

A new species of *Habeas* (Eupulmonata, Urocoptidae) from Canarana region, Bahia, Brazil

Luiz Ricardo L. Simone¹

¹ Universidade de São Paulo (USP), Museu de Zoologia (MZUSP). São Paulo, SP, Brasil.
ORCID: <https://orcid.org/0000-0002-1397-9823>. E-mail: lr Simone@usp.br

Abstract. A new species of the recently described genus *Habeas* is described. The genus is the single urocoptid representant in Brazil. The new species is named as *Habeas centraris*, occurring in Paz de Salobro, Canarana, Bahia, Brazil. It is mainly characterized by its dense, delicate sculpture, peristome slightly centrally positioned. Its anatomy is similar to what is currently known, differing mainly by small pallial gland, short stomach, presence of anterior duct to digestive gland, vas deferens very posteriorly originated, prostate lying further the vas deferens origin, and visceral ganglia connected directly to pleural ganglia. The new species is another example of how weak the knowledge on the land mollusks in central Brazilian semi-dry region is, a biome that deserves protection. <https://zoobank.org/0DD6D7B5-60C4-42F4-BA72-A4A229D8C92E>.

Keywords. Gastropoda; Caves; Anatomy; Morphology; Taxonomy.

INTRODUCTION

The urocoptid genus *Habeas* Simone, 2013 was originally described encompassing three species: *Habeas corpus* Simone, 2013, the type species, occurring in Serra do Ramalho, Bahia; *H. data* Simone, 2013, from another cave of Serra do Ramalho; and *H. priscus* Simone, 2013, from Central, Bahia. Nine years later, Simone (2022) introduced another four species: *Habeas lekulus* Simone, 2022, from Cônego Marinho, Minas Gerais; *H. peruassus* Simone, 2022, from Januária, Minas Gerais; *H. lapensis* Simone, 2022, from Bom Jesus da Lapa, Bahia, and *H. claudus* Simone, 2022, from Cocos, Bahia. In that last paper, the first anatomical features were possible to be described, confirming its taxonomical status as the unique known Urocoptidae branch occurring in Brazil (Simone, 2006). The urocoptids are quite common in the Caribbean, Central America, and only occur in the north-Caribbean littoral of South America (Weerd, 2008; Kabat *et al.*, 2012; Weerd *et al.*, 2016).

Habeas so far only occurs in central Brazilian territory, between Bahia and Minas Gerais states, usually in calcareous and cavernicolous environments (Simone, 2013, 2022). Its species has so far proven to be highly endemic from restrict areas, presenting significative and convincing conchological differences amongst the species, such as size, shape, sculpture, peristome positions, etc. Further information on urocoptid history, ana-

tomical attributes, phylogeny, references, etc. are provided elsewhere (Simone, 2022).

Samples of the four species described by Simone (2022) were collected by a collector team of the naturalist José Coltro-Jr., who is exploring calcareous regions from central Brazilian area up to its northeast region. They are founding lots of new taxa, from new species to new genera, as well as expanding the known occurrence of several species. Taxonomic papers on those are being produced. The present paper is concerned to the eighth species of *Habeas*, this time collected in the Canarana region, Bahia, Brazil, collected recently.

The present sample has specimens collected alive, allowing anatomical investigation and further comparison with *Habeas lekulus*, so far the only species of the genus also described anatomically. As the anatomical characters of the new species are relatively similar to *H. lekulus*, the focus on the present paper is the anatomical comparison between these two species. Wider comparative scenario is already found in Simone (2022), which is perfectly applicable herein.

MATERIAL AND METHODS

The sample was donated already preserved in 70% ethanol, with no previous narcotization method. The sample was mainly deposited in Museu de Zoologia da Universidade de São Paulo (MZSP)

collection, such list is in the formal description below. The anatomically studied specimens had their shells broken for specimens' extraction. The dissection was performed under usual techniques (e.g., Simone, 2011, 2018), under stereo-dissecting-microscope, with the specimens immersed under ethanol. Photos of all studied shells and all dissection steps were obtained by digital cameras (avulse and also connected to the microscope) and are stored in the MZSP Malacological Laboratory digital archives. The photos used in this paper were processed by image editor software (mainly Corel PhotoPaint), including multi-focus composition (mainly Axio-Vision). The drawings of anatomical features were obtained with the aid of a camera lucida. Also, to avoid redundance, the present anatomical description is performed as comparative to that of *H. lekulus* (Simone, 2022).

Anatomical abbreviations: **ac**, albumen gland chamber; **ag**, albumen gland; **an**, anus; **au**, auricle; **bg**, buccal ganglion; **bm**, buccal mass; **bv**, blood vessel; **cc**, cerebral commissure; **ce**, cerebral ganglion; **cv**, pulmonary (efferent) vein; **da**, digestive gland anterior lobe; **dd**, duct to digestive gland; **dg**, digestive gland posterior lobe; **eg**, folded glandular portion of esophagus; **eo**, spermoviduct; **es**, esophagus; **fe**, fecal pellet; **fp**, genital pore; **go**, gonad; **gv**, visceral ganglia; **hd**, hermaphrodite duct; **in**, intestine; **jw**, jaw; **ki**, kidney; **m1-m10**, extrinsic and intrinsic odontophore muscles; **mb**, mantle border; **mf**, inner fold of pneumostome (deflected); **mo**, mouth; **ne**, nephrostome; **nr**, nerve ring; **od**, odontophore; **pc**, pericardium; **pe**, penis; **pg**, pallial white gland; **pl**, pleural ganglion; **pn**, pneumostome; **pp**, pedal ganglion; **pt**, prostate; **pu**, pulmonary (pallial) cavity; **rn**, radular nucleus; **rs**, radular sac; **rt**, rectum; **sd**, salivary gland duct; **sg**, salivary gland; **sr**, seminal receptacle; **st**, stomach; **sy**, statocyst; **un**, union of mantle border with nuchal surface; **ur**, urinary gutter; **ut**, uterus; **vd**, vas deferens; **ve**, ventricle; **vg**, vagina.

Institutional abbreviations: **MNRJ**, Museu Nacional da Universidade Federal do Rio de Janeiro, Brazil; **MZSP**, Museu de Zoologia da Universidade de São Paulo, Brazil; **USNM**, National Museum of Natural History, Smithsonian Institution, Washington DC, USA.

RESULTS

Systematics

Habeas centroris new species (Figs. 1-23)

<https://zoobank.org/5B23C638-7D5B-4AAC-BB41-34C7B51366BB>

Types: holotype MZSP 155200. Paratypes: MZSP 153866, 25 specimens, MNRJ 23646, 2 specimens; USNM, 2 specimens, all from type locality.

Type locality: BRAZIL. **Bahia;** Canarana, Paz de Salobro, 11°51'56"S, 41°45'07"W [W. Vailant-Mattos col., 20/iv/2021].

Etymology: the specific epithet is a junction of the Latin words *centro* (center) and *oris* (mouth), an allusion to the central position of the peristome.

Diagnosis: Shell ~7 mm; inferior half almost cylindric; peristome relatively centrally positioned; umbilicus narrow; sculpture sense quantity of narrow and well-delimited axial lines; rounded whorls profile. Pallial gland small. Ureteral groove well-marked, wide. Stomach short; duct to anterior lobe of digestive gland present. Seminal receptacle very small, always present; penis small, simple, lacking retractor muscle; vas deferens originating between posterior and middle thirds of spermoviduct; prostate lying anteriorly to vas deferens origin. Both visceral ganglia connected to pleural ganglia.

Description

Shell (Figs. 1-9, 11-14): Sinistral. Adult length ~7 mm, ~10 whorls; ~2.1 times longer than wide; apex angle ~60°, tip blunt; profile becoming almost cylindrical after ~5 whorls, with profile angle of ~20°. Color whitish (Fig. 7), pale cream (Figs. 6, 8) to pale beige (Figs. 1-5). Protoconch with almost 4 smooth, opaque, rounded whorls (Figs. 4, 12); height = 0.8 mm, maximum width = 1 mm; occupying ~16% of total shell length, ~46% of shell width; transition with teleoconch relatively clear (Figs. 3, 7, 11-12). Teleoconch of 5.5-6 whorls; whorls profile rounded to slightly planar; ~4 last whorls almost similar-sized, weakly increasing (Figs. 1-3, 6-8, 11)). Last half whorl weakly projected exteriorly, expanding shell width ~20% (Figs. 1, 6-8, 11); last ¼ whorl weakly dislocated inferiorly (Figs. 3, 13), bluntly angled, ending in external notch of outer lip. Sculpture uniform axial narrow ribs, interspaces twice wider than ribs; ~90 ribs in penultimate whorl; ribs density similar in all whorls. Peristome expanded, bugle-like, orthocline (Figs. 2, 13); complete (Figs. 1, 6, 11, 13) or with callus region weak (Figs. 7, 8), slightly elliptic except for strong, wide notch in superior region of outer lip (Figs. 1-2, 6-7, 11, 13); peristome occupying ~22% of shell length, ~45% of shell width. Umbilicus of small size, occupying ~5% of inferior shell area (Figs. 5, 9); umbilical hollow column lying uniformly all along inferior ¾ of teleoconch length (Figs. 13, 14: arrow).

Head-foot: Of ordinary shape, with similar feature of *H. lekulus* (Simone, 2022).

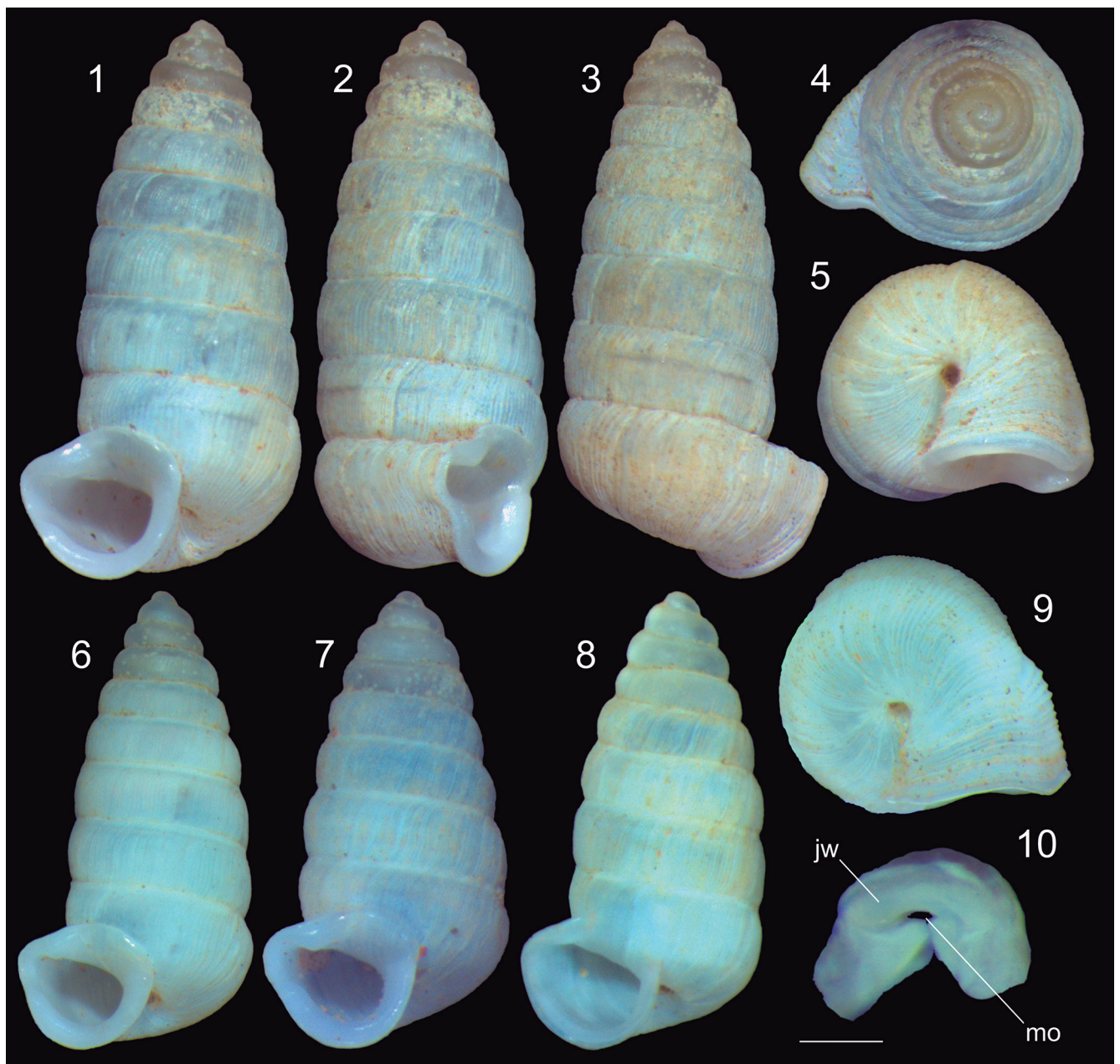
Pallial cavity (Fig. 19): General organization similar to that of *H. lekulus* (Simone, 2022), distinctions and remarks following. Pallial gland (pg) present, but much smaller, occupying ~15% of entire mantle edge. Anus (an) opening very close to mantle edge. Inner pulmonary surface lacking developed vessels, uniformly smooth; rectum (rt) bulging along left edge, lacking developed adrectal sinus. Ureteral gutter (ur) wide, clearly running at right from rectum, from nephrostome (ne) up to pneumostome (pn). Reno-pericardial structures bulging in posterior half whorl, described below.

Visceral mass (Fig. 20): Also with similar features as *H. lekolus* (Simone, 2022), differing mainly by minuteness of stomach (described below).

Circulatory and excretory systems (Fig. 19): Mostly similar to those of as *H. lekolus* (Simone, 2022); distinctions following. Pericardium (pc) and heart (au, ve) ~30% smaller; its pulmonary vein (cv) difficultly seen, lying along right pallial edge. Kidney (ki) mostly solid, white, antero-posteriorly shorter, slightly squared.

Digestive system (Figs. 20-22): Most characters similar to those of *H. lekolus* (Simone, 2022); remarkable and distinctive features following. Jaw plate (Fig. 10: jw) simple, thin, translucent, yellowish, smooth. Buccal mass (Figs. 20-21) with pair m1d (dorsal protractor muscles)

well-developed; pair m1l more ventrally positioned, thin, wider; pair m2 thinner (Fig. 21); m3 lacking; internal organization, including oral cavity and odontophore, similar, except for narrower pair m5. Radula (Figs. 15-18) composed of rachidian (arrows) plus ~15 pairs of lateral-marginal tooth, no clear separation of types (Fig. 15); rachidian and lateral teeth with single, large curved cusp, longer and more pointed than those of *H. lekolus*; rachidian occupying ~4% of radular ribbon width, ~30% narrower than neighboring teeth; lateral teeth 8-10 pairs, similar to rachidian except in being slightly wider and weakly turned outside (Figs. 16, 18), gradually diminishing towards lateral; marginal teeth marked by gradual further diminish length, and appearance of more secondary cusps (Fig. 17), in more central teeth small cusps appearing in medial side of main cusp, gradually cusps becom-

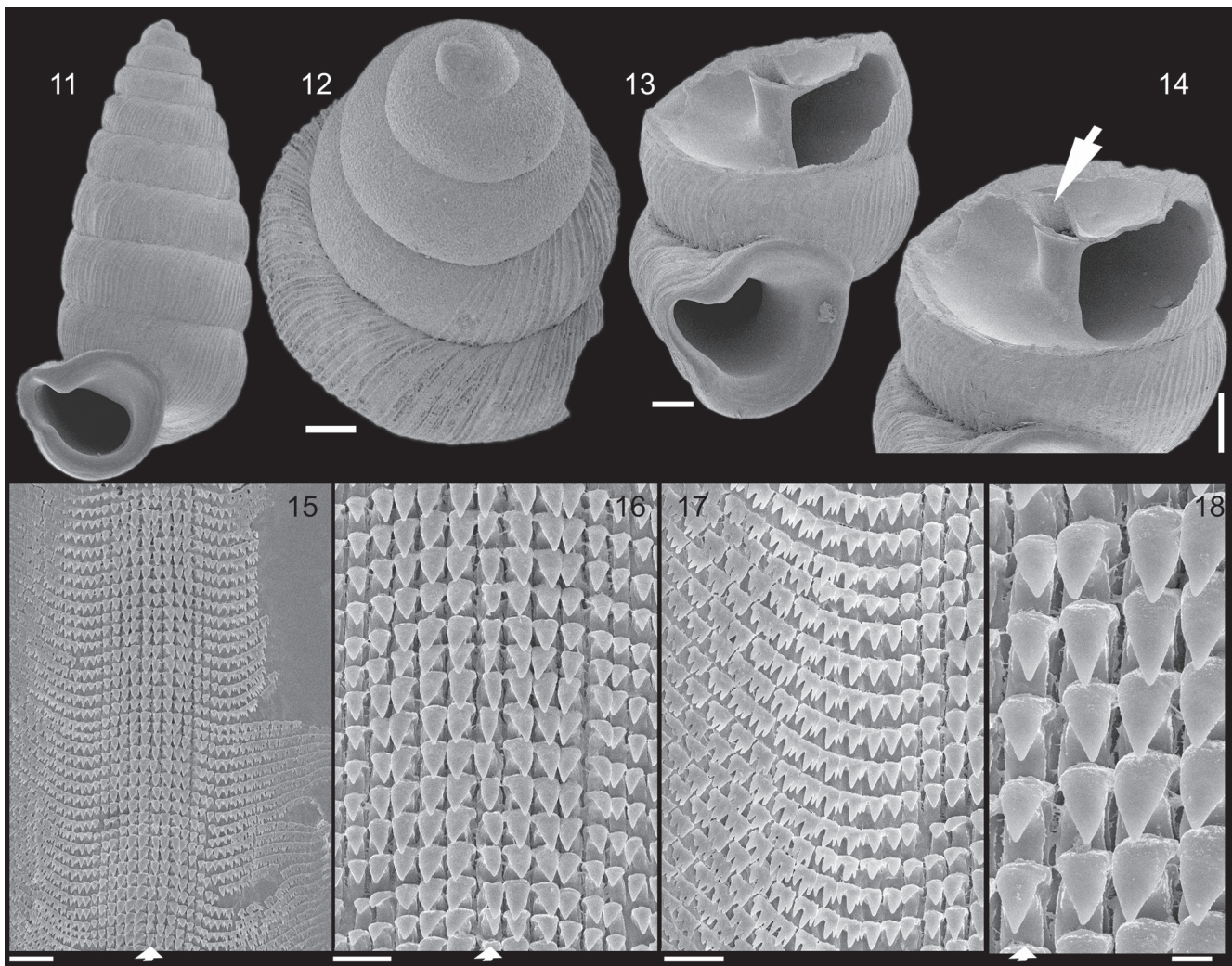


Figures 1-10. *Habeas centroris* shells of types: (1-5) Holotype MZSP 155200 (L 7.0 mm); (1) frontal view; (2) right view; (3) dorsal view; (4) apical view; (5) inferior view; (6) paratype MZSP 153866#1, frontal view (L 6.8 mm); (7) #2, frontal view (L 5.6 mm); (8) #3, frontal view (L 5.9 mm); (9) same, inferior view (W 3.0 mm); (10) buccal region, ventral view, with concern to jaw, scale 0.2 mm.

ing smaller and same-sized towards lateral teeth, usually with 3 cusps. Lateral and marginal teeth performing wide curves (concavity posterior) in both sides of rachidian (Fig. 15), curve more accentuated in marginals (Fig. 17). Pair of salivary glands (sg) with shorter and broader ducts (Fig. 21: sd). Esophagus (Fig. 20: es) narrow, walls thin, internally smooth, after ~1.5 whorls esophagus gradually becoming weakly folded, with internal thick mucosa, up to left side of stomach. Stomach (st) small, as simple, swollen curve; esophageal insertion and intestinal origin side by side in its anterior side (Fig. 20); anterior duct to digestive gland (dd) narrow, elongated, located in intersection between esophagus and intestine, turned anteriorly, slightly ventrally positioned; posterior duct to digestive gland slightly broader, located in right side of stomach, directed posteriorly. Digestive gland with anterior lobe (da) flattened, long, thin, compressed between local digestive tubes and columellar muscle. Intestine loops as in Fig. 20; narrow and relatively uniform along its length. Rectum and anus described above; rectum forming distinct squared fecal pellets (Fig. 19: fe), stored all along its length.

Genital system (Fig. 22): General organization similar to that of *H. lekolus* (Simone, 2022: figs. 19-20); distinctions and remarks following. Hermaphrodite duct (hd) simpler, narrow all along its length. Seminal receptacle (sr) very small, sac-like, always present. Albumen gland (ag) elliptical, ~1/2 whorl in length. Spermoviduct (eo) of ~1.5 whorl in length, narrow, running close to diaphragm; uterus (ut) hollow, thick walled; and prostate (pt) mostly solid; both equally sized. Vas deferens (vd) originating in edge of prostate, about between posterior and middle thirds of spermoviduct; prostate further lying anteriorly about same length as posterior length. Vas deferens (vd) simple, thin, ~0.5 whorl in length; inserting after small curve in penis' tip. Penis (pe) small, ~1/3 whorl, ~twice longer than wide, weakly curved; tip blunt, strongly curved, epiphallus-like; no detectable penis retractor muscle, nor accessory genital muscle. Penis mostly hollow, inner arrangement with three narrow, equidistant longitudinal folds.

Central nervous system (Fig. 23): Nerve ring, located anterior to buccal mass (Fig. 21), with similar features of *H. lekolus* (Simone, 2022: fig. 21); distinctions following.



Figures 11-18. *Habeas centroris* SEM images of paratypes MZSP 153886 shells: (11) whole frontal view, specimen #6 (L 6.4 mm); (12) young specimen with protoconch and first teleoconch whorl, apical-slightly left view, scale = 200 µm; (13) broken specimen #5, detail of last whorl, frontal-slightly right view, scale = 400 µm; (14) same, higher magnification in penultimate whorl showing umbilicus (arrow); 15-18, radula, arrow showing rachidian column; (15) wide view, scale = 40 µm; (16) detail of central region, scale = 20 µm; (17) detail of lateral region, scale = 20 µm; (18) detail of central region, scale = 5 µm.

Cerebral commissure (cc) further longer. Cerebral glandular region not so clear. Pair of pleural ganglia (pl) also small, located equidistant from cerebral and pedal ganglia in both sides. Commissure between both pedal ganglia (pp) located more centrally, between both ganglia. Left visceral ganglion (gv) connected to adjacent pleural ganglion (instead of pedal ganglion). Pair of statocysts (sy) easily detectable, located in postero-ventral region of pedal ganglia.

Habitat: On calcareous rocks, crevices, and sheltered areas; dry vegetation.

Measurements (in mm): Holotype MZSP 155200 (Figs. 1-5): 7.0 by 3.4; MZSP 153886 #1 (Fig. 6): 6.8 by 3.2; #2 (Fig. 7): 5.6 by 2.8; #3 (Fig. 8): 5.9 by 3.0; #6 (Fig. 11): 6.4 by 3.1. The paratypes 1, 2 and 3 have their shells posteriorly damaged, for specimen's extraction.

Material examined: Types.

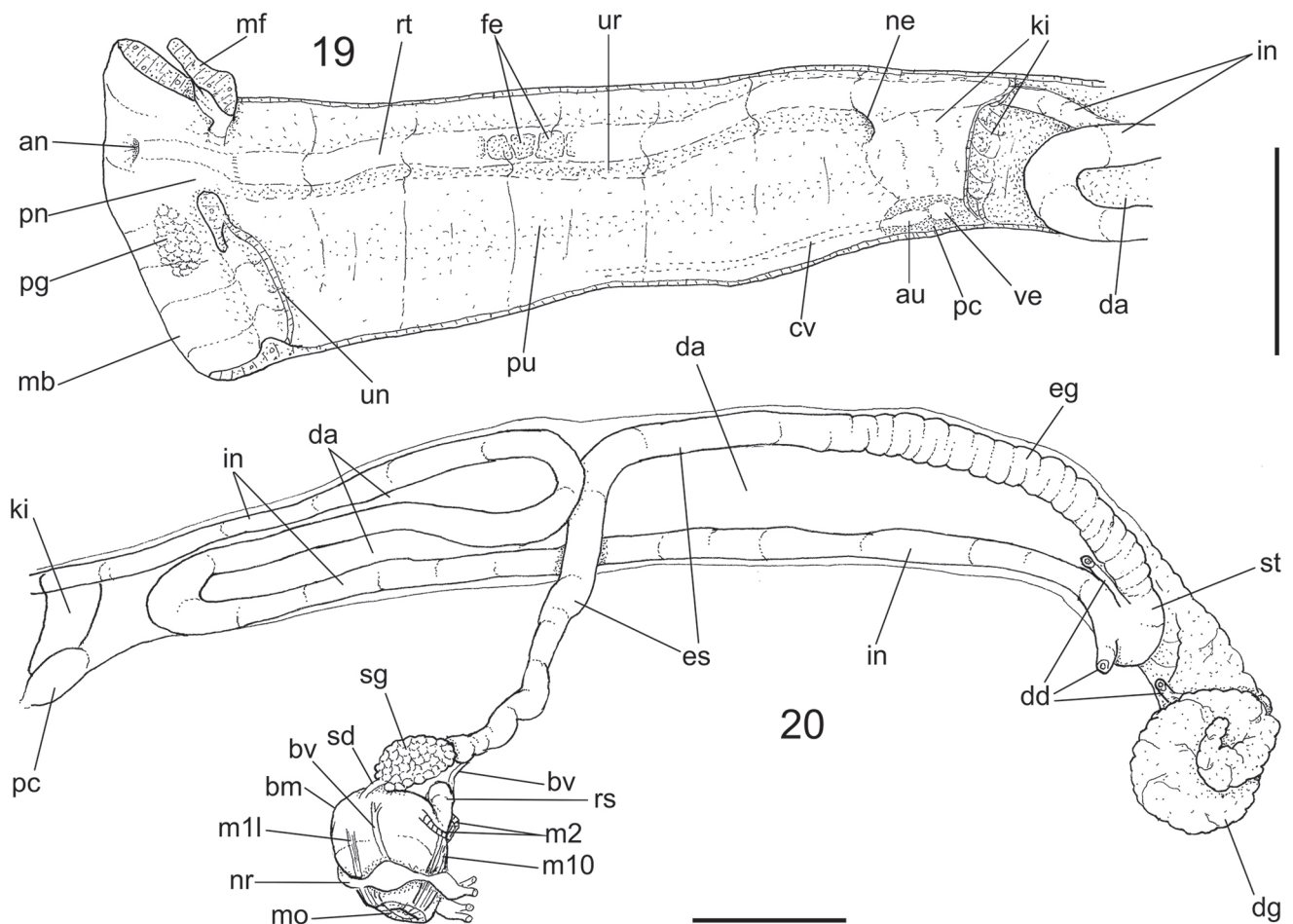
DISCUSSION

The shell of the eight species of *Habeas* is represented in Fig. 24, which has representatives (mostly holo-

types) of all known species and their geographic localization. The illustrated shells are not in the same scale, for a same-scale illustration see Simone (2022: figs. 43-49), in which *H. centroris*, with ~7 mm, is slightly longer than *H. lekulus* (Simone, 2022, fig. 47).

Related to the shell features, Simone (2022) suggested that the genus *Habeas* can be divided into two groups (subgenera?). Group 1, with *H. lapensis* and *H. priscus*, has smaller shells, i.e., ~5 mm, umbilicus almost closed, and conic profile of spire. The group 2, which includes the remaining hitherto known five species, has the adult shell about and over 10 mm, and the four last whorls are similar-sized, producing a rather cylindric inferior shell profile, and opened umbilicus. The addition of *H. centroris*, a further division of the group 2 into two subgroups appears possible: 2A, with the peristome highly dislocated outside, with consequent wide umbilicus, and having the larger sizes (almost 20 mm), such as *H. corpus*, *H. peruassus* and *H. claudus*; and 2B, with peristome more centrally positioned, umbilicus narrow, semi-covered, and smaller size (around 10 mm), including *H. data*, *H. lekulus* and the new *H. centroris*. Thus, *H. centroris* must be compared more closely with these 2 last species, fortunately one of them has anatomical features known, which will be compared below.

The peristome located more centrally already distinguishes *H. centroris* from all *Habeas* species, except for

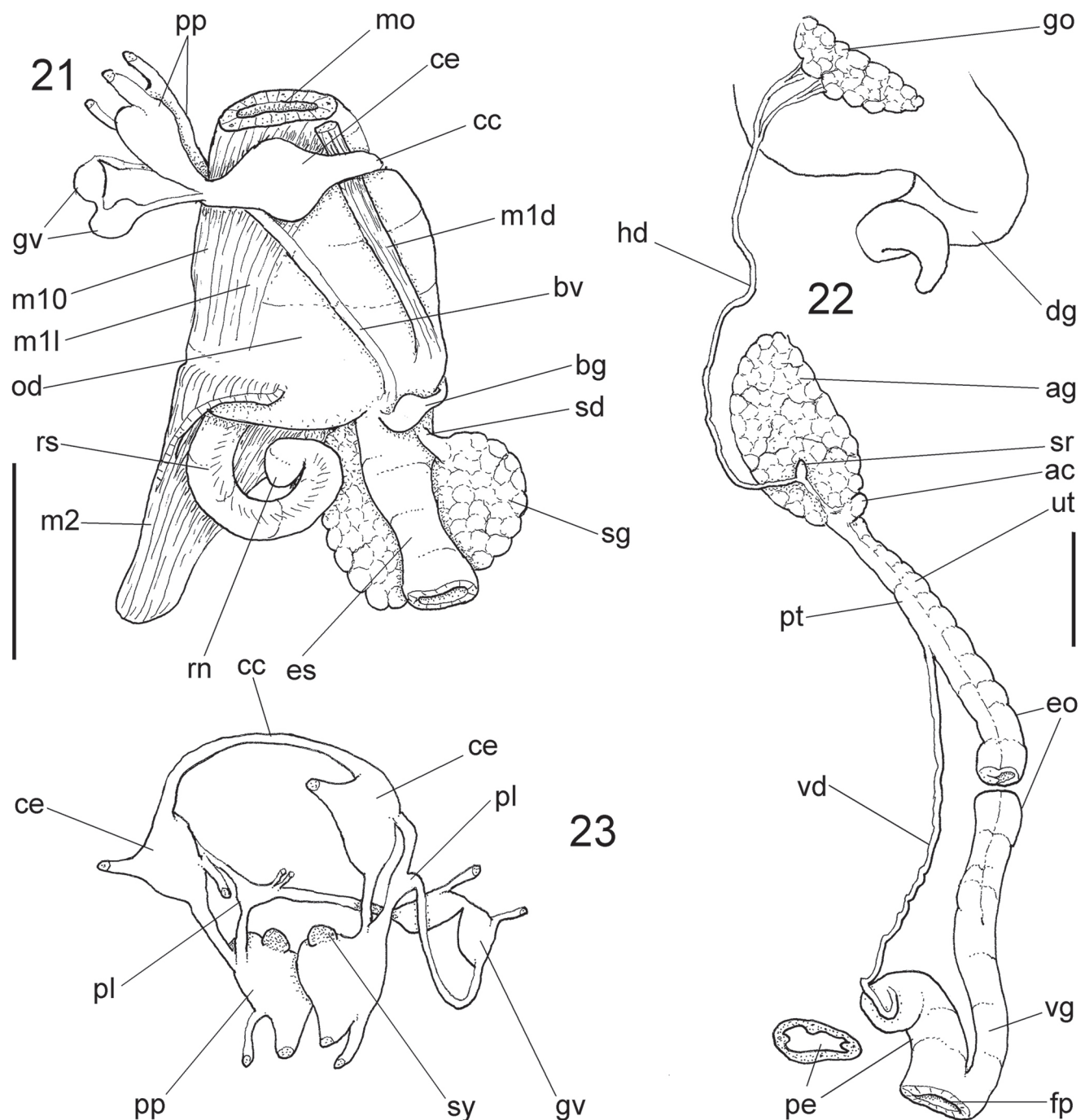


Figures 19-20. *Habeas centroris* anatomical drawings: (19) pulmonary cavity and adjacent end of visceral mass, ventral view, ventral fold of pneumostome sectioned and deflected upwards; (20) uncoiled visceral mass, mostly ventral view, structures seen as in situ, anterior lobe of digestive gland removed, buccal mass m2 also removed, some structures only indicated by their topology, anterior digestive tubes (located in haemocoel) still attached. Scales = 1 mm.

H. data and *H. lekolus*. From *H. lekolus*, *H. centraris* differs in being slightly smaller (*H. lekolus* usually is over 8 mm), lacking slightly shouldered whorls, and by higher density of the axial sculpture (*H. lekolus* has spaced axial lines); actually, *H. lekolus* has the most central positioned peristome from its congeners (Fig. 24). *Habeas centraris* differs from *H. data* in being slightly larger (*H. data* has about 6 mm); spire slightly more inflated (*H. data* has a more acuminate spire, in angle $\sim 40^\circ$, while *H. centraris* starts with $\sim 60^\circ$ in its apex); umbilicus slightly narrower (Figs. 5, 9); peristome slightly larger (22% of shell length, while *H. data* has $\sim 18\%$); and by the dense and well-

marked axial sculpture (Fig. 11), as *H. data* has less-dense, rather obsolete and irregularly distributed axial lines. With ~ 90 axial cords in penultimate whorl, *H. centraris* has the denser axial sculpture from all *Habeas*.

Related to the anatomy, both known species, *H. lekolus* and *H. centraris*, have similar attributes. Some characters appear to be exclusive of *Habeas* if compared to other urocoptids (Simone, 2022, and references therein), such as the pallial border gland (Fig. 19: pg); the lung lacking visible vessels, with the pulmonary vein lying along its right edge (Fig. 19: cv); the anus positioned externally, preceded by a narrow portion of the rectum;



Figures 21-23. *Habeas centraris* anatomical drawings: (21) buccal mass, left view, left portion of m2 removed; (22) genital structures, uncoiled, mostly in ventral view, artificial section on middle region of spermoviduct done, topology of posterior lobe of digestive gland also shown; (23) central nervous system (nerve ring), dorsal view. Scales = 0.5 mm.

and the simplicity of the genital structures (Fig. 22). Both anatomically known species have the genital tubes strangely narrow and delicate. The gonad and albumen gland looking mature, associated to the complete shell's peristome formation, suggests that the delicateness of the genital structures is a character of the genus, instead of being immaturity. Another possibility is that both *Habeas* species only reproduce in determinate times, having latent genital structures in the intervals. In this scenario, the collection of both species would have occurred in the interval. Anyway, up to contrary information, the genital structure's idiosyncrasies are considered genus characters, as already two species have them.

The anatomical distinction between *H. centroris* and *H. lekolus* is already explored in the above description, which was performed in a comparative manner. The

more important differences are the following: *H. centroris* lack so developed adrectal sinus at the pallial cavity as that of *H. lekolus*. In the same region, the *H. centroris* ureteral gutter (Fig. 19: ur) looks much more evident, being wide, uniform, and smooth; and the pallial gland (pg) is much smaller. The stomach of *H. centroris* is much more reduced, marked only by a swollen region of the curve between esophagus and intestine, in posterior most region of the digestive tubes (Fig. 20: st); while *H. lekolus* has a much wider and long gastric region. *H. centroris* has a clear gastric duct to anterior lobe of the digestive gland, such duct was not found in *H. lekolus*. In the genital system, *H. centroris* has a clear division between prostate and uterus in the spermoviduct (Fig. 22: eo), the spermoviduct of *H. lekolus* looks more uniform, lacking clear divisions. The origin of the vas deferens (vd) of



Figure 24. Mapping of approximate localities of the eight species of *Habeas*, along the states of Bahia (BA) and Minas Gerais (MG). São Francisco River also shown. Shells not for proportions. Map upper left Brazil with displayed amplified squared East region shown in center. Figured shells in frontal view: *Habeas centroris*: holotype (L 7.0 mm); *H. claudus*: holotype MZSP 152145 (L 9.6 mm); *H. corpus*: holotype MZSP 110000 (L 10.3 mm); *H. data*: paratype MZSP 109965 (L 5.7 mm); *H. lapensis*: holotype MZSP 152144 (L 3.0 mm); *H. lekolus*: holotype MZSP 152143 (L 7.5 mm); *H. peruassus*: holotype MZSP 152146 (L 8.5 mm); *H. priscus*: holotype MZSP 103044 (L 4.6 mm).

H. centroris is between the posterior and middle thirds of the spermovi duct, more posterior than that of *H. lekolus*. Strangely, the prostate goes anteriorly, further along the spermovi duct, beyond the vas deferens origin. The prostate usually ends in the point in which vas deferens originates in most stylommatophorans (Simone, 2011). No detectable retractor muscle of the penis was found in *H. centroris*, as well as no genital muscle, both present in *H. lekolus*. The penis retraction possibly is provided by the ordinary minute jugal muscles, present in entire haemocoel; this appears to be sufficient in a so minute penis. In the central nervous system (neve ring) the pair of visceral ganglia (Fig. 23: gv) are both connected to the pleural ganglia (pl), while in *H. lekolus* the left visceral ganglion has a connective directly to the left pedal ganglion.

Related to the biogeography (Fig. 24), the new *H. centroris* is the second *Habeas* found at east side of São Francisco River, beyond *H. data*. This mighty river may be an important barrier for so minute snails. The remaining six congener species occur at west from that river. Moreover, *H. centroris* is the furthest from that river, in a distance of ~180 km; besides, there is the Mangabeira Mountain Range separating that river from the region of the species' occurrence. *H. centroris* so far is the northernmost and easternmost species of the genus, but the genus remains endemic from the region between north of Minas Gerais and central region of Bahia. That region typically has a semi-dry, Caatinga environment. Most *Habeas* species are related to cavernicolous environments, being troglophile organisms; however, no such environmental information is available for *H. centroris* and even to the remaining *Habeas*. Possibly their relation to the cave surroundings may be another speciation factor, and these are usually separated from one another in that Brazilian region (Lobo, 2013).

CONFLICTS OF INTEREST: Author declare that there is no conflicts of interest.

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