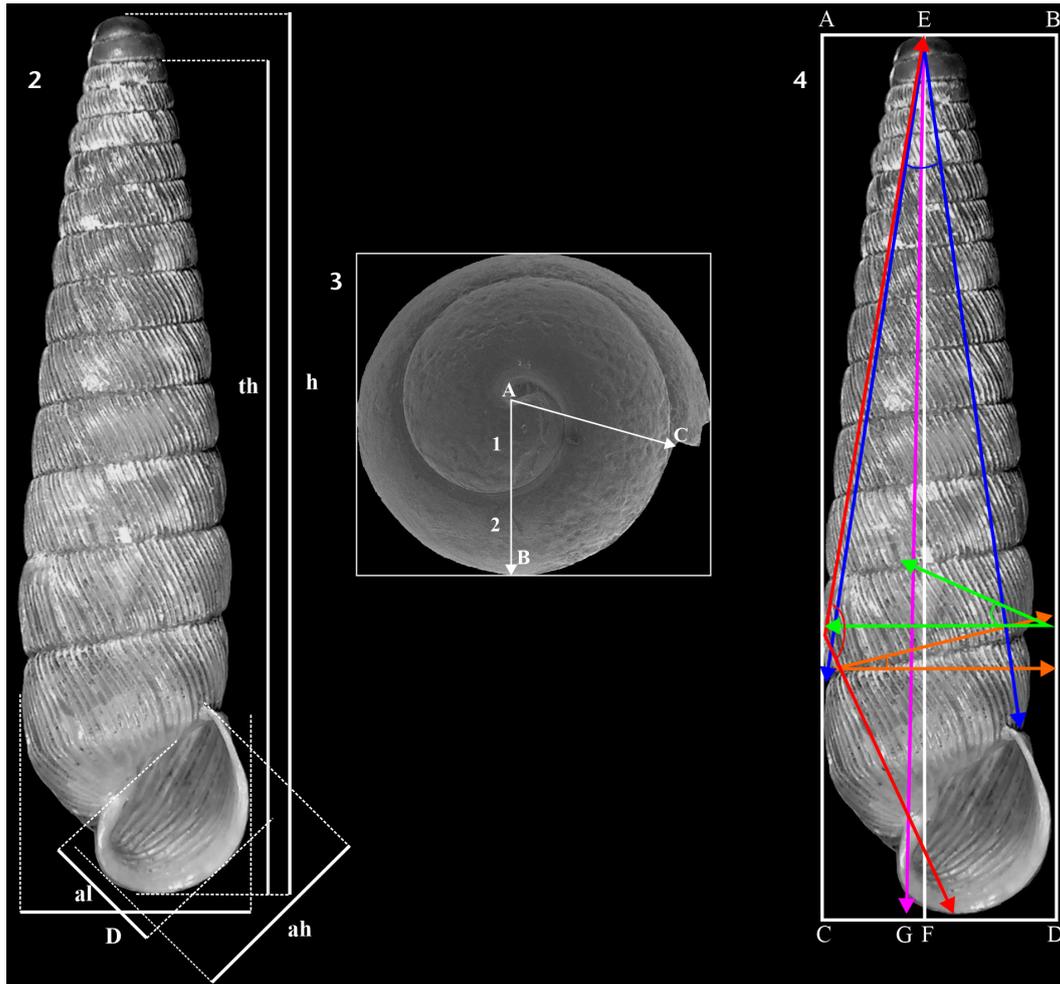
Megaspiridae Pilsbry, 1904

Megaspira I. Lea in Jay, 1836

Type species *Megaspira ruschenbergiana* I. Lea in Jay, 1836 type by monotype.

Table 1. Comparisons among *Megaspira adenticulata* sp. nov. from the Jararaca trail and other species/subspecies of *Megaspira*.

Species	Number of whorls	Shell high (mm)	Apertural lamella	Inner lamellae	Type locality
<i>Megaspira elatior</i> Spix, 1927	23	75	Present	Three ascending three whorls	Minas Gerais
<i>Megaspira elata</i> Gould, 1847	19 to 21	40	Present	Lower radial barrier	Brazil
<i>Megaspira iheringi</i> Pilsbry, 1925	14.5	28	Present	Three small ascending two whorls	Macaé
<i>Megaspira elatior gracilis</i> Pilsbry, 1904	18½ to 19½	36 to 36.5	Present	Same pattern of that of <i>M. elatior robusta</i>	Brazil
<i>Megaspira elatior robusta</i> Pilsbry, 1904	19	38	Present	Three lamellae ascending three whorls	Brazil
<i>Megaspira pilsbryi</i> Rehder, 1945	19	38	Present	No data	Brazil
<i>Megaspira adenticulata</i> sp. nov.	16	27	Absent	Absent	Ilha Grande



Figures 2–4. Shell measurements of *Megaspira adenticulata* sp. nov.: (2) linear measurements taken from specimens; (3) apical view showing the partial angle of the first two whorls that part of the protoconch; (4) angular measurements taken from specimens: maximum angle in red, spiral angle in blue, growth angle in green, columellar angle in pink, suture angle in orange. (h) Height, (sh) spire height, (ah) aperture height, (al) aperture width, (D) major diameter.

Megaspira adenticulata sp. nov.

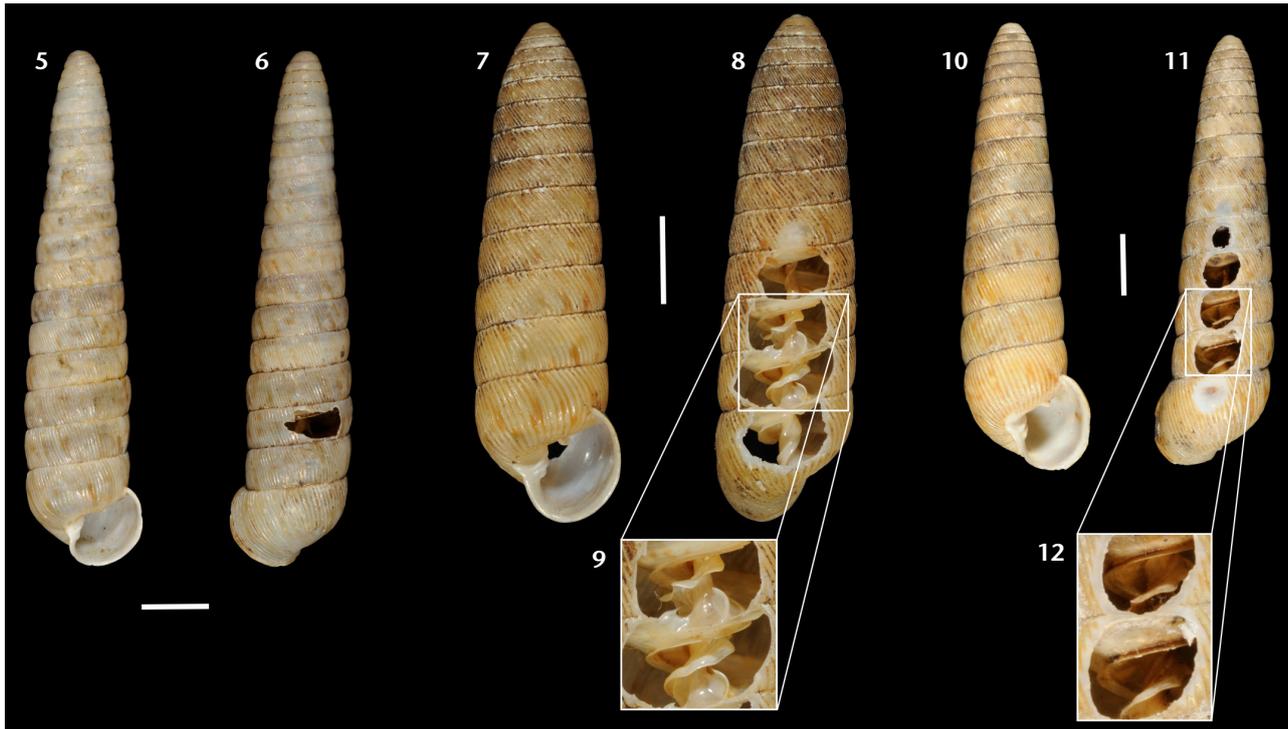
Figs 13–35

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Diagnosis. Shell with 16 whorls and 27 mm in height, on average. Aperture with no lamella folded on inner lip of smooth aperture. Columella sculpture with a rough texture over entire surface.

Description. Cephalo-pedal mass brownish in all its extension, especially close to cephalic portion, and presence of several ridges along body (Figs 13, 14). Thin, cylindrical tentacles, with central axis of dark gray. Foot with gradual tapering in its posterior portion, no external gland in the posterior terminal part of the foot. Sole almost entire, groove not deep in its median portion.

Shell. Oblong (in juvenile specimens) or conical-elongated (in adults) (Figs 15–18), shell height from 18.2 to 32.8 mm with 16 convex whorls on average (Table 2). Spire high with moderate growth, spiral angle with 15.8° on average (Table 2). Aperture oval, with apertural height and length almost similar on average (Table 2; Figs 15, 16), with lower lip slightly enlarged; lamella folded on inner lip of aperture, absence of parietal teeth; peristome with reflected edges, mainly on the columellar lip side (Fig. 16). Umbilicus closed covered by peristome reflection. Protoconch smooth, without sculpture, with 2.5 to 2.75 whorls (Figs 19, 20). Third whorl, with faint incomplete radial lines (Fig. 20). Teleoconch sculpture with numerous oblique ribs, well marked, arranged close to each other (Fig. 21). Columellar axis microsculpture with a rough texture along its entire length surface, without internal columellar lamellae (Figs 22–24).



Figures 5–12. Shell of *Megaspira* species: (5, 6) lectotype of *Megaspira pilsbryi* (ANSP 25041) apertural and dorsal views of the shell; (7–9) lectotype of *Megaspira iheringi* (ANSP 100532) apertural, dorsal views of the shell and detail of inner collumellar lamellae; (10–12) lectotype of *Megaspira elatior robusta* (ANSP 71925) apertural, dorsal views of the shell and detail of inner collumellar lamellae. Scale bars: 5 mm.

Jaw. Shaped like horseshoe, with rectangular curved central plate; lateral plates of smaller size, overlapped each other on both sides of jaw (Fig. 25). Lateral plate surfaces with fine, parallel lines, evident on the outer margin without forming true sculpture (Fig. 25).

Radula formula: 20 + 18 + 1 + 18 + 20 and 18 + 16 + 1 + 16 + 18 (M + L + R + L + M), being: M: Marginal, L: Lateral, and R: Rachidian. Rachidian tooth symmetric, tricuspid with mesocone well developed, triangular blunt end, trapezoidal basal plate; ecto- and endocone smaller than mesocone, without accessory cusps (Figs 26, 27). Lateral teeth, asymmetric, bicuspid, with larger and conical mesocone; ectocone smaller than mesocone, triangular, rounded end; basal plate rectangular (Figs 25, 26). Marginal teeth bicuspid, with oblique insertion, basal plate reduced to small square-shaped plate, mesocone elongated, ectocone triangular, smaller than mesocone (Fig. 28).

Pallial system. Kidney elongated, triangular, thin, about $\frac{1}{4}$ of pallial cavity in length, between pericardial cavity and rectum. Pericardial cavity located on left side of kidney (Figs 29–31); pulmonary vein visible in median and distal region of mantle roof (Figs 30, 31). Slender vessels on both sides of main pulmonary vein (close to distal portion of pallial system).

Reproductive system. Ovotestis with five or six branches of enlarged digitiform acini, each branch with 12 to 15 acini simple or

bifurcated (Fig. 32). Hermaphrodite duct tubular, contorted, with same diameter along its extension (Fig. 33). Albumen gland elon-

Table 2. Minimum, maximum, mean and standard deviation of linear (in mm) and angular (degree) measurements for 30 adult specimens of *Megaspira adenticulata* sp. nov. from the Jararaca trail. (SD) Standard deviation, (D) major diameter, (d) minor diameter, (dw) diameter of body whorl, (h) total shell height, (th) teleoconch height, (ah) apertural height, (al) apertural length, (NW) number of whorls, (SpA) spiral angle, (SA) suture angle, (CA) columellar angle, (GA) growth angle, (MA) maximum angle.

Measurements	Minimum	Maximum	Mean	SD
D	5.88	7.30	6.50	0.44
d	5.00	6.90	5.90	0.40
H	18.20	32.80	27.00	4.00
th	15.10	31.60	22.20	4.20
al	3.00	5.20	4.10	0.45
ah	3.60	6.71	5.00	0.82
NW	13.75	18.30	16.00	1.17
MA	120.00	153.00	140.30	6.81
SA	9.00	20.00	12.63	2.20
GA	24.00	59.00	42.46	9.44
SpA	12.00	22.00	15.78	2.50
CA	0.50	3.00	1.68	0.63



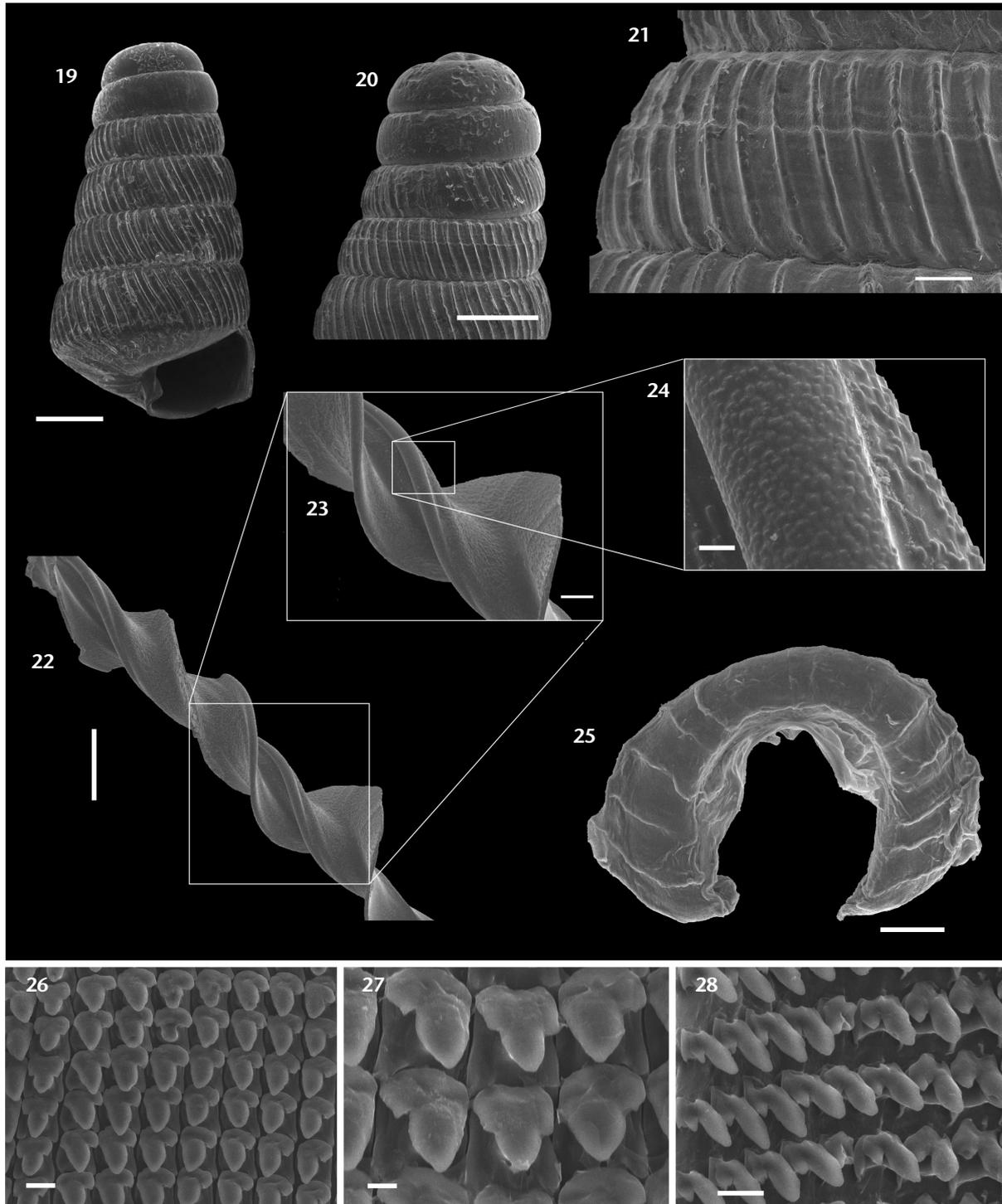
Figures 13–18. Living specimen of *Megaspira adenticulata* sp. nov. and shell morphology in different views: (13, 14) specimen showing the pigmentation of the cephalopedal mass; (15–18) apertural, dorsal and lateral views of the shell. Scale bars: 1 mm. Photos: Regiana Salgado de Mello.

gated, irregularly shaped, translucent, formed by small irregular acini (Figs 32, 34). Oviduct cylindrical, elongated, accompanying shape of spire (Figs 33, 34). Penial complex tubular, long and slender, with three regions differentiated (proximal phallus, median epiphallus and distal flagellum), proportions of those regions 4: 1: 1 length respectively, each delimited by well-defined narrowing (Figs 32, 34, 35). Prostate with numerous digitiform acini over oviduct surface. Genital diverticle in club shaped, between crossing penial complex and female system (Fig. 35). Genital atrium short, cylindrical, with insertion of bursa copulatrix (also called the copulation pouch), six times length of genital flagellum, bursa sac slightly elongated in its terminal portion (Fig. 35).

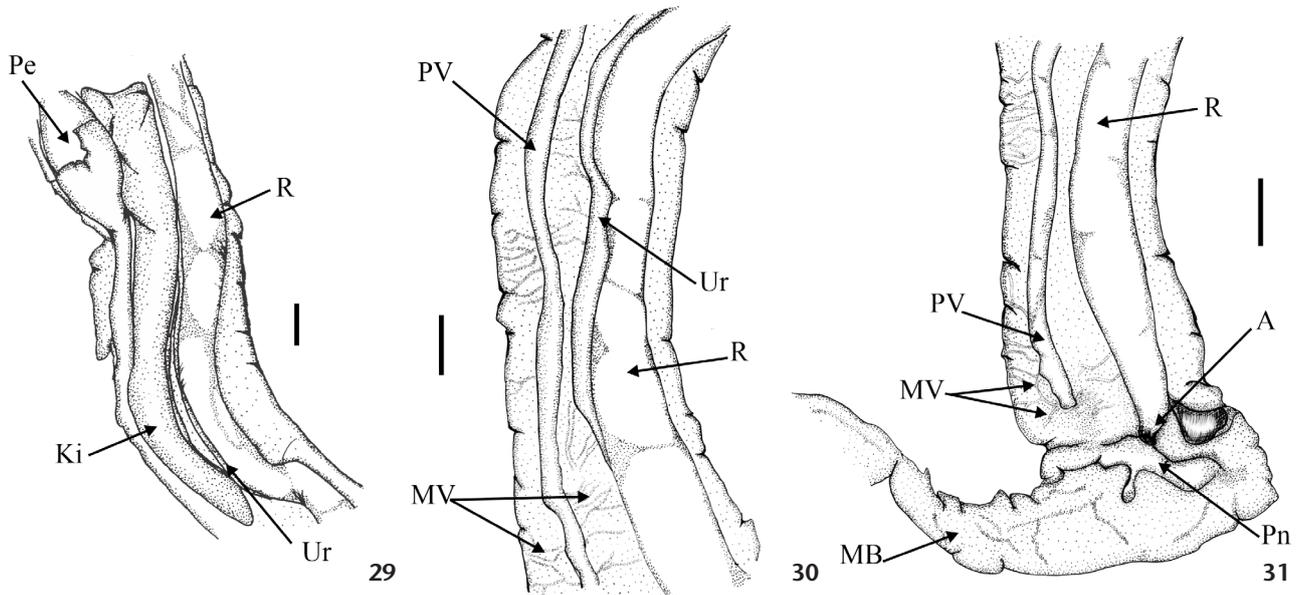
Type locality. Brazil: state of Rio de Janeiro, municipality of Angra dos Reis, Ilha Grande, Jararaca trail, 23.17950° S, 44.20421° W.

Type material. Holotype. Shell and soft parts preserved in alcohol. Original label; Daniel VR, Ovando XMC, Santos SB, Souza ST, Lacerda LEM leg. “Col. Mol. UERJ 11395-A”. Paratypes: Eleven. Collected with Holotype. Col. Mol. UERJ 11395-B; One. Collected with Holotype. MNRJ 23.760.

Additional material examined. BRAZIL, Ilha Grande, 1 shell, Jararaca trail; 23.17950° S, 44.20421° W; 22 Mar. 1997; Santos SB et al. leg.; Col. Mol. UERJ 695 • 1 shell Same locality; 20 Sep. 1995; Queiroz V leg.; Col. Mol. UERJ 697 • 2 shells, Same locality; 15 Aug. 1996; Queiroz V leg.; Col. Mol. UERJ 701 • 1 (1 shell), Same locality; 15 Aug. 1996; Queiroz V leg.; Col. Mol. UERJ 1076 • 4 (2 shells, 2 specimens preserved in ethanol), Same locality; 29 Aug. 2002, Santos SB et al. leg.; Col. Mol. UERJ 1742 • 2 (1 shell, 1 specimen preserved in ethanol), Same locality; 09 Jan. 2002, Santos SB et al. leg.; Col. Mol. UERJ 1749 • 4 shells,



Figures 19–28. *Megaspira adenticulata* sp. nov.: (19–21) shell of young specimen in SEM showing the absence of apertural lamellae and detail of the microsculpture of the teleoconch; (22–24) detail of microsculptura of columella in SEM showing small papillae on the entire surface; (25) jaw; (26–28) detail of radula showing the rachidian, lateral and marginal tooth. Scale bars: 19, 20, 22 = 1 mm; 21, 24 = 200 μm; 24, 26, 28 = 20 μm; 25 = 100 μm; 27 = 10 μm.



Figures 29–31. *Megaspira adenticulata* sp. nov.: detail of proximal, median and distal portions of pallial system. (A) Anus, (MB) Mantle border, (Ki) kidney, (MV) Mantle vessels, (Pe) Pericardium, (PV) Pulmonary vein, (Pn) Pneumostome, (R) Rectum, (Ur) Ureter). Scale bars: 20–24 = 1 mm.

Same locality; 09 Jan. 2002, Santos SB et al. leg.; Col. Mol. UERJ 1771 • 7 shells, Same locality; 13 Apr. 2002; Santos SB et al. leg.; Col. Mol. UERJ 1794 • 6 (3 shells, 3 specimens preserved in ethanol), Same locality; 20 Oct. 2000; Santos SB et al. leg.; Col. Mol. UERJ 2076 • 4 shells, Same locality; 07 Jan. 2001; Santos SB Ribeiro F leg.; Col. Mol. UERJ 2135 • 10 (6 shells, 4 specimens preserved in ethanol), Same locality; 21 Apr. 2001; Santos SB et al. leg.; Col. Mol. UERJ 2167 • 4 shells, Same locality; 27 Oct. 2001, Santos SB et al. leg.; Col. Mol. UERJ 2228 • 2 (1 shell, 1 specimen preserved in ethanol), Same locality; 31 Jul. 2001; Monteiro SP leg; Col. Mol. UERJ 2239 • 2 shells, Same locality; 13 Apr. 2003; Santos SB leg.; Col. Mol. UERJ 2957 • 3 (2 shells, 1 specimen preserved in ethanol) Same locality; 25 Jan. 2005; Miyahira IC leg.; Col. Mol. UERJ 6677 • 13 (5 shells, 8 specimens preserved in ethanol), Same locality; 25 Oct. 2015; Daniel VR, Ovando XMC, Santos SB, Souza ST, Lacerda LE leg.; Col. Mol. UERJ 11395.

Etymology. The epithet “*adenticulata*”, meaning without teeth, refers to the absence of parietal teeth in the shell aperture. The presence of a parietal tooth is considered a diagnostic character for other species of *Megaspira*.

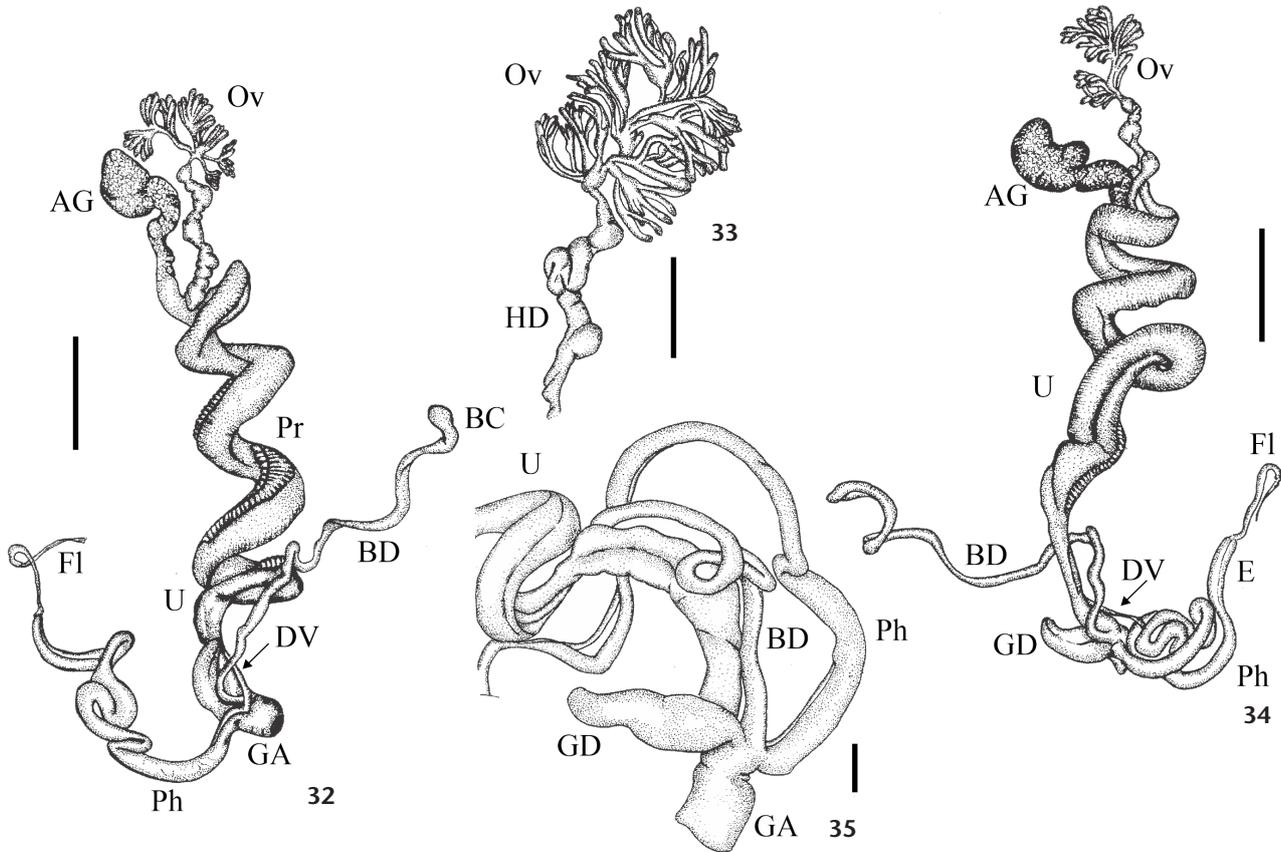
Habitat and distribution. The species was found under leaf litter, especially near rocks and in shallow soil. Only known from the type locality.

Comparison with other species. *Megaspira adenticulata* sp. nov. have an aperture without lamella parietal. This structure is present in the other species of *Megaspira*. Also, the columellar sculpture in *M. adenticulata* sp. nov. shows a rough texture and not inner lamellas, characteristic of *Megaspira iheringi* Pilsbry,

1925, *M. pilsbryi* and *M. elatior robusta*. In *M. iheringi* and *M. elatior robusta* have three small lamellae that rise 3 ½ whorls inward (Pilsbry 1904, 1925). The shell in *M. adenticulata* sp. nov. has 16 whorls on average and 27 mm in height whereas *M. iheringi* have 14 whorls and 28 mm. In *Megaspira elatior robusta* the shell is 16.7 mm in height and has 39 whorls (Table 1). The shell does not have light brown spots, as observed by Pilsbry (1925) in *Megaspira iheringi* and *M. elatior*.

DISCUSSION

We present new information on the anatomy, microsculpture, radula and morphometry of the shell of a *Megaspira* species. *Megaspira adenticulata* sp. nov. is characterized based on its morphology (shell and inner anatomy) and compared with the shells of the other species of *Megaspira*. Lea (1839) considered the presence of inner lamellae as diagnostic of *Megaspira* (Figs 7–9). Instead of a complex with inner lamellae or inner folds, characteristic of several other species such as *Megaspira elatior*, *M. robusta*, *M. pilsbryi* and *M. iheringi*, the entire surface of the columella of *Megaspira adenticulata* sp. nov. has a rough texture. However, the inner columellar lamellae are also present in other genera of terrestrial gastropods such as *Holospira* Martens, 1860. Therefore, it is not an exclusive character of *Megaspira*. The adult shell of species of *Holospira* has an internal barrier formed by inner lamellae usually in the last 1–4 whorls. Basically, the barrier consisting of four lamellae: the columellar, parietal, the basal and the palatal (Thompson and Mahalcik 2005) are similar to the condition observed in some species of *Megaspira* (ST



Figures 32–35. General view of reproductive system dissected out of *Megaspira adenticulata* sp. nov.: (32, 34) dorsal and ventral views of reproductive; (33) detail of ovotestis; (35) detail of distal portion of reproductive system showing the genital atrium and genital diverticle. (Ov) Ovoteste, (HD) Hermaphrodite Duct, (AG) Albumen gland, (BC) Bursa copulatrix, (BD) Bursa duct, (DV) Deferens vas, (Ep) epiphallus, (Ph) proximal phallum, (GA) Genital atrium, (FI) Flagellum, (Ov) Ovotestis, (Pr) Prostate, (U) uterus, (BD) Bursa duct, (GD) Genital diverticle, (Ph) Proximal phallum, (GA) Genital atrium, (U) Ureter). Scale bars: 32–35 = 1 mm.

Vieira, unpublished data). On the other hand, Pilsbry (1904) also mentioned the presence of a lamella located on the inner lip of the aperture and another on the parietal surface as a diagnostic character of Megaspiridae. *Megaspira adenticulata* sp. nov. lacks those apertural lamella mentioned by Pilsbry (1904) and the columellar axis has only two small folds in its basal portion (Fig. 15).

Even though the height of the shell of *M. adenticulata* sp. nov. is almost one-third the height of the shell of *M. elatior*, the general shell morphology and teleoconch sculpture of *M. adenticulata* sp. nov. matches the generic diagnosis proposed by Lea (1839) and Pilsbry (1904).

Similar to the observations of Pilsbry (1904) on *Megaspira ruschenbergiana*, the jaw of *M. adenticulata* sp. nov. also has the central plate larger than the lateral plate. (Fig. 25). Unfortunately, we have no information on the morphology of the other species, but we suspect that this character is diagnostic for the genus.

Callioneption is another genus that is accepted as a member

of the Megaspiridae (Salgado and Coelho 2003) and has also been described from Brazil. *Megaspira adenticulata* sp. nov. shows differences when compared to the type species *Callioneption iheringi* Pilsbry & Vanatta, 1899, mainly in the shell sculpture and reproductive system (Figs 32–35). *Callioneption iheringi* has a protoconch sculpture consisting of round nodules and simple columellar lamella (Pilsbry and Vanatta 1899, Salvador 2019), while the protoconch in *M. adenticulata* sp. nov. is smooth. Pilsbry and Vanatta (1899) pointed out that the reproductive system of *C. iheringi* does not have accessory organs, while in *M. adenticulata* sp. nov., a genital diverticle is present between the bursa copulatrix and the vagina.

There are no similar characters in the reproductive system, radula and jaw among some species of Orthalicoidea and *M. adenticulata* sp. nov. In *M. adenticulata* sp. nov. the central plate of the jaw is larger than the plates that extend laterally (Fig. 25). This differs from other genera of Orthalicoidea, for instance *Orthalicus* Beck, 1837; *Bostryx* Troschel, 1847 and

Thaumastus, which have a central plate that is smaller than the marginal plates (Pena et al. 2011, Miranda and Cuezco 2014). When Lea (1839) described the jaw of *Megaspira ruschenbergiana*, he highlighted the presence of a central plate that is larger than the lateral plate. The radula of *M. adenticulata* sp. nov. has a rachidian tooth with a well-developed mesocone, and both the ecto and endocone (Figs 26–28) are smaller than the mesocone, which differ from some *Thaumastus* (Pena et al. 2011), *Bulimulus* Leach, 1814 and *Bostryx* species (Miranda and Cuezco 2014). In those, the rachidian tooth does not differ in morphology from the lateral teeth.

Megaspira adenticulata sp. nov. was found in only one location of Ilha Grande (Fig. 1). Despite exhaustive field survey carried out in different trails of the island, we were unable to find any live specimens or dry shells of either *M. adenticulata* sp. nov. or any other species of *Megaspira*. Ilha Grande is inserted within the Atlantic Forest Biome, which is one of the world's biodiversity "hotspots" (Mittermeier et al. 2011). Ilha Grande is considered an area of endemism for certain vertebrate species (Rocha et al. 2018) and is one of the largest continuous remnants of Atlantic Forest in the state of Rio de Janeiro state. *Megaspira iheringi* and *M. elatior* have been recorded from the state of Rio de Janeiro (Macaé as type locality and Rio de Janeiro municipality respectively) (Pilsbry 1925, Rangel et al. 2021). The most recent separation of Ilha Grande from the continent is estimated at seven thousand years and the island is located 110 km off the coast of Rio de Janeiro. It is possible that *M. adenticulata* sp. nov. has been present at the island since the separation. It is also possible that it was transported there by oceanic birds. We think that transport by birds is unlikely because the shells of these snails are large.

In the near future we expect to carry out a taxonomic review of the genus *Megaspira* in order to better resolve the status of the nominal species, and generate a phylogeny based on molecular data, to better understand the relationship between the species and to clarify the position of the genus within Orthalicoidea.

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SBS conceptualized and supervised the work; SBS, XMCO and VRD did field work and examined material; VRD and XMCO dissected and illustrated; XMCO organized data and wrote original draft; XMCO, SBS and VRD revised and edited drafts

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