

Taxonomic study on the molluscs collected during the Marion-Dufresne expedition (MD55) off SE Brazil: the Naticidae (Mollusca: Caenogastropoda)

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ABSTRACT

The deep-water Naticidae Guilding, 1834 collected in the expedition MD55 off SE Brazil are taxonomically studied; of the eleven species found, nine species and one genus are new. *Microlinices* n. gen., mainly characterized by its minute shell size (5-8 mm), thick unpigmented shell walls, weak callus, umbilicus wide lacking central fold, corneous operculum, absence of eyes, osphradium somewhat peduncular, penis at right of or ventral to right cephalic tentacle, nerve ring highly concentrated, and found in deepwater environment. The following taxa are studied here: *Microlinices latiusculus* n. gen., n. sp., the type species, off Rio de Janeiro (RJ), 430-450 m (anatomy included); *M. ibitingus* n. gen., n. sp., off Espírito Santo (ES) and RJ, 640-1575 m (anatomy included); *M. benthovus* n. gen., n. sp., same distribution, 607-1575 m (anatomy included); *M. ombratus* n. gen., n. sp., off ES, 1500-1575 m; *M. apiculus* n. gen., n. sp., off ES, 367 m; *M. gaiophanis* n. gen., n. sp., off RJ, 830 m; *Natica jukyriuva* n. sp., off ES, 295-620 m; *N. pipoca* n. sp., off ES, 15 m; *N. juani* Costa & Pastorino, 2012, off ES, 52-105 m, expanding the geographic distribution to north, to ES and Trindade Island; an operculum of *Natica* (ss) sp., off ES, 295 m; *Eunaticina abyssalis* n. sp., off ES, 1500-1575 m. The *Natica* Scopoli, 1777 ss and *Eunaticina* Fisher, 1885 are reported on the Brazilian coast for the first time. The three species with anatomical descriptions, representing the new genus *Microlinices* n. gen., had their phenotypic characters coded and inserted in a wider cladistic analysis (Simone 2011), with no inclusion of new characters. The three species resulted as a monophyletic taxon amongst the basal Naticoida Guilding, 1834, supported by 20 synapomorphies.

KEY WORDS

Brazil,
Anatomy,
Naticidae,
Caenogastropoda,
Deep-water,
new genus,
new species.

RÉSUMÉ

Étude taxonomique des mollusques collectés pendant la campagne Marion-Dufresne (MD55) au large du sud est du Brésil : les Naticidae (Mollusca: Caenogastropoda). L'étude taxonomique des Naticidae Guilding, 1834 d'eaux profondes collectés pendant la campagne MD55 au large du sud est du Brésil révèle la présence de onze espèces, dont neuf sont nouvelles. Un genre nouveau est décrit *Microlinices* n. gen., principalement caractérisé par la très petite taille de sa coquille (5-8 mm) aux murs épais et non pigmentés, un callus peu épais, un ombilic large sans pli central, un opercule corné, l'absence d'yeux, l'osphradium légèrement pédonculé, le pénis situé à la droite ou ventralement au tentacule céphalique droit et le anneau nerveux très concentré; *Microlinices* n.gen. est trouvé en eaux profondes. Les taxa suivants sont ici traités : *Microlinices latiusculus* n. gen., n. sp., l'espèce type, trouvée au large de Rio de Janeiro (RJ) 430-450 m (anatomie décrite); *M. ibitingus* n. gen., n. sp., au large de Espírito Santo (ES) et RJ, 640-1575 m (anatomie décrite); *M. benthovus* n. gen., n. sp., même distribution, 607-1575 m (anatomie décrite); *M. ombratus* n. gen., n. sp., au large ES, 1500-1575 m; *M. apiculus* n. gen., n. sp., au large ES, 367 m; *M. gaiophanis* n. gen., n. sp., au large RJ, 830 m; *Natica jukyriuva* n. sp., au large ES, 295-620 m; *N. pipoca* n. sp., au large ES, 15 m; *N. juani* Costa & Pastorino, 2012, au large ES, 52-105 m, ce qui étend sa répartition géographique au nord, à ES et l'île de Trindade; un opercule de *Natica* (ss) sp., au large ES, 295 m; *Eunaticina abyssalis* n. sp., au large ES, 1500-1575 m. *Natica* Scopoli, 1777 ss et *Eunaticina* Fisher, 1885 sont répertoriés des côtes brésiliennes pour la première fois. Les caractères phénotypiques des trois espèces dont l'anatomie est décrite et qui représentent le nouveau genre *Microlinices* n. gen., sont codés et intégrés dans une analyse cladistique plus large (Simone 2011), sans inclusion de caractère nouveau. Les trois espèces forment une groupe monophylétique au sein des Naticoidea Guilding, 1834 basaux, supporté par 20 synapomorphies.

MOTS CLÉS

Brésil,
Anatomie,
Naticidae,
Caenogastropoda,
Deep-water,
espèces nouvelles,
genre nouveau.

INTRODUCTION

The Brazilian deep-waters have been shown to bear a high diversity, including a high level of species and endemism. This aspect gains importance as Brazil has recently started the deep-water exploration of petroleum, in the so-called Pré-Sal (pre-salt) basin off SE Brazil. The detailed research of the local fauna is, therefore, fundamental. The MD55 expedition of the R/V *Marion-Dufresne*: Terres Australes et Antarctiques française, in 1987, explored the fauna of the pre-salt basin at a time when the region was still unexplored. Recently, Philippe Bouchet (MNHN), kindly invited me to study the Brazilian mollusks collected during the cruise MD55. The collected material has been since then gradually

processed and taxonomically described (Simone & Cunha 2012). Other details of MD55 cruise can be found in Simone & Cunha (2012). This paper focuses on the deepwater Naticidae Guilding, 1834. Among the 11 species collected, nine are formally described herein as new, as well as one new genus.

The Naticidae is the single living family of the superfamily Naticoidea Guilding, 1834 (Caenogastropoda Cox, 1960). They are also known as moon-snails, because most of them possess a globose, bulged shell. The family is cosmopolitan and represents voracious predators of invertebrates, mostly of other shelled molluscs. Naticids bore the prey shells with a special organ called accessory boring organ (ABO). The ABO is a glandular protuberance located in ventral tip of the proboscis (Kabat 1991;

Huelsken *et al.* 2008; Simone 2011; Torigoe & Inaba 2011). They also characteristically have a wide foot, adapted to dig in unconsolidated substrates. The foot can expand to 2-3 times the shell volume.

The Brazilian coast includes about 20 species of naticids (Pastorino 2005; Rios 2009; Costa & Pastorino 2012), most of them occurring in shallow waters. Only three species have been reported in depths over 100 m: *Euspira radiata* (Watson, 1881), *Polinices fringillus* (Dall, 1881), and *Notochelis laurae* Costa & Pastorino, 2012 (Rios 2009; Costa & Pastorino 2012). However, the Brazilian records of the two former species possibly represent misidentifications of North Atlantic species.

MATERIAL AND METHODS

The samples studied here included both dry shells and 70% ethanol preserved specimens, all deposited in below indicated institutional collections. The shells were additionally processed under a Zeiss V12 autofocus microscope for illustration. The preserved specimens were extracted from their shells, and dissected by standard techniques. All drawings were obtained with the aid of a camera lucida. Digital photos of all dissecting steps were also obtained. Some hard parts, such as radula and jaws, were also examined in Scanning Electron Microscope (SEM) provided by the Laboratório de Microscopia Eletrônica do Museu de Zoologia da Universidade de São Paulo (Zeiss DSM 940).

The three species herein anatomically studied had their characters coded in a character-matrix (Table 1), under the criteria and methodologies described in Simone (2011: 163-175). The three lines of the present matrix (Table 1) were added to the matrix of Simone (2011: 267-308); the obtained cladogram is shown here (Figs 12; 13), focusing on the region of the cladogram with the presently studied taxa and neighboring taxa; the remaining cladogram is exactly the same of Simone (2011: fig. 20) and it is not completely shown. The set of synapomorphies of each node is also shown here in the same way of that paper (Simone 2011: 309-317). No new character was added to those already presented in Simone (2011), in that ma-

trix and appendix. All these are properly debated in the Discussion section. The additional intent is to display the present results in a wider scenario.

ABBREVIATIONS

Morphology

aa	anterior aorta;
ab	accessory boring organ;
af	afferent gill vessel;
ag	albumen gland;
an	anus;
ao	posterior aorta;
ap	female pore;
au	auricle;
bg	buccal ganglion;
br	subradular membrane;
ce	cerebral-pleural ganglia;
cg	capsule gland;
cm	columellar muscle;
cv	ctenidial vein;
dd	duct to digestive gland;
df	dorsal fold of buccal mass;
dg	digestive gland;
di	diaphragmatic septum separating haemocoel from visceral cavity;
ec	esophageal crop;
ef	esophageal fold;
eg	esophageal gland;
ep	epipodium;
es	esophagus;
ey	eye;
fp	female pore;
ft	foot (mesopodium);
gi	gill or gill filament;
gp	pleural ganglion;
ha	haemocoel;
he	head;
hg	hypobranchial gland;
in	intestine;
ir	insertion of m4 in tissue on radula;
is	insertion of m5 in subradular membrane;
jw	jaw;
ki	kidney;
L	length;
m1-m14	extrinsic and intrinsic odontophore muscles;
mb	mantle border;
mj	jaws, buccal and oral tube muscles;
mo	mouth;
ne	nephrostome;
ng	nephridial gland;
nr	nerve ring;
oa	opercular pad;
oc	odontophore cartilage;
od	odontophore;
of	osphradium satellite fold;

om	ommatophore;
op	operculum;
os	osphradium;
ot	oral tube;
ov	pallial oviduct;
oy	ovary;
pa	posterior aorta;
pb	proboscis;
pc	pericardium;
pd	penis duct;
pe	penis;
pf	penis furrow;
pg	pedal glands anterior furrow;
pp	penis papilla;
pr	propodium;
pt	prostate;
pu	pedal ganglion;
ra	radula;
rm	retractor muscle of proboscis or snout;
rn	radular nucleus;
rr	retractor muscle of proboscis passing through nerve ring;
rs	radular sac;
rt	rectum;
rv	renal efferent vessel;
ry	rhynchostome;
sa	salivary gland aperture at buccal cavity;
sc	subradular cartilage;
sd	salivary duct;
se	septum between esophagus and odontophore in buccal mass;
sg	salivary gland;
sn	snout;
sp	supra-esophageal ganglion;
st	stomach;
su	subesophageal ganglion;
sv	seminal vesicle;
sy	statocyst;
te	cephalic tentacle;
tg	integument;
to	tissue on middle region of radula preceding buccal cavity;
ts	testis;
vd	vas deferens;
ve	ventricle;
vg	vaginal atrium;
vo	visceral oviduct;
W	width.

Geography

ES	Espírito Santo;
RJ	Rio de Janeiro.

Institutions

MNHN	Muséum national d'Histoire naturelle, Paris;
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MZSP Museu de Zoologia da Universidade de São Paulo, Brazil.

SYSTEMATICS

Superfamily NATICOIDEA Guilding, 1834

Family NATICIDAE Guilding, 1834

Genus *Microlinices* n. gen.

DIAGNOSIS. — Small size, *c.* 5 mm. Protoconch wide, of *c.* 1.5 whorl, smooth, simple. Surface simple, smooth, glossy, only with growth lines; sometimes with narrow shoulder. Colorless or with pale-brown pigmentation, no spots, mostly translucent. Callus narrow, restricted to upper half of inner lip; only partially covering upper region of umbilicus. Umbilicus open, varying from narrow to wide, central fold absent. Head-foot lacking eyes and pedal gland. Operculum horny, translucent, paucispiral. Opercular attachment with opercular scar simple, uniform. Oosphradium with few, but well-developed filaments; somewhat peduncular, with base much narrower than middle filamentary region. Proboscis broad and short. Odontophore possessing only basic muscles. Esophageal gland very large, occupying *c.* 80% or more of haemocoel. Penis simple, lacking appendices, not retractile. Pleural and cerebral ganglia fused with each other. Living in bathyal deep-waters (*c.* 400-1500 m).

TYPE SPECIES. — *Microlinices latiusculus* n. sp.

LIST OF INCLUDED TAXA. — Type species; *Microlinices ibitingus* n. gen., n. sp.; *M. benthovus* n. gen., n. sp.; *M. ombratus* n. gen., n. sp.; *M. apiculus* n. gen., n. sp.; *M. gaiophanis* n. gen., n. sp.

GENDER. — Masculine.

ETYMOLOGY. — The generic name is a contraction of the Greek word *mikros*, meaning small, little, with one of the most diverse genus of the family, *Polinices* Montfort, 1810, normally used to accommodate the horny-operculated species.

TAXONOMIC DISCUSSION

The small size, i.e. the adult specimens mostly with less than 5 mm, is one of the most distinctive characters of *Microlinices* n. gen., as normally the naticids are relatively medium to large snails, easily reaching 30-40 mm and more of shell length. However, some specimens of *Microlinices benthovus* n. gen., n. sp. may reach about 10 mm. Besides, the characteristic shell of *Microlinices* n. gen. is relatively simple, lacking sculpture, spots, etc. which are common in other

naticid genera. The umbilicus is poorly covered by the callus, and it completely lacks a middle fold, which are found in most genera except the more basal ones, like *Amauropsis* Mörch, 1857, and *Lunatia* Gray, 1847 (Simone 2011). *Microlinices* n. gen. differs from both genera by the already mentioned much smaller size, in lacking a well-developed periostracum, by its relatively thick shell walls, and in having a paucispiral protoconch. *Microlinices* n. gen. still differs from other simple-shelled genera, such as *Pseudopolinices* Golikov & Sirenko, 1983, and *Bulbus* Brown, 1839 in being much smaller (species of those genera are over 15 mm), with thinner callus and by the lack of the umbilical central fold. No other naticid genera can be confused with *Microlinices* n. gen., as the juvenile specimens of other genera with equivalent size of *Microlinices* n. gen. usually have fewer shell whorls, up to three.

Despite the relatively poor anatomical knowledge on the naticids, most genera have been anatomically studied elsewhere (Simone 2011), therefore, it is possible to infer that the set of anatomical characters reported in the Diagnosis is exclusive of *Microlinices* n. gen., warranting the generic separation. The considered most important feature is the peduncle-like and few-filamentary osphradium. This is an apomorphic feature never found in any naticid, and demonstrates that the genus is a monophyletic assemblage, instead of an artificial arrangement of minute, simple shelled, deep-water species. On the other hand, most anatomical features, mainly the short pleurembolic proboscis possessing an accessory boring organ, points to the naticid nature of the genus. Other inferences are given in phylogenetic analysis below.

The odontophore is relatively simplified, as only the so called basic muscles (sensu Simone 2011) are discernible. Some muscles that are found in other naticids, such as m7, m14, are absent in the species of *Microlinices* n. gen. so far studied; despite a pair of m7 that is found in *M. benthovus* n. gen., n. sp. (Fig. 7G).

Microlinices latiusculus n. gen., n. sp.
(Figs 1A-K; 2A-H; 3A-E; 11D, E)

HOLOTYPE. — MNHN 27126, 1 ♀.

PARATYPES. — MNHN 27127, 14 shells, 2 ♂♂, 3 ♀♀; MZSP 105134, 4 shells from type locality.

TYPE LOCALITY. — **Brazil**. Rio de Janeiro: off Arraial do Cabo, MD55 sta. CB104, 23°41'S, 42°06'W, 430–450 m, 01.VI.1987 (coll. Bouchet, Leal & Métivier).

DIAGNOSIS. — Shell *c.* 4 mm, *c.* 92% taller than wide. Umbilicus widely open, ¼ of upper area covered by callus, inner middle fold absent. Sculpture lacking, surface glossy, translucent white. Protoconch low, dome-shaped, of 1.5 whorls. Spire angle *c.* 120°.

DESCRIPTION

Shell (Fig. 1A–F)

Diameter of *c.* 4 mm; height *c.* 92% of width; general form globose-somewhat discoid. Color translucent white; thin periostracum pale brown in peri-umbilical area (Fig. 1A, D–F). Protoconch simple, dome-shaped, of 1.5 flattened whorls (Fig. 1C); surface smooth, glossy; diameter *c.* 0.8 mm, occupying *c.* 18% of upper shell surface. Teleoconch of *c.* 2.0 whorls; suture well-marked by angle *c.* 135° (Fig. 1B, E); spire angle *c.* 120°. Sculpture absent except for growth lines and axial weak undulations; undulations slightly stronger in subsutural region (Fig. 1D, E). Aperture semicircular, narrow, occupying *c.* 70% of shell height and *c.* 43% of shell width; outer lip thick, prosocline weak (Fig. 6D), simple; inner lip slightly concave to almost straight (Fig. 1A, D, E), upper half covered by thick callus, lower half as thick edge (Fig. 1A, D). Umbilicus very widely open, lacking middle fold; *c.* ¼ covered by callus with straight-oblique, concave edge; its aperture occupying *c.* 21% of lower surface, possessing strong axial irregular undulations (Fig. 1D).

Head-foot (Figs 2A–C, F; 3D)

Head slightly protruded, pair of tentacles uniformly tapering up to pointed tip; eyes absent; tentacles separated from each other by distance *c.* 3 × tentacles width. Head as short flap uniting both tentacles (Figs 2F; 8D). Rhinchostronge in middle region of head ventral side; thick edged, accessory boring organ normally exposed inside. Foot broad, of *c.* ½ whorl (Fig. 2A); propodium from foot anterior edge up to flap covering head ventrally; mesopodium with thick edges, sole

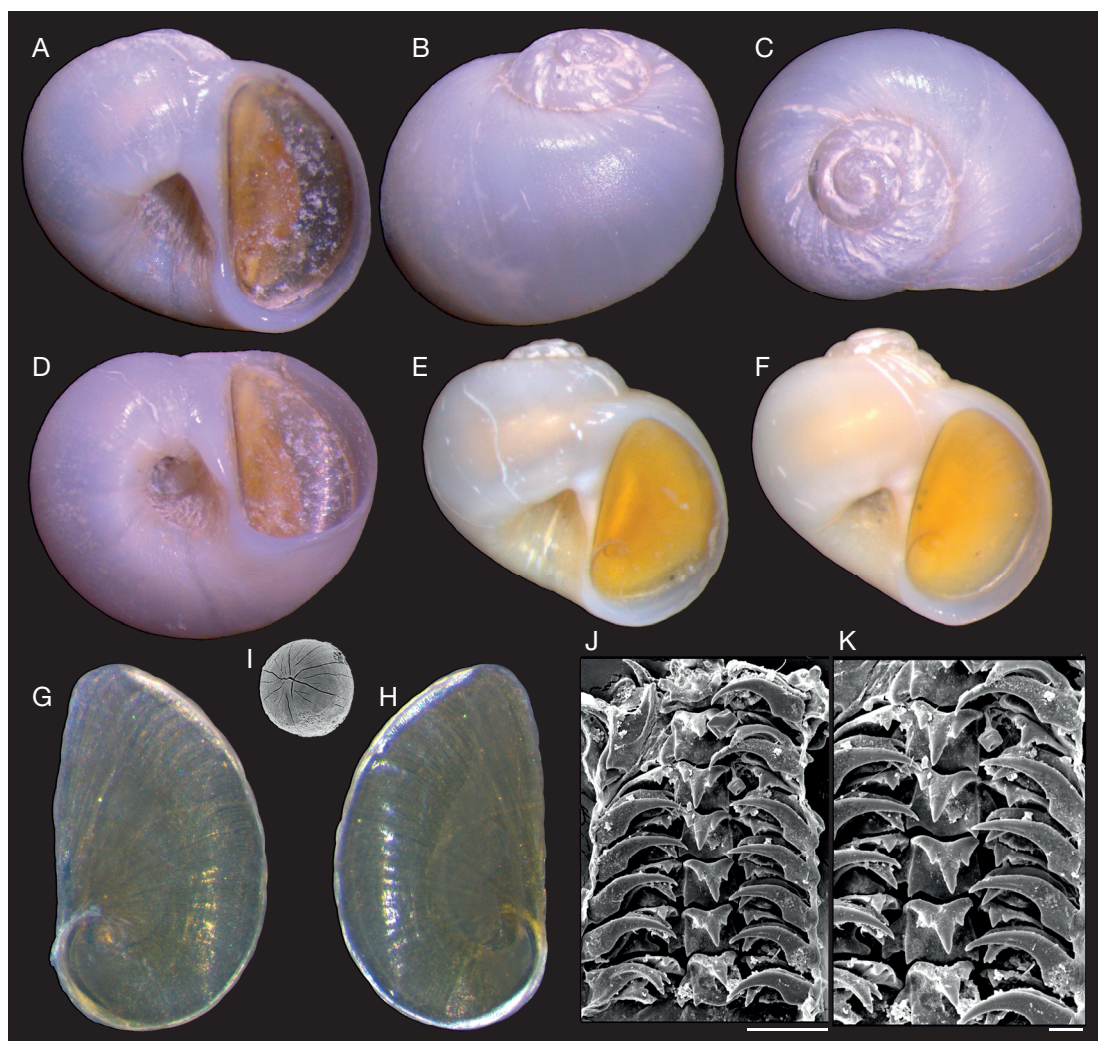


FIG. 1. — *Microlinices latiusculus* n. gen., n. sp.: **A-D**, holotype MNHN; **A**, apertural-slightly umbilical view; **B**, dorsal view; **C**, apical view; **D**, umbilical view; **E**, paratype MNHN (sta. 104), apertural view; **F-H**, another more globose specimen (sta. 104): **F**, apertural view; **G**, operculum, outer view; **H**, inner view; **I**, statocyst in SEM; **J, K**, radula in SEM extracted from dry specimen. Measurements: A-D, W 4.1 mm; E, W 4.3 mm; F, W 3.7 mm; G, H, W 2.5 mm; I, W 0.1 mm. Scale bars: J, 20 μ m; K, 10 μ m.

(Fig. 2C) simple, small notch preceding anterior edge. Opercular pad (Fig. 2A, B [oa]) with thick edges, extending beyond mesopodium. Columellar muscle (Fig. 2B [cm]) wide, of *c.* $\frac{1}{4}$ whorl. Haemocoel relatively small, occupying *c.* 20% of head-foot volume, mostly filled with foregut (Fig. 2F). Diaphragmatic septum thin, compressed by esophageal gland.

Operculum (Fig. 1G, H)

Semi-circular, thin, corneous, flexible, occupying entire aperture. Nucleus in middle of inner to lower quadrant; spiral sculpture with 2 whorls, low, weakly visible; low undulations parallel to inner edge. Inner surface smooth, glossy; scar elliptical (twice wider than long), closer to inner edge, occupying *c.* 40% of inner surface (Fig. 1H).

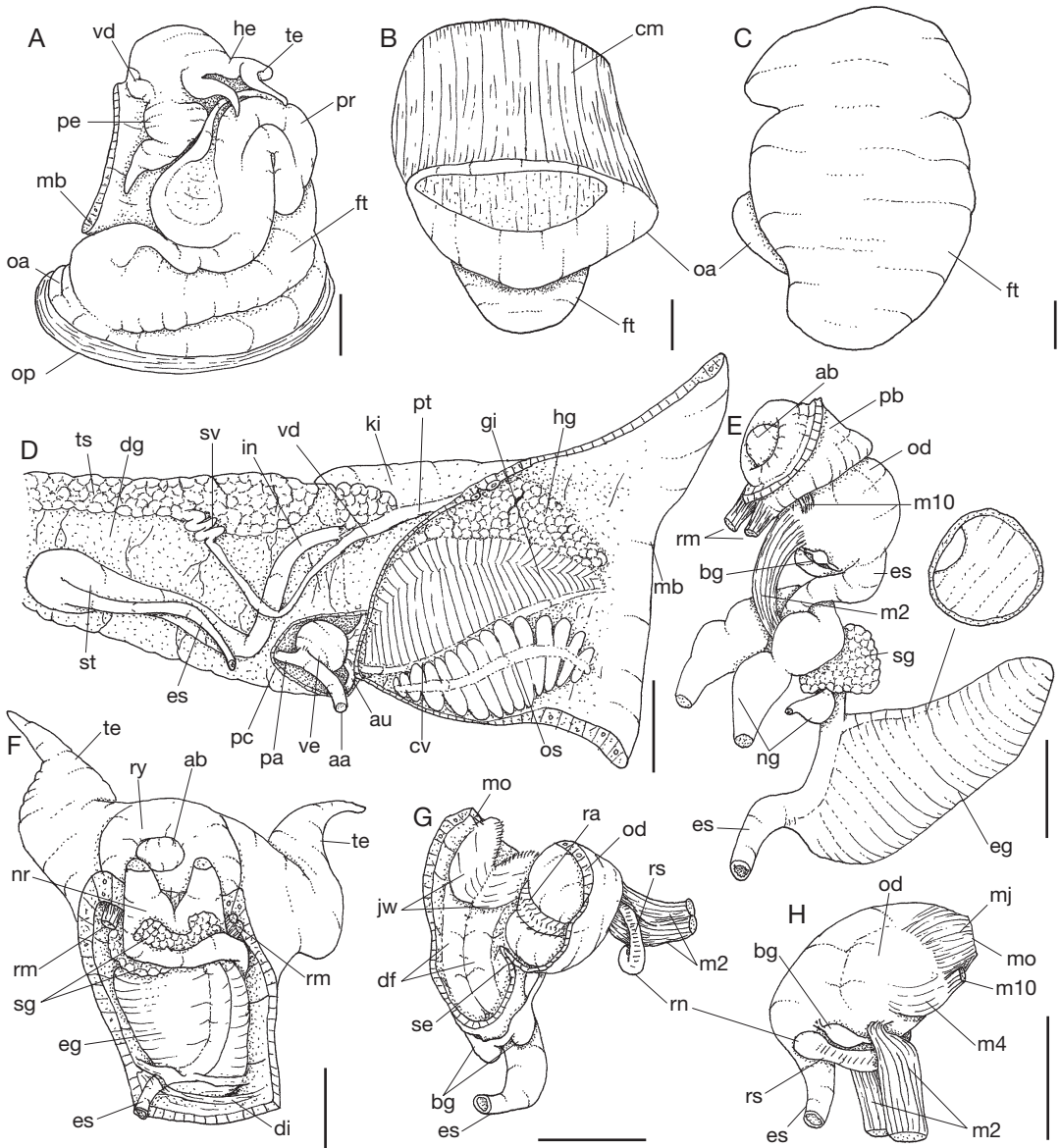


FIG. 2. — *Microlinices latiusculus* n. gen., n. sp. anatomy; **A–C**, head-foot, male: **A**, frontal view; **B**, dorso-posterior view; **C**, ventral view (foot sole); **D**, pallial cavity roof and last whorl of visceral mass, ventral view, digestive gland portion ventral to stomach and ventral region of pericardium removed; **E**, foregut, left view, transverse section of indicated region of esophageal gland shown; **F**, head and haemocoel, ventral view, foot removed; **G, H**, buccal mass, right view, odontophore partially deflected. Abbreviations: see Material and methods. Scale bars: 0.5 mm.

Mantle organs (Fig. 2D)

Pallial cavity triangular, of *c.* $\frac{1}{3}$ whorl. Osphradium occupying *c.* $\frac{1}{4}$ of pallial hoof area; 14–16 filaments

on right side, 10–12 on left side; anterior third slightly curved to left. Each osphradium filament relatively thick, its base narrower than middle portion, pro-

jected outside, covering neighbor structures such as ctenidial vein. Gill slightly larger than osphradium; blunt anterior end, wider region between middle and posterior regions; each filament triangular, about as tall as wide, apex central. Ctenidial vein simple, narrow. Hypobranchial gland relatively thick, white, occupying area between gill and rectum. Rectum and genital structures running in left-ventral region, relatively narrow (possibly immature); anus simple, located between middle and anterior thirds of cavity.

Visceral mass (Fig. 2D)

Of *c.* three whorls posterior to pallial cavity. Kidney and pericardium as anterior structures, kidney encroaching right-posterior region of pallial cavity; occupying *c.* $\frac{1}{6}$ of visceral volume. Pericardium with *c.* $\frac{1}{2}$ of kidney volume, located on opposed side, slightly more posteriorly. Digestive gland pale beige, occupying most of visceral volume. Gonad also pale beige, located in right and columellar side of each whorl posterior to kidney. Stomach narrow, located longitudinally *c.* $\frac{1}{2}$ whorl posterior to pallial cavity.

Circulatory and excretory systems (Fig. 2D)

Pericardium just posterior to gill posterior end, with small portion dorsal to gill. Auricle small and short, connected both to ctenidial vein and kidney anterior-left side. Ventricle with *c.* $\frac{1}{2}$ of pericardium volume, rounded and simple. Aortas in postero-left side of ventricle; anterior aorta *c.* $3 \times$ wider than posterior aorta. Kidney mostly solid, white, dorsal and right regions entirely filled by solid lobe, ventral-left region narrowly hollow. Nephridial gland narrow, located between kidney and pericardium. Nephrostome as slit in left side of membrane between kidney and pallial cavity.

Digestive system (Figs 2D-H; 3A-C)

Pleurembolic proboscis (Figs 2E; 3D [pb]) short, occupying *c.* $\frac{1}{8}$ of haemocoel length in retracted condition. Accessory boring organ rounded, located in apical proboscis region, in ventral side of mouth. Pair of retractor muscles in ventro-lateral region of proboscis base, originating in lateral-anterior region of haemocoel floor, running converging to medial region, inserting along ventral wall of proboscis. Buccal mass spherical *c.* $3 \times$ larger than

proboscis, protruding posteriorly beyond it in retracted condition. Pair of jaw plates (Fig. 2G [jw]) large, thick, occupying most of dorsal surface of oral cavity; antero-medial edge serrated. Pair of dorsal folds of buccal cavity wide, running close to each other. Pair of salivary gland clustering posteriorly to nerve ring (Fig. 2E [sg]); ducts very narrow, running through nerve ring attached to anterior esophagus; opening in anterior region of dorsal folds. Odontophore spherical (Fig. 2E, G [od]), occupying same volume as proboscis.

Odontophore muscles (Fig. 3A-C)

mj. Pair of peri-buccal and jaw muscles, thick, originating in lateral and anterior surface of odontophore cartilages, running anteriorly splaying in oral tube.

m1l. Two pairs of lateral protractor jugal muscles (Fig. 3A, B), one parallel to each other, originating in latero-ventral surface of proboscis, running towards dorsal, flanking odontophore lateral side *c.* $\frac{1}{2}$ odontophore width, inserting superficially in latero-dorsal region of odontophore.

m2. Pair of thick retractor muscles of odontophore, originating in middle level of haemocoel ventral surface, part (*c.* $\frac{1}{3}$) passing through nerve ring and part (*c.* $\frac{2}{3}$) running ventrally to it (Fig. 2E), running towards anterior close to median line and attached to each other, inserting in median region of odontophore posterior surface, surrounding radular sac (Fig. 3A, B), mostly on m4.

m4. Pair of thick dorsal tensor muscles of radula (Fig. 3C), originating in outer surface of odontophore cartilages just posterior and medial to origin of mj, surrounding entire ventral edge of cartilages, tensioning subradular membrane, additionally inserting in tissue of radula preceding oral cavity (Fig. 3C [ir]).

m5. Pair of narrow and short auxiliary dorsal tensor muscles of radula (Fig. 3C), originating in posterior end of odontophore cartilages, running towards anterior and medial, inserting on radula in its portion preceding oral cavity, length *c.* $\frac{3}{5}$ of cartilage length.

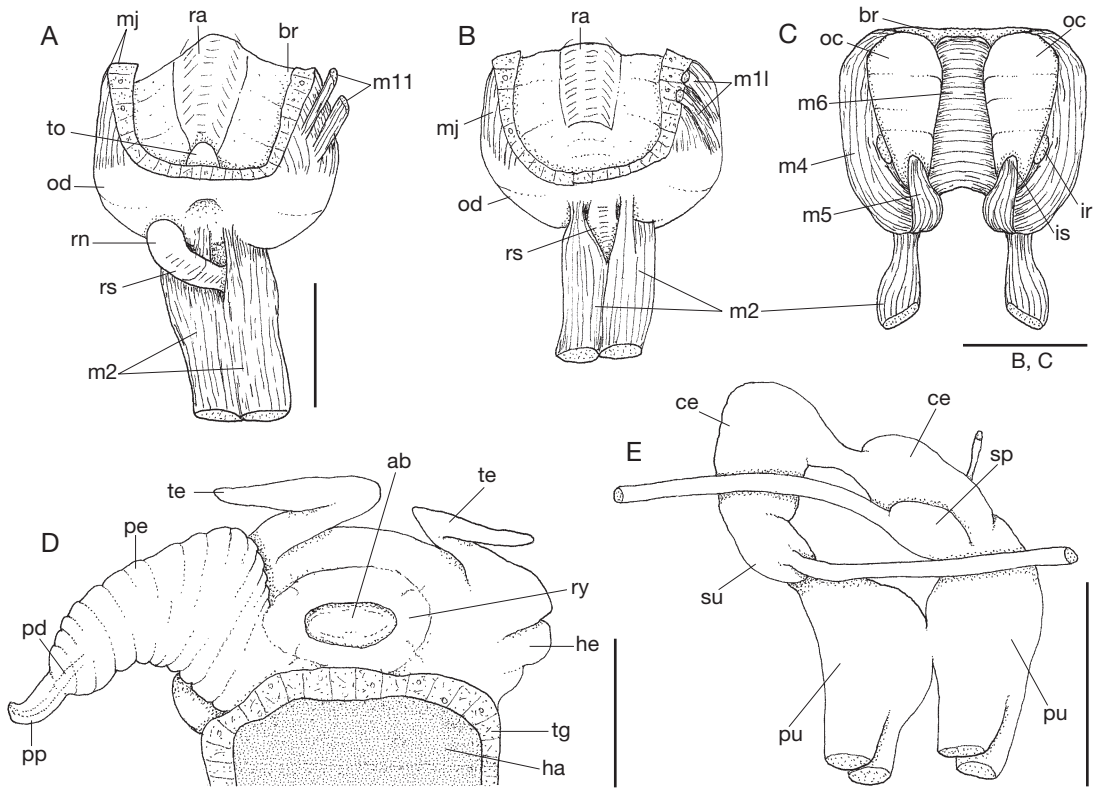


FIG. 3. — *Microlinices latiusculus* n. gen., n. sp. anatomy: **A–C**, odontophore: **A**, dorsal view, oral tube and some superficial muscles removed; **B**, ventral view; **C**, dorsal view, superficial layer of muscles and membranes removed, both odontophore cartilages deflected; **D**, head, male, ventral view, foot removed; **E**, nerve ring, ventral view. Abbreviations: see Material and methods. Scale bars: 0.5 mm.

m6. Horizontal muscle, connecting both ventro-medial edges of odontophore cartilages along almost their entire length, width *c.* $\frac{3}{4}$ of cartilages width.

m10. Pair of small and thin odontophore protractor muscles (Fig. 2E), originating in lateral region of mouth, inside proboscis, running towards posterior covering lateral edges of oral tube along *c.* $\frac{1}{3}$ of proboscis length, inserting in latero-anterior surface of odontophore.

oc. Odontophore non-muscular structures, pair of odontophore cartilages, somewhat elliptical, anterior region slightly wider than posterior region, *c.* twice longer than wide, *c.* $3 \times$ wider than thick.

to. Tissue on radula occluding radular sac in region preceding oral cavity (Fig. 3A).

sc. Subradular cartilage, transparent, thin but strong, running all along radula holding teeth, expanding in oral cavity forming cover to odontophore, protecting br.

br. Subradular membrane, covering internally subradular cartilage and building it.

Radula (Figs 1J, K; 11D, E)

Rachidian. About as long as wide, occupying *c.* $\frac{1}{5}$ of radular width, triangular, strongly bent in middle level, forming anterior shallow concavity, 3 terminal pointed cusps being median cusp *c.* twice larger than lateral cusps and about as long as basal length, pair of basal cusp in edges of base; pair of rachidian expansions, triangular, wing-like, wider distally ending in small cusp same sized as basal

rachidian cusps, expansions widening rachidian *c.* 50%.

Lateral tooth. Similar to rachidian, but strongly turned medially, *c.* twice rachidian width, 3 terminal cusps, being middle cusp *c.* twice larger than remaining cusps.

Inner marginal tooth. Similar to lateral tooth in form and length, but slightly narrower and with only 2 terminal cusps, outer cusps about twice inner cusp's size.

Outer marginal tooth. Hook-like, same length as inner marginal, terminal cusp single, sharply pointed, base wide, with small blunt projection on base of distal concavity. Radular sac relatively narrow, almost twice odontophore length. Anterior esophagus originating just posterior to odontophore (Fig. 2E [es]), *c.* twice odontophore length, *c.* $\frac{1}{8}$ odontophore width; inner surface simple, smooth. Middle esophagus as base of esophageal gland, with *c.* $\frac{1}{2}$ anterior esophagus length. Esophageal gland as wide ventral expansion of mid esophagus (Fig. 2E [eg]), *c.* half expanded anteriorly as blunt beak; size *c.* $\frac{3}{4}$ of haemocoel volume (Fig. 2F); internally filled by transverse glandular septa, except for narrow dorsal canal. Posterior esophagus as long and wide as anterior esophagus (Fig. 2D [es]). Stomach as simple curve and expansion, *c.* 5 $\times$ wider than adjacent esophagus, dorso-ventrally flattened; wider (posterior) region with *c.* $\frac{1}{4}$ adjacent width of visceral mass; inner surface smooth, simple. Stomach gradually narrowing anteriorly, with no clear separation from intestine. Intestine (Fig. 2D [in]) slightly broader than esophagus; with perpendicular curve in left side, just posterior to pericardium; crossing from left to right sides in visceral mass portion preceding kidney; in kidney cavity crossing through kidney lobe. Rectum and anus described above.

Genital system

Male (Figs 2A, D; 3D). Testis lying in right and columellar side of visceral coils, cream in color; anterior end just posterior to kidney. Seminal vesicle simple zigzags located subterminally in left-ventral

side of testis (Fig. 2D [sv]), restricted to short distance (*c.* $\frac{1}{8}$ whorl). Vas deferens running in perpendicular curve flanking postero-ventral border of pallial cavity (Fig. 2D [vd]), narrow; becoming slightly broader in pallial cavity right edge as prostate gland (Fig. 2D [pt]). Vas deferens running somewhat sinuously in right edge of pallial cavity floor (Fig. 2A [vd]) up to right side of penis base. Penis originated in ventro-right side of head, near side of rhynchostome (Fig. 3D [pe]); size *c.* $\frac{1}{8}$ that of head-foot (Fig. 2A [pe]); base wide and slightly flattened, gradually tapering up to sharply pointed tip; terminal papilla pointed, with *c.* $\frac{1}{5}$ remaining penis length and width (Fig. 3D [pp]). Penis duct simple, non-sinuous, running along middle region of penis; opening at penis tip.

Female. Visceral structures similar to those analogous in the males. Pallial oviduct occupying *c.* $\frac{1}{4}$ of pallial cavity. Albumen and capsule glands mixed with each other in coiled pattern. Female aperture simple, close to anus.

Central nervous system (Fig. 3E)

Located at base of proboscis (Fig. 2E, F). Cerebral and pleural ganglia fused with each other, each cerebro-pleural ganglia with approximately same size as adjacent esophagus section, form spherical. Cerebral commissure *c.* $\frac{1}{4}$ narrower than ganglia, with *c.* $\frac{1}{2}$ length of each ganglion. Sub- and supra-esophageal ganglion located close to cerebral ganglia. Pedal ganglia *c.* $\frac{1}{2}$ larger than cerebro-pleural ganglia, spherical, closed placed to each other. Each one with pair of anterior nerves. Statocyst ventral to pedal ganglia, with large statolith each (Fig. 1I). Pair of buccal ganglia (Fig. 2E, G [bg]) located in region between odontophore and esophagus; buccal commissure very narrow, as long as each ganglion.

Measurements (width and height in mm)

Holotype (Fig. 1A-D): 4.1 $\times$ 4.3.

Paratype: MNHN, 1 ♀ (sta. 104; Fig. 1E): 4.3 $\times$ 4.1; 2 ♂♂ (Fig. 1F): 3.7 $\times$ 3.3.

Habitat

430–450 m depth, muddy bottoms.

Etymology

The specific epithet is a diminutive of the Latin word *latus*, meaning broad, wide, an allusion to the wide shape of the shell.

Microlinices ibitingus n. gen., n. sp.

(Figs 4A-G; 5A-F; 11E, G)

HOLOTYPE. — MNHN 27128.

PARATYPES. — MNHN 27129, 3 shells; MZSP 105250, 3 shells from type locality. Brazil (MD55; coll. Bouchet, Leal & Métivier). Espírito Santo: off Itaúnas, slope of Abrolhos (27.V.1987); 18°58'S, 37°48'W, 1200 m, MNHN 27130, 4 shells (sta. CB78), 18°58'S, 37°48'W, 682 m, MNHN 27131, 1 shell (sta. SY74); 18°58'S, 37°49'W, 367 m, MNHN 27132, 16 shells; MZSP 105252, 6 shells (sta. CB76); 18°59'S, 37°48'W, 607-620 m, MNHN 27133, 7 shells; MZSP 105251, 3 shells (sta. DC73); 19°00'S, 37°48'W, 950-1050 m, MNHN 27134, 2 shells (sta. DC72); 19°01'S, 37°47'W, 1500-1575 m, MNHN 27135, 3 shells (sta. CB79); off Regência, off mouth of Rio Doce, 19°36'S, 38°53'W, 640 m, MNHN 27136, 1 ♀, 4 shells (sta. CB93, 30.V.1987). Rio de Janeiro: off Cape of São Tomé, 21°34'S, 40°05'W, 750 m, MNHN 27137, 1 shell (sta. DS08, 10.V.1987).

TYPE LOCALITY. — Brazil, Espírito Santo: off Regência, 19°40'S, 37°48'W, 790-940 m (MD55 sta. CB77; coll. Bouchet, Leal & Métivier, 27.V.1987).

DIAGNOSIS. — Shell *c.* 10 mm, *c.* 105-120% taller than wide. Umbilicus open, upper part covered by thick callus, inner middle fold absent; low peri-umbilical carina. Sculpture lacking, surface glossy, translucent white with pure white subsutural band. Protoconch wide, dome-shaped, of 1.5 whorls. Spire angle *c.* 110°.

DISTINCTIVE DESCRIPTION

Shell (Fig. 4A-F)

Diameter of *c.* 10 mm; height *c.* 105-120% of width; general form globose. Color translucent white; broad subsutural pure white band, lower border unclear, occupying *c.* 15% of body-whorl area (Fig. 4B, C, E). Protoconch dome-shaped, of 1.5 flattened whorls (Fig. 4E, F); surface smooth, glossy; diameter *c.* 1.5 mm, occupying *c.* 15% of upper shell surface. Teleconch of *c.* 2.5 whorls; suture well-marked by angle *c.* 150° (Fig. 4A-C);

spire angle *c.* 110°. Sculpture absent except for growth lines and axial weak undulations; undulations stronger in subsutural region (Fig. 4E, F). Aperture semicircular, wide, occupying *c.* 70% of shell height and *c.* 48% of shell width; outer lip thick, weakly prosocline (Fig. 4B), simple; inner lip slightly concave to almost straight (Fig. 4A, D), upper half covered by thick callus, lower half as thick edge (Fig. 4A). Umbilicus lacking middle fold, wide, open; *c.* ¾ covered by callus with straight-oblique edge; its aperture occupying *c.* 15% of lower surface; umbilicus protected by peripheral, low carina (Fig. 3D).

Head-foot (Fig. 5C)

General organization as those described for *Microlinices latiusculus* n. gen., n. sp., with main differences as follows: Tentacles separated from each other distance *c.* 2 × their width. Haemocoel occupying *c.* 30% of head-foot volume.

Operculum (Fig. 4G)

Characters similar to those of preceding species, except in being weakly more rounded and with clearer spiral sculpture in region surrounding nucleus.

Mantle organs (Fig. 5A, B)

Most characters similar to those of *Microlinices latiusculus* n. gen., n. sp., with main differences as follows: Osphradium larger, occupying *c.* ⅓ of pallial hoof area; *c.* 30 filaments in right side, *c.* 25 in left side; anterior third curved to left. Each osphradium filament also with its base narrower than middle portion. Gill slightly more elongated; each filament triangular, about as tall as wide, apex central. Hypobranchial gland thick, white.

Visceral mass (Fig. 2D)

As described for preceding species.

Circulatory and excretory systems

Same characters as *Microlinices latiusculus* n. gen., n. sp.

Digestive system (Fig. 5C, E, F)

General organization as those of *Microlinices latiusculus* n. gen., n. sp., with main distinctions as follows:

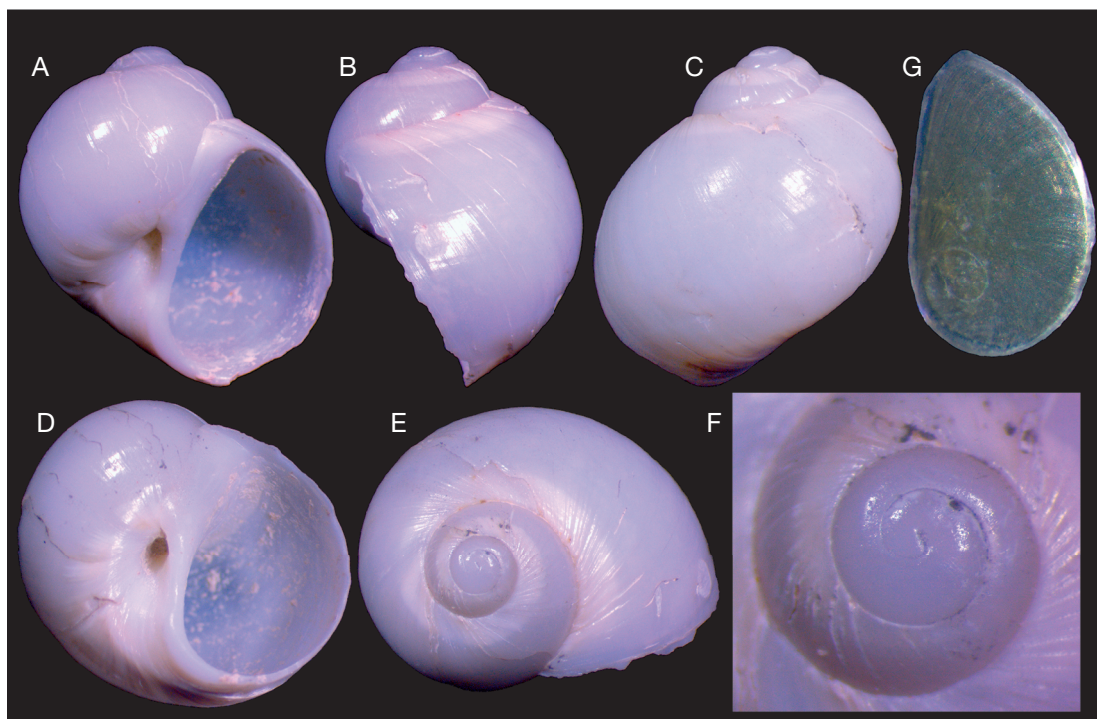


FIG. 4. — *Microlinices ibitingus* n. gen., n. sp., shell holotype: **A**, frontal view; **B**, right view; **C**, dorsal view; **D**, umbilical-slightly apertural view; **E**, apical view; **F**, detail of apex; **G**, operculum of specimen (sta. CB93), outer view. Measurements: A-F, W 10.1 mm; G, L 2.9 mm.

Pleurembolic proboscis occupying *c.* $\frac{1}{4}$ of haemocoel length in retracted condition. Odontophore muscles similar, except for slightly longer pair of m5. Radula (Fig. 11F, G) similar to that of *M. latiusculus* n. gen., n. sp., except for: rachidian with short bent tricuspid portion (*c.* $\frac{1}{2}$ – $\frac{3}{4}$ of base), lateral expansions *c.* 50% narrower, basal cusps turned perpendicularly to base (instead of distally); lateral tooth with terminal cusps slightly smaller, turned medially (instead of distally); inner marginal tooth forming small cusp in middle level of outer edge; outer marginal tooth slightly more curved in apex. Anterior esophagus with same width but *c.* 50% longer. Esophageal gland similarly-shaped, but with transverse septa strongly-marked, forming transverse folds in ventral and lateral surfaces. Midgut not seen.

Genital system

Male: not seen (only female available).

Female: not seen in details (pallial oviduct not fully mature).

Central nervous system (Fig. 5D)

Arrangement and localization (Fig. 5C) similar to those of preceding species. Single detected difference: pair of pedal ganglia with single main anterior nerve, preceded by shallow constriction.

Measurements (width and height in mm)

Holotype (Fig. 4A-F): 10.1 by 12.3.

Paratype: MZSP 105252: 10.3 $\times$ 10.5.

Habitat

640–1575 m depth, muddy bottoms.

Etymology

The specific epithet is derived from the native Tupy language, *ibitinga*, meaning white earth, an

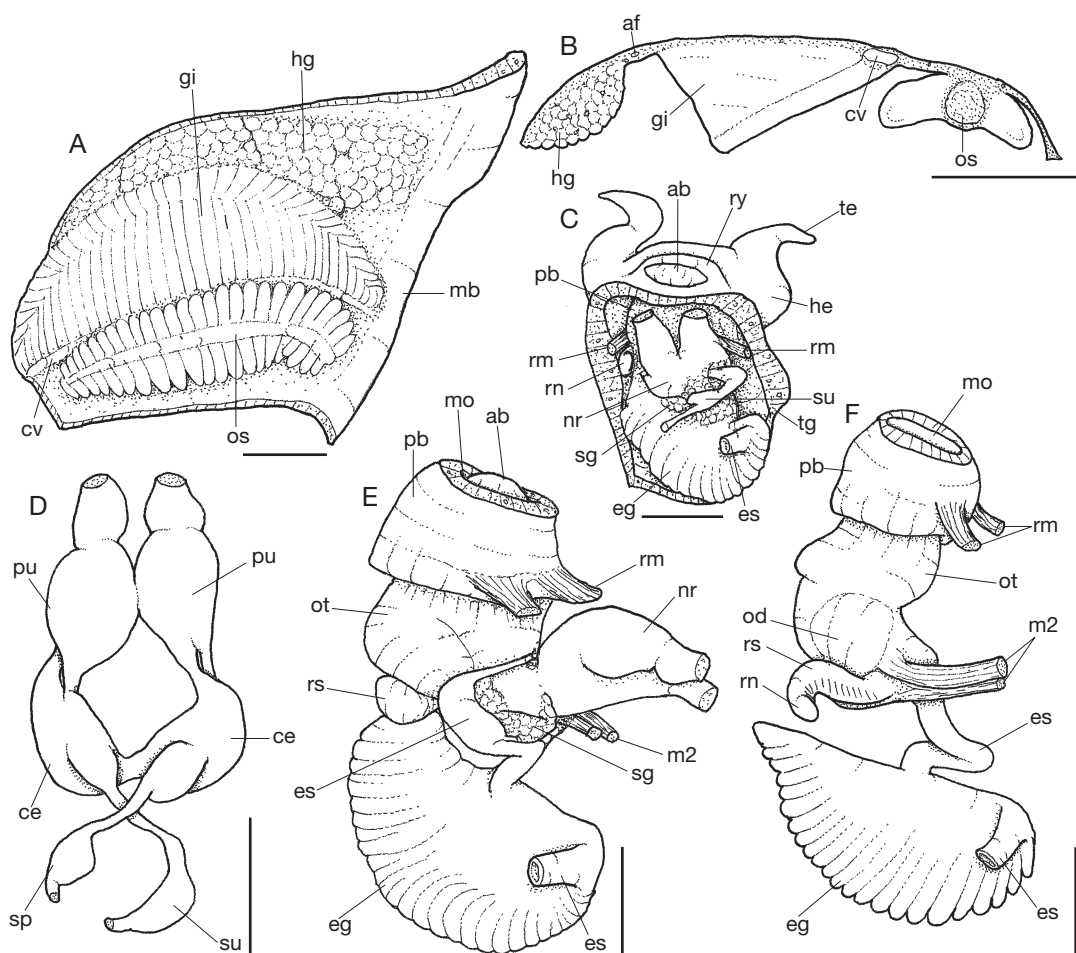


FIG. 5. — *Microlinices ibitingus* n. gen., n. sp., anatomy: **A**, pallial cavity roof, ventral view; **B**, same structure, transverse section on middle level of osphradium; **C**, head and haemocoel, ventral view, foot removed; **D**, nerve ring, ventral view; **E**, foregut as in situ, right-slightly ventral view, topology of nerve ring also shown; **F**, same structure, most structures uncoiled, right view. Abbreviations: see Material and methods. Scale bars: 0.5 mm.

allusion to the white subsutural band characteristic of the shell.

Microlinices benthovus n. gen., n. sp.
(Figs 6A-J; 7A-H; 11A-C)

HOLOTYPE. — MNHN 27138.

PARATYPES. — MNHN 27139, 37 shells, 1 ♂, MZSP 105250, 3 shells from type locality. Brazil (MD55; coll. Bouchet, Leal & Métivier), Espírito Santo: off Itáúnas,

slope of Abrolhos, sta. CB78, 18°58'S, 37°48'W, 1200 m, 27.V.1987, MNHN 27140, 1 shell, sta. SY74, 18°58'S, 37°48'W, 682 m, MNHN 27141, 22 shells, sta. DC73, 18°59'S, 37°48'W, 607-620 m, MNHN 27142, 22 shells, MZSP 105269, 5 shells, sta. DC70, 18°59'S, 37°47'W, 1540-1550 m, MNHN 27143, 4 shells, sta. DC72, 19°00'S, 37°48'W, 950-1050 m, MNHN 27144, 15 shells, MZSP 105270, 5 shells, sta. CB79, 19°01'S, 37°47'W, 1500-1575 m, MNHN 27145, 7 shells, MZSP 105272, 2 shells; off Regência, off mouth of Rio Doce, sta. CB93, 19°36'S, 38°53'W, 640 m, MNHN 27146, 10 shells, 2 ♀♀, sta. CB77, 19°40'S, 37°48'W, 790-940 m, 27.V.1987, MNHN 27147, 16 shells, MZSP 105271, 8 shells; Rio

de Janeiro: off Saquarema, sta. CB105, 23°46'S, 42°10'W, 610 m, 02.VI.1987, MNHN 27148, 1 shell.

TYPE LOCALITY. — **Brazil**. Espírito Santo: off Conceição da Barra, MD55 sta. CB76, 18°58'S, 37°49'W, 637 m, 27.V.1987 (coll. Bouchet, Leal & Métivier).

DIAGNOSIS. — Shell *c.* 5 mm, *c.* 105-140% taller than wide. Umbilicus open but narrow, $\frac{3}{4}$ upper area covered by thick callus, inner middle fold absent. Sculpture lacking, surface glossy, translucent white with pure white subsutural band barely visible. Protoconch mammillate, dome-shaped, of 1.5 whorls. Spire angle *c.* 80°.

DISTINCTIVE DESCRIPTION

Shell (Fig. 6A-F, I, J)

Diameter of *c.* 4 mm; height *c.* 105-140% of width; general form globose-elongate. Color translucent white; broad subsutural pure white band barely visible, lower border unclear, occupying *c.* 15% of body-whorl area (Fig. 6E, J). Protoconch mammillate, of 1.5 flattened whorls (Fig. 6E, F); surface smooth, glossy; diameter *c.* 0.9 mm, occupying *c.* 25% of upper shell surface. Teleoconch of *c.* 2.0 whorls; suture well-marked by angle *c.* 160° (Fig. 6B, C); spire angle *c.* 80°. Sculpture absent except for growth lines and weak axial undulations; undulations slightly stronger in subsutural region (Fig. 6E). Aperture semicircular, narrow, occupying *c.* 61% of shell height and *c.* 39% of shell width; outer lip thick, weakly prosocline (Fig. 6B), simple; inner lip slightly concave to almost straight (Fig. 6A, D, I, J), upper half covered by thick callus, lower half as thick edge (Fig. 6A, D). Umbilicus lacking middle fold, narrow, open; *c.* $\frac{3}{4}$ covered by callus with straight-oblique, concave edge; its aperture occupying *c.* 8% of lower surface, possessing strong axial irregular undulations (Fig. 6D).

Head-foot (Fig. 7A, B)

Characters similar to those of *Microlinices latiusculus* n. gen., n. sp., except for proportionally wider head.

Operculum (Fig. 6G, H)

Semi-circular, thin, corneous, flexible, occupying entire aperture. Nucleus in middle of inner to lower quadrant; spiral sculpture with 2 whorls, slightly scale-like; low undulations parallel to inner edge (Fig. 6G, I). Inner surface smooth,

glossy; scar elliptical (twice wider than long), closer to inner edge, occupying *c.* 40% of inner surface (Fig. 4H).

Mantle organs (Fig. 7C, E)

Most characters similar to those of *Microlinices latiusculus* n. gen., n. sp., remarks and distinctions as follows: Osphradium proportionally shorter, with fewer filaments (*c.* 11 at right, *c.* 7 at left); each filament narrow, flattened, separated from each other. Gill with more rounded anterior region; filaments with elongated, slightly rounded tip.

Visceral mass (Fig. 7E)

Organization similar to that of *Microlinices latiusculus* n. gen., n. sp.; length *c.* 2 whorls posterior to stomach.

Circulatory and excretory systems (Fig. 7E)

Same characters as *Microlinices latiusculus* n. gen., n. sp.

Digestive system (Fig. 7F, G)

Most features similar to those of *Microlinices latiusculus* n. gen., n. sp., remarks and distinctions as follows: Proboscis with narrow extra pair of ventral retractor muscles passing through nerve ring. Buccal mass *c.* 30 % smaller. Pair of jaw plates slightly ticker.

Odontophore muscles (Fig. 7G)

m2. With single insertion, in border between m4 and m5.

m5. Slightly more elongated.

m6. Shorter, *c.* $\frac{3}{4}$ of cartilages length.

m7. Narrow pair of muscles originating in subradular cartilage in its region ventral to m6, running posteriorly, penetrating inside radular sac, splaying in its internal surface.

m11. Narrow pair of ventral tensor muscles, originating in ventral-inner corner of odontophore cartilages, running towards anterior and lateral to both m7, inserting in subradular cartilages in distal (older) level of radula.

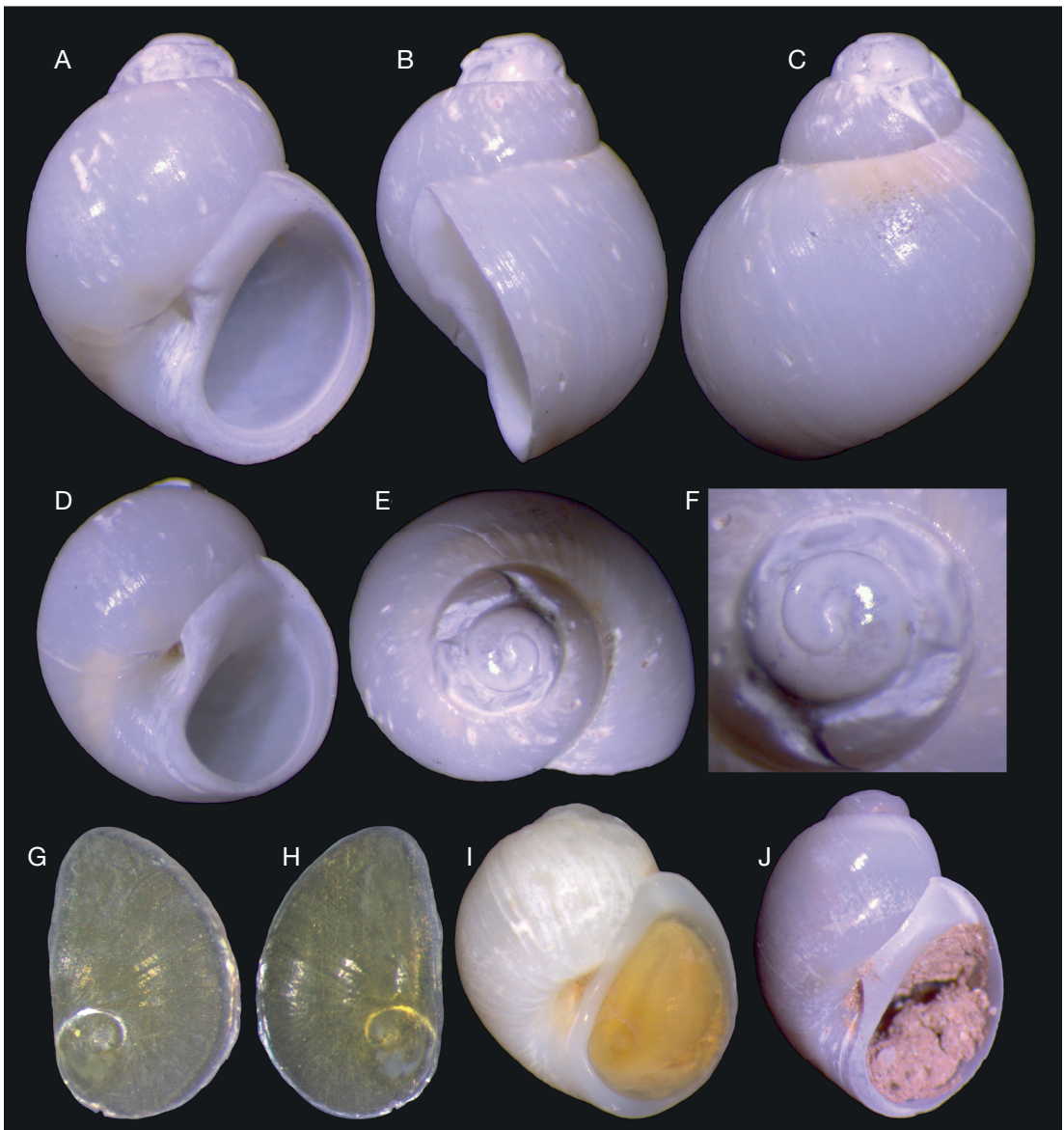


FIG. 6. — *Microlinices benthovus* n. gen., n. sp.: **A-F**, holotype: **A**, apertural view; **B**, right view; **C**, dorsal view; **D**, umbilical-slightly apertural view; **E**, apical view; **F**, detail of apex; **G, H**, operculum of paratype MNHN, 1 ♀: **G**, outer view; **H**, inner view; **I**, paratype MNHN, 1 ♀, apertural view, specimen still inside; **J**, paratype MZSP 105270, apertural view. Measurements: A-F, W 3.8 mm; G, H, 3.2 × 2.2 mm; I, W 4.8 mm; J, W 3.4 mm.

Radula (Fig. 11A-C)

Similar to that of *M. latiusculus* n. gen., n. sp., with following remarks: rachidian with shorter bent portion (c. $\frac{3}{4}$ of base length), and narrower

wing-like expansions, widening rachidian c. 30%; lateral tooth with basal cusp c. twice larger; inner marginal tooth with outer cusps about 3 × smaller than inner cusp's size; outer marginal tooth more

slender (Fig. 11B, C). Esophageal gland internally filled by transverse thick glandular septa, nearly solid. Stomach with wider esophageal insertion (Fig. 7E [es]); duct to digestive gland single and wide, at ventral base of esophagus insertion (Fig. 7E [dd]).

Genital system

Male (Fig. 7B, D). General organization similar to *Microlinices latiusculus* n. gen., n. sp., with following distinctions and remarks. Penis originated in right side of head, by side of right tentacle (Fig. 7B [pe]); size *c.* $\frac{1}{6}$ that of head-foot; base *c.* $10 \times$ wider than right tentacle, slightly flattened; *c.* $4 \times$ longer than wide; gradually tapering up to relatively rounded tip. Penis groove (Fig. 7D [pf]) open, simple, shallow, running along ventral region of penis; opening subterminally at penis tip.

Female (Fig. 7A, E). Structures mostly similar to those of *Microlinices latiusculus* n. gen., n. sp. Pallial oviduct (Fig. 7E [ov]) occupying *c.* $\frac{1}{4}$ of pallial cavity. Albumen and capsule glands mixed with each other in coiled pattern. Female aperture simple, transverse, preceded by region free from glands at *c.* $\frac{1}{8}$ of pallial oviduct length; located at some distance from to anus equivalent to *c.* $\frac{1}{9}$ of pallial cavity length.

Central nervous system (Fig. 7H)

Organization as that described for *Microlinices latiusculus* n. gen., n. sp., with following remarks: Supra-esophageal ganglion somewhat indistinct. Statocyst ventral and slightly lateral to pedal ganglia. Pair of buccal ganglia (Fig. 7F [bg]) about twice as large in proportion to adjacent buccal mass.

Measurements (width and height in mm)

Holotype (Fig. 6A-F): 3.8×4.0 .

Paratype: MNHN, 1 ♀ (sta. CB93) (Fig. 6I): 4.8×5.3 ; MZSP 105270 (Fig. 6J): 3.4×4.7 .

Habitat

607–1575 m depth, muddy bottoms (living specimens in 637–640 m).

Etymology

The specific epithet is derived from the Greek word *benthos*, meaning sea bottom, with the Latin *ovum*,

meaning egg. This is an allusion to the oval shape of the shell.

REMARKS

The degree of elongation of the shell has some variability, the shape is sometimes wider (Fig. 6I), while others are more elongated (Fig. 6A, J). The subsutural white band is only visible in few specimens (Fig. 6J) and only partially (Fig. 6C) or not seen in others.

Microlinices ombratus n. gen., n. sp. (Fig. 8A, B)

HOLOTYPE. — MNHN 27149.

TYPE LOCALITY. — **Brazil.** Espírito Santo: off Itaúnas, MD55 sta. CB79, $19^{\circ}01'S$, $37^{\circ}47'W$, 1500–1575 m depth, 25.V.1987 (coll. Bouchet, Leal & Métivier).

DIAGNOSIS. — Shell *c.* 3 mm, *c.* 84% taller than wide. Umbilicus open, narrow and simple. Sculpture lacking, subsutural narrow shoulder present. Protoconch flattened, of 1 whorl. Spire angle *c.* 70° .

DESCRIPTION

Shell (Fig. 8A, B)

Diameter of 2.7 mm; height *c.* 120% of width; general form somewhat tall turbinoid. Color pale brown. Protoconch flattened, of 1 rounded whorl; surface smooth, eroded; diameter *c.* 0.5 mm, occupying *c.* 20% of upper shell surface. Teleoconch of *c.* 3 whorls; suture marked by subsutural shoulder, performing angle of *c.* 110° in relation to whorl's profile; upper surface of shoulder planar and almost horizontal, occupying *c.* 10% of whorl's area; spire angle *c.* 70° . Sculpture absent except for growth lines and axial weak undulations; undulations stronger in umbilicus. Aperture oval, narrow, occupying *c.* 55% of shell height and *c.* 44% of shell width; outer lip thick, orthocline, simple; inner lip widely concave, upper half covered by thin callus, lower half as thick edge (Fig. 8A). Umbilicus simple, narrow, open; its aperture occupying *c.* 6% of lower surface.

Measurements (width and height in mm)
Holotype (Fig. 8A, B): 3.2×2.7 .

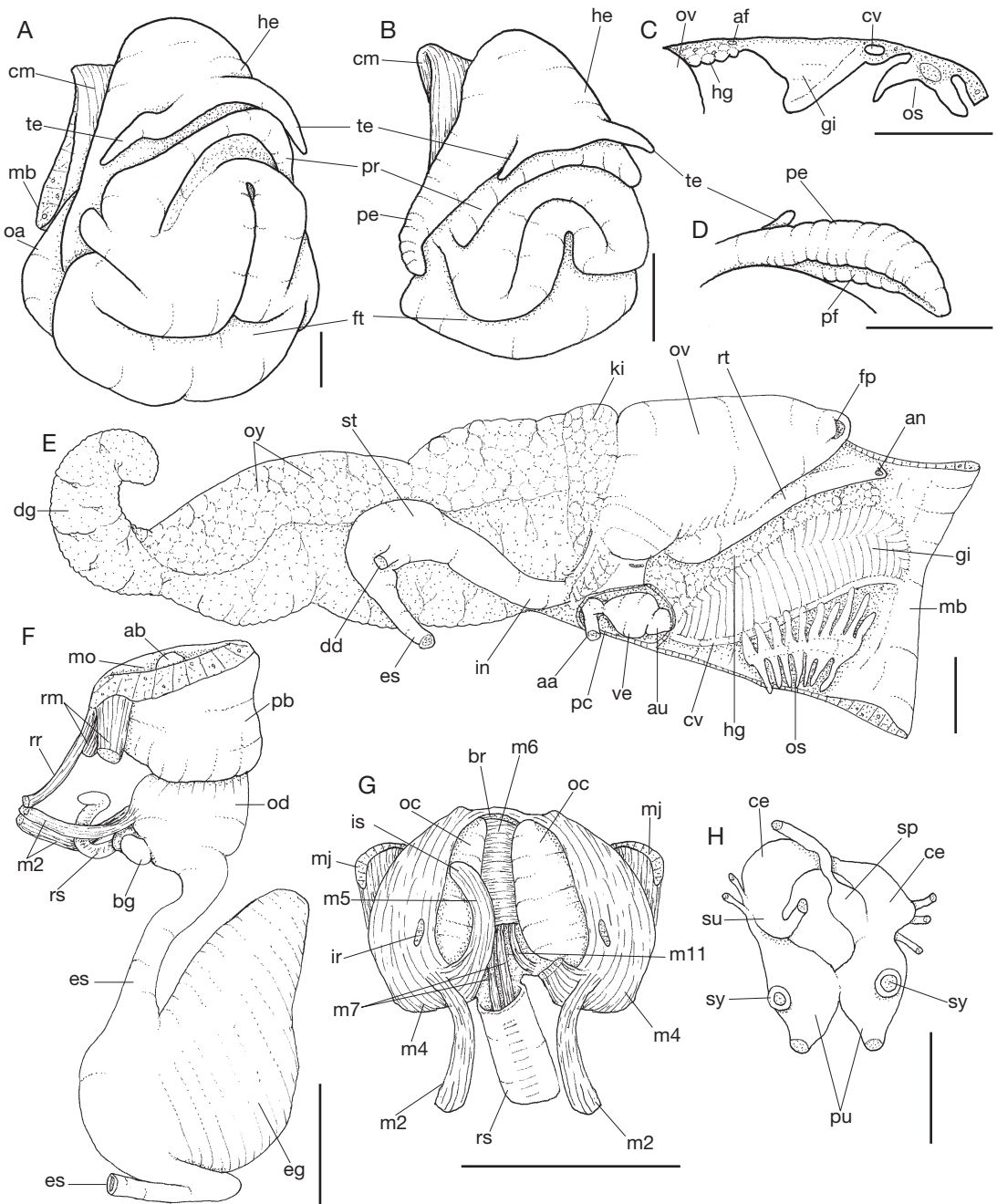


FIG. 7. — *Microlinices benthovus* n. gen., n. sp., anatomy: **A**, **B**, head-foot, frontal view: **A**, female; **B**, male; **C**, pallial cavity hoof, female, transverse section in middle level of osphradium; **D**, penis, ventral view, some adjacent structures also shown; **E**, pallial cavity roof and visceral mass, ventral view, digestive gland portion ventral to stomach and ventral region of pericardium removed; **F**, foregut, left view; **G**, odontophore, dorsal view, superficial layer of muscles and membranes removed, both odontophore cartilages deflected, radular sac only partially shown; **H**, nerve ring, ventral view. Abbreviations: see Material and methods. Scale bars: 0.5 mm.

Habitat

1500-1575 m depth, compact blocks (no living specimen collected).

Etymology

The specific epithet is derived from the Portuguese word *ombro*, meaning shoulder, an allusion to the shoulder-like subsutural carina, characteristic of the species.

Microlinices apiculus n. gen., n. sp. (Fig. 8C-G)

HOLOTYPE. — MNHN 27150.

PARATYPES. — MNHN 27151, 9 shells; MZSP 105146, 6 shells from type locality.

TYPE LOCALITY. — **Brazil**. Espírito Santo: off Conceição da Barra, MD55 sta. CB76, 18°58'S, 37°49'W, 637 m, 27.V.1987 (coll. Bouchet, Leal & Métivier).

DIAGNOSIS. — Shell *c.* 5 mm, *c.* 105-118% taller than wide. Umbilicus open, narrow, upper region covered by thick callus, inner middle fold wanting. Sculpture lacking, surface opaque, white. Protoconch blunt, of 1.5 whorls, normally eroded. Spire angle *c.* 90-110°.

DESCRIPTION

Shell (Fig. 8C-G)

Diameter of *c.* 5 mm; height *c.* 105-118% of width; general form globose. Color pure white, mostly with irregular erosion furrows scantily splayed on older portions. Protoconch blunt, of 1.5 rounded whorls (Fig. 8D, F); surface smooth, opaque; diameter *c.* 0.9 mm, occupying *c.* 18% of upper shell surface. Teleoconch of *c.* 2.5 whorls; suture well marked; spire angle *c.* 90-110° (Fig. 8D, G). Sculpture absent except for growth lines and axial weak undulations; undulations slightly stronger in umbilicus. Suture shallow, marked by subsutural low shoulder at angle of *c.* 130° (Fig. 6D, E). Aperture semicircular, wide, occupying *c.* 70% of shell height and *c.* 43% of shell width; outer lip thick, weakly prosocline (Fig. 8E), simple; inner lip slightly concave to almost straight (Fig. 8C, G), upper half covered by callus, about as wide as lower half. Umbilicus lacking middle fold, narrow, open; *c.* ½ covered by callus with

straight, vertical edge; its aperture occupying *c.* 5% of lower surface.

Measurements (width and height in mm)

Holotype (Fig. 8C-F): 5.3 × 5.6.

Paratype: MZSP 105146 (Fig. 8G): 4.4 × 5.2.

Habitat

367 m depth, muddy bottoms (no living specimens).

Etymology

The specific epithet is derived from the Latin word *apiculus*, meaning point, tip, an allusion to the pointed apex of the shell.

Microlinices gaiophanis n. gen., n. sp. (Fig. 8H-K)

HOLOTYPE. — MNHN 27152.

Paratype. — MZSP 105127, 1 shell from type locality.

TYPE LOCALITY. — **Brazil**. Rio de Janeiro: off Araruama, MD55 sta. CB106, 23°54'S, 42°10'W, 830 m, 02.VI.1987 (coll. Bouchet, Leal & Métivier).

DIAGNOSIS. — Shell *c.* 6 mm, *c.* 115% taller than wide. Umbilicus open, wide, upper region covered by thick callus, inner middle fold wanting. Sculpture lacking, surface shining, pale brown. Protoconch blunt, of 1 whorl. Spire angle *c.* 90°.

DESCRIPTION

Shell (Fig. 8H-K)

Diameter of *c.* 5 mm; height *c.* 115% of width; general form turbiform. Color pale brown, slightly darker close to upper suture. Protoconch blunt, of 1 rounded whorl (Fig. 8I, K); surface smooth, shining; diameter *c.* 0.6 mm, occupying *c.* 12% of upper shell surface. Teleoconch of *c.* 2.5 whorls; suture well marked; spire angle *c.* 90° (Fig. 8H, J). Sculpture absent except for growth lines and axial sparse strong undulations; undulations slightly stronger in umbilicus. Suture well-marked, subsutural low shoulder at angle of *c.* 110° (Fig. 8I, J). Aperture semicircular, narrow, occupying *c.* 62% of shell height and *c.* 45% of shell width; outer lip thick, weakly prosocline (Fig. 8J), simple; inner lip slightly concave to almost straight (Fig. 8H),

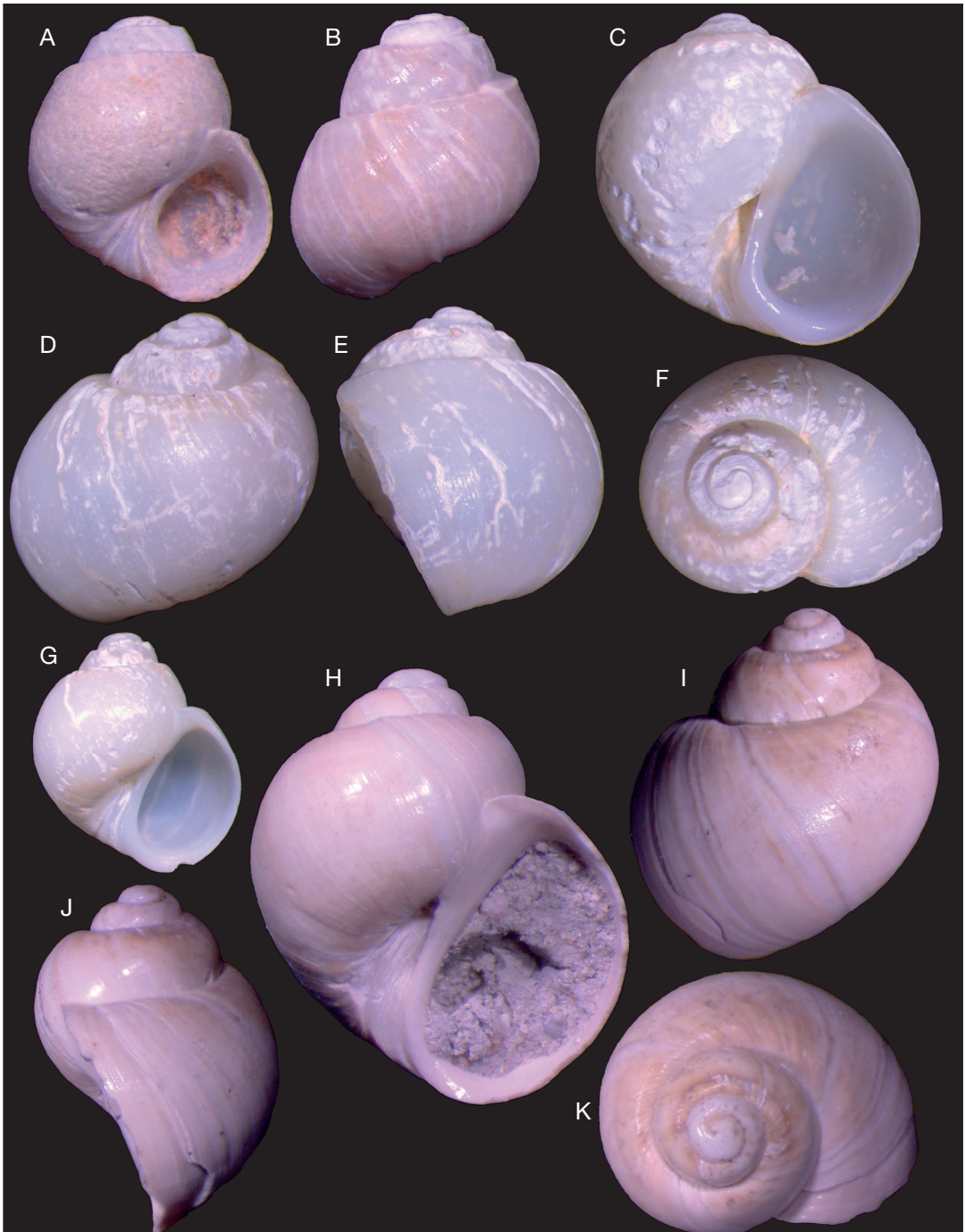


FIG. 8. — Shells of MD55 naticid species: **A-B**, *Microlinices ombratus* n. gen., n. sp. shell of holotype: **A**, frontal view; **B**, dorsal view; **C-G**, *Microlinices apiculus* n. gen., n. sp.: **C-F**, holotype: **C**, apertural view; **D**, dorsal view; **E**, right view; **F**, apical view; **G**, paratype MZSP 105146; **H-K**, *Microlinices gaiophanis* n. gen., n. sp., holotype MNHN: **H**, apertural view; **I**, dorsal view; **J**, right view; **K**, apical view. Measurements: A, B, W 3.2 mm; C-F, W 5.3 mm; G, W 4.4 mm; H-K, W 5.2 mm.

upper half covered by callus, slightly wider than lower half. Umbilicus lacking middle fold, wide, open; *c.* ½ covered by callus with straight, vertical edge; its aperture occupying *c.* 10% of lower surface.

Measurements (width and height in mm)

Holotype (Fig. 8H-K): 5.2 × 6.1.

Paratype: MZSP 105127: 5.0 × 5.6.

Habitat

830 m depth, muddy bottoms (no living specimens).

Etymology

The specific epithet is derived from the Greek word *gaiophanes*, meaning earth-colored, an allusion to the brownish color of the shell.

Genus *Natica* Scopoli, 1777

Natica jukyriuva n. sp.

(Fig. 9A-E)

HOLOTYPE. — MNHN 27153.

PARATYPES. — MNHN 27154, 2 shells, MZSP 105144, 2 shells from type locality. Brazil, Espírito Santo: off Itaúnas, MD55 sta. DC73, 18°59'S, 37°48'W, 607-620 m depth, 27.V.1987 (coll. Bouchet, Leal & Métivier), MNHN 27155, 2 shells.

TYPE LOCALITY. — **Brazil**. Espírito Santo: off Itaúnas, MD55 sta. DC75, 18°59'S, 37°50'W, 295 m depth, 27.V.1987 (coll. Bouchet, Leal & Métivier).

DIAGNOSIS. — Shell *c.* 9 mm, *c.* 92% taller than wide. Umbilicus open, upper region covered by thick callus, inner middle fold present. Sculpture lacking, surface glossy, white with sparse small yellow spots. Protoconch blunt, of 1 whorl. Spire angle *c.* 110°.

DESCRIPTION

Shell (Fig. 9A-E)

Diameter of *c.* 9 mm; height *c.* 92% of width; general form globose. Color white, with small, sparse yellow spots splayed sequentially in subsutural and middle level of whorls; upper spots performing irregular radial band; middle spots as acute chevrons (Fig. 9C). Protoconch blunt, of 1 rounded whorl (Fig. 9D, E); surface smooth,

glossy; diameter *c.* 0.9 mm, occupying *c.* 10% of upper shell surface. Teleoconch of *c.* 2.5 whorls; suture shallow, marked by subsutural low elevation (Fig. 9A-C); spire angle *c.* 110°. Sculpture absent except for growth lines and axial weak undulations; undulations stronger in umbilicus. Suture shallow, marked by narrow subsutural elevation (Fig. 9B, C). Aperture semicircular, wide, occupying *c.* 70% of shell height and *c.* 45% of shell width; outer lip thick, weakly prosocline (Fig. 9B), simple; inner lip slightly concave to almost straight (Fig. 9A), upper half covered by thick callus, lower half as thick edge (Fig. 9A). Umbilicus with middle fold, wide, open; *c.* ¾ covered by callus with sinuous edge; its aperture occupying *c.* 15% of lower surface.

Measurements (width and height in mm)

Holotype (Fig. 9A-E): 9.2 × 8.5.

Paratype: MZSP 105144: 6.6 × 6.0.

Habitat

295-620 m depth, muddy bottoms (no living specimen).

Etymology

The specific epithet is derived from the Amazon Paritintin native language, a combination of *jukyry*, meaning yellow, and *uva*, meaning spot (Betts 1981), an allusion to the yellow spots on the shell.

Natica pipoca n. sp.

(Fig. 9F-I)

HOLOTYPE. — MNHN 27156.

PARATYPES. — MNHN 27157, 19 shells, MZSP 105142, 6 shells from type locality.

TYPE LOCALITY. — **Brazil**. Espírito Santo: off Regência, MD55 sta. DC87, 19°34'S, 39°42'W, 15 m, 29.V.1987 (coll. Bouchet, Leal & Métivier).

DIAGNOSIS. — Shell *c.* 2 mm, *c.* 85% taller than wide. Umbilicus entirely closed by callus. Sculpture lacking, surface glossy, translucent, basic color white, with irregular pale brown chevrons splayed and mostly coalescent. Protoconch dome-shaped, of 1.5 whorls. Operculum smooth, glossy, with low fold in outer edge. Spire angle *c.* 120°.



Fig. 9. — Shells of MD55 naticid species: **A-E**, *Natica jukyriuva* n. sp., shell holotype: **A**, apertural view; **B**, right view; **C**, dorsal view; **D**, apical view; **E**, detail of apex; **F-I**, *Natica pipoca* n. sp., shell, holotype: **F**, apertural view; **G**, dorsal view; **H**, apical view; **I**, operculum, outer view. Measurements: A-D, W 9.2 mm; E, side, 2.5 mm; F-H, W 2.1 mm; I, 1.4 × 0.9 mm.

DESCRIPTION

Shell (Fig. 9F-H)

Diameter of *c.* 2 mm; height *c.* 85% of width; general form globose. Color translucent white in base; irregular pale brown chevrons splayed and mostly coalescent in most area except for peri-umbilical area (Fig. 9G). Protoconch dome-shaped, of 1.5 flattened whorls (Fig. 9H); surface

smooth, glossy; diameter *c.* 0.2 mm, occupying *c.* 10% of upper shell surface. Teleoconch of *c.* 2.5 whorls; suture planar, weakly marked; spire angle *c.* 120°. Sculpture absent except for growth lines. Aperture semicircular, wide, occupying *c.* 74% of shell height and *c.* 44% of shell width; outer lip thick, weakly prosocline, simple; inner lip slightly concave to almost straight

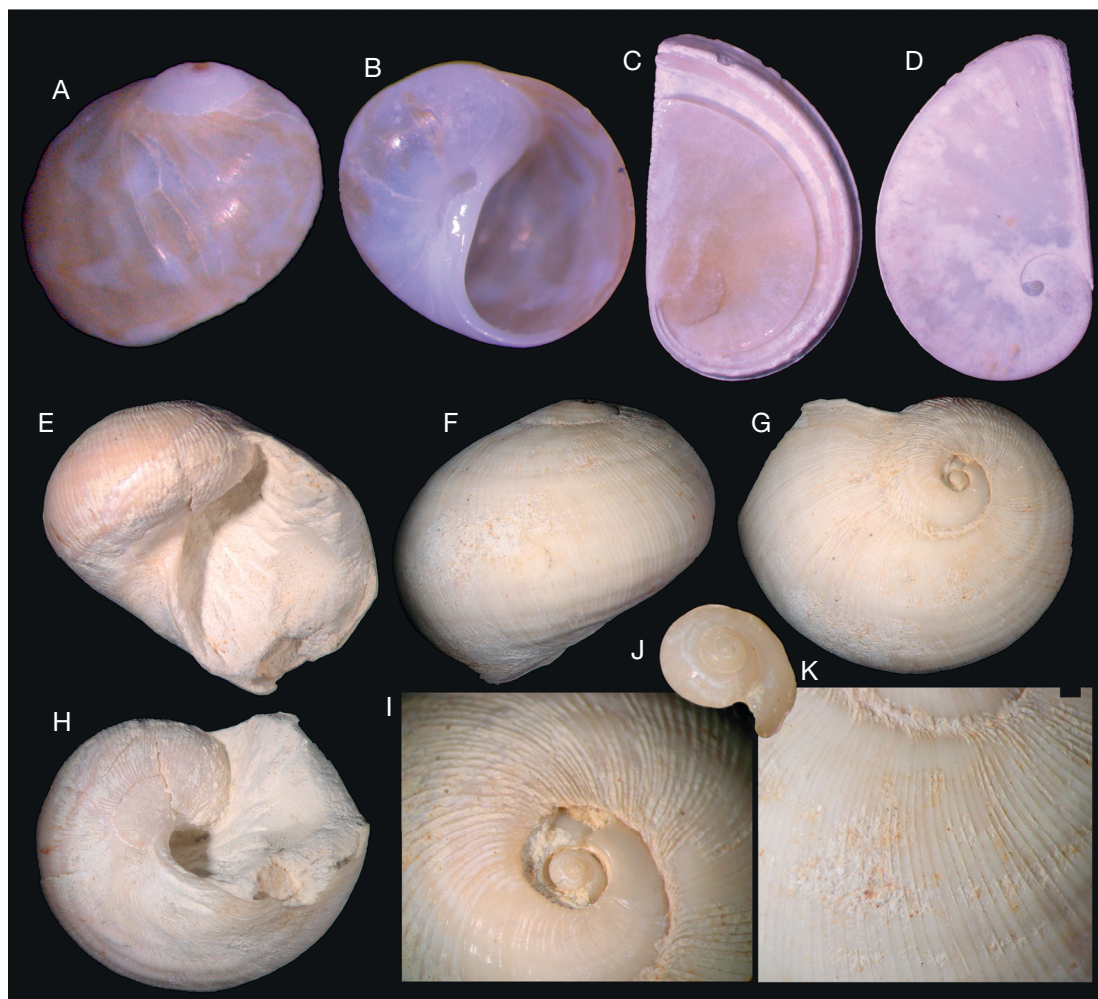


FIG. 10. — Shells and operculum of MD55 naticid species; **A, B**, *Natica juani* Costa & Pastorino, 2012, shell MNNH (sta. DC82): **A**, dorsal view; **B**, apertural view; **C, D**, collected isolated operculum of a *Natica* ss; **C**, outer view; **D**, inner view; **E–K**, *Eunaticina abyssalis* n. sp. holotype: **E**, frontal view; **F**, dorsal view; **G**, apical view; **H**, umbilical view; **I**, detail of apex; **J**, protoconch, apical view; **K**, detail of superficial sculpture in middle level of body whorl. Measurements: A, B, W 3.0 mm; C, D, 14.4 × 8.3 mm; E–H, W 26.6 mm; I, K, 1.0 mm; J, 1.6 mm.

(Fig. 9F), almost entirely covered by thick callus. Umbilicus entirely covered by thick callus, only short lower portion of umbilicus remaining uncovered (Fig. 9F); its aperture occupying *c.* 15% of lower surface.

Operculum (Fig. 9F, I)

Semi-circular, thin, calcareous, occupying entire aperture. Nucleus in middle of inner-lower quadrant;

spiral sculpture with 2 barely visible whorls; low undulations parallel to inner edge. Inner surface smooth, glossy; scar elliptical (twice wider than long), closer to inner edge, occupying *c.* 40% of inner surface.

Measurements (width and height in mm)

Holotype (Fig. 9H, I): 2.1 × 1.8.

Paratype: MZSP 105142: 2.1 × 1.8.

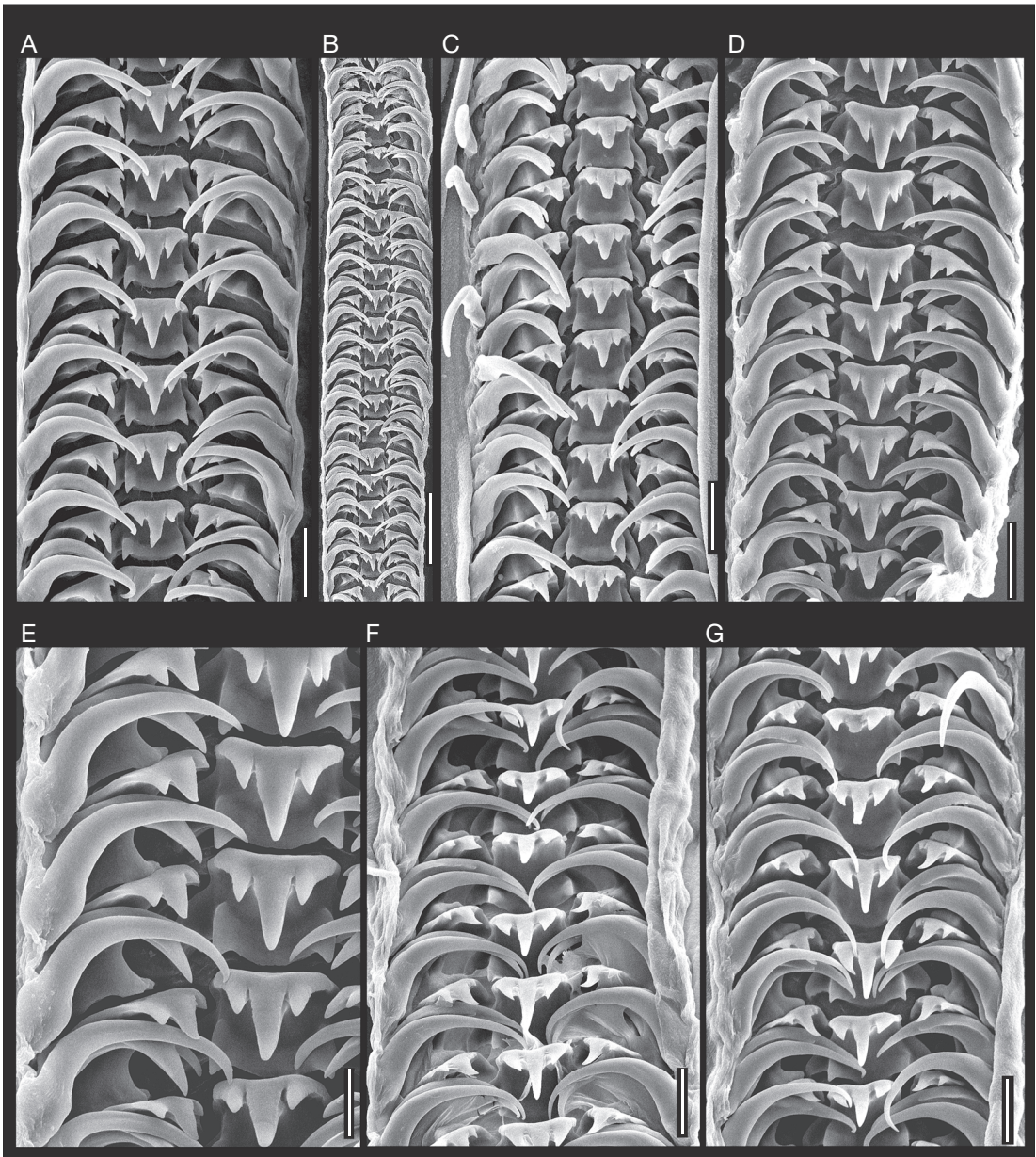


FIG. 11. — Radulae in SEM: **A, B**, *Microlinices benthovus* n. gen., n. sp.; **C**, radula of other specimen; **D**, *M. latiusculus* n. gen., n. sp.; **E**, same of other specimen; **F, G**, *Microlinices ibitingus* n. gen., n. sp. Scale bars: A, C, D, F, G, 20 µm; B, 50 µm; E, 10 µm.

Habitat

15 m depth, muddy bottoms (included living specimens).

Etymology

The specific epithet is a nom in apposition, from the native Tupuy word *pipoca*, meaning cracked

skin, an allusion to the appearance of the shell spotted surface.

Natica juani Costa & Pastorino, 2012
(Fig. 10A, B)

Natica juani Costa & Pastorino, 2012: 30-32, figs 21-28, 30, 37-40.

Natica cf. *sagrayana* – Simone 2011: 167, 269, 276, 283, 290, 297, 304 (*non* d'Orbigny, 1850).

EXAMINED MATERIAL. — **Brazil.** Espírito Santo: off Itaúnas, MD55 sta. DC82, 18°56'S, 37°52'W, 85-105 m, 28.V.1987 (coll. Bouchet, Leal & Métivier), MNHN, 2 shells (coll. Bouchet, Leal & Métivier); Trindade Island, MD55 sta. DC59, 20°30'S, 29°18'W, 52-60 m depth, 22.V.1987 (coll. Bouchet, Leal & Métivier), MNHN, 1 shell (coll. Bouchet, Leal & Métivier).

REMARKS. — *Natica juani* has been described including the material examined by Simone (2011), which provisionally determined the samples as *N. cf. sagrayana*. The known distribution was from Rio de Janeiro to Uruguay (Costa & Pastorino 2012: 31). The three specimens presently studied are dry, but well-preserved young shells; this indicates low transportation. The two samples expand the known distribution of the species northward, reaching middle Espírito Santo coast, and to east, reaching Trindade oceanic island. The deepest known environment also increases from 65 m to 105 m.

Natica (ss) sp. (an operculum)
(Fig. 10C, D)

MATERIAL EXAMINED. — Brazil, Espírito Santo: off Itaúnas, 18°59'S, 37°50'W, 295 m, MNHN, 1 operculum (MD55 sta. DC75; coll. Bouchet, Leal & Métivier, 27.V.1987).

REMARKS

An operculum was collected (14.4 × 8.3 mm), and its analysis shown that it does not belong to anyone of the known species in Brazilian coast and neighborhood. It barely resembles the operculum of *Natica* ss, as that of *N. vitellus* (Linnaeus, 1758), the type species of the genus, has an elaborated set of folds in outer edge (Fig. 10C), and is relative smooth in remaining regions. The erosion of its inner surface, which lacks the usual organic matrix

that normally covers it (Fig. 10D), shows a certain degree of transportation or long time after death. The relative good preservation allows the deduction that the enigmatic species occurs in the region. Because of the obvious incompleteness of data, a formal description of the species is here considered premature.

Genus *Eunaticina* Fisher, 1885

Eunaticina abyssalis n. sp.
(Fig. 10E-K)

HOLOTYPE. — MNHN 27158.

TYPE LOCALITY. — **Brazil.** Espírito Santo: off Itaúnas, MD55 sta. CB79, 19°01'S, 37°47'W, 1500-1575 m depth, 25.V.1987 (coll. Bouchet, Leal & Métivier).

DIAGNOSIS. — Shell almost as tall as wide. Umbilicus completely closed by thick callus. Sculpture of narrow axial cords uniformly distributed. Protoconch of 3 whorls.

DESCRIPTION

Shell

Diameter of *c.* 27 mm; height *c.* 77% of width; general form broadly discoid. Color pale beige. Protoconch flattened (Fig. 10I, J), of 3 rounded whorls; surface smooth, shining; suture somewhat deep; transition with teleoconch clear, orthocline; diameter *c.* 1.6 mm, occupying *c.* 6% of upper shell surface (Fig. 10G). Teleoconch of *c.* 2.5 whorls; suture almost planar, marked by small elevation in lower whorl on preceding whorl (Fig. 10I, K). Sculpture absent in first ¾ whorl, with smooth surface; after this unvarying axial cords uniformly distributed; each cord very narrow, low; interspaces *c.* 5 × cord width; *c.* 8 wide and low spiral threads barely visible in middle level of body whorl (Fig. 10F-H). Aperture oval, wide, occupying *c.* 90% of shell height and *c.* 58% of shell width (Fig. 10E, H); outer lip broken, fragile, orthocline; inner lip widely concave, upper half covered by thin callus, lower half as thick edge (Fig. A). Umbilicus fully covered by thick smooth callus.

Measurements (width and height in mm)
Holotype (Fig. 10 E-K): 26.6 × 20.6.

Habitat

1500-1575 m depth, compact blocks (no living specimen).

Etymology

The specific epithet is derived from the Latin word *abyssos*, meaning deep sea, an allusion to the abyssal environment where the sample was collected.

DISCUSSION

A total of 11 species of naticids was collected by the MD55 expedition, including nine new and one possibly new (the operculum; Fig. 10C, D). As above descriptions were performed under a comparative scheme, it decreases considerably the length of the descriptions without loss of information; besides, it diminishes the length of this discussion, as several details are compared and reported along the descriptions and diagnoses. This section is, then, concerned to more general and interesting aspects.

The new genus *Microlinices* n. gen. was properly discussed above. It is introduced here including six species, all new. It appears to be endemic to the middle Atlantic deep waters, although small naticids may be found in other parts of the globe and interpreted as young specimens. The anatomical investigation has shown that they are fully mature specimens, indicating that the size of the new taxon is actually miniaturized. An outstanding character of the *Microlinices* n. gen. shell is the thick calcified walls, which are hard and difficult to be broken for the study; *M. latiusculus* n. gen., n. sp. is the single species in which the walls have some degree of translucency (Fig. 1A-F). They are mostly colorless, despite the fact that *M. ombratus* n. gen., n. sp. and *M. gaiophanis* n. gen., n. sp. have a pale brown pigmentation (Fig. 8A, B, H-K). Most species have characteristically a globose shell; the widest species is *M. latiusculus* n. gen., n. sp., with the height c. 92% of the width (Fig. 1A-F), and *M. benthovus* n. gen., n. sp., with that index of 105-140% (Fig. 6I, J); the remaining species orbit around 100-120%. The protoconch is proportionally wider in *M. ibitingus* n. gen., n. sp. and *M. benthovus* n. gen., n. sp., if compared to

remaining species; the protoconch absolute diameter can be divided into three categories: c. 0.5 mm of *M. benthovus* n. gen., n. sp., *M. ombratus* n. gen., n. sp. and *M. gaiophanis* n. gen., n. sp., c. 0.8 mm of *M. latiusculus* n. gen., n. sp. and *M. apiculus* n. gen., n. sp., and the largest c. 1.5 mm of *M. ibitingus* n. gen., n. sp. is mainly characterized by the white band along subsutural region, despite a similar band is barely visible in *M. latiusculus* n. gen., n. sp. (Fig. 1B, C) and *M. benthovus* n. gen., n. sp. (Fig. 6B, J). A strong shoulder, i.e. a low subsutural carina, is only found in *M. ombratus* n. gen., n. sp. (Fig. 8A, B). The height of the spire is very low in *M. latiusculus* n. gen., n. sp. (Fig. 1A, B), medium in *M. ibitingus* n. gen., n. sp. and *M. apiculus* n. gen., n. sp., and relatively tall in *M. benthovus* n. gen., n. sp., *M. ombratus* n. gen., n. sp. and *M. gaiophanis* n. gen., n. sp. The spire angulation varies in a similar way among the species as the height of the spire. The umbilicus is open in all species, and in most of them it is narrow, with upper half occluded by narrow callus; an exception is *M. latiusculus* n. gen., n. sp., with a widely open umbilicus (Fig. 1A, D); the umbilicus of *M. ibitingus* n. gen., n. sp. is different in having a low peripheral carina (Fig. 4A, D). The anatomical differentiation and discussion are discussed in the cladistic analysis below. Three depth classes are also possible to be attributed for the *Microlinices* n. gen. species: c. 360 m to *M. apiculus* n. gen., n. sp., c. 440 m to *M. latiusculus* n. gen., n. sp., and 600-1575 m to the remaining species.

Despite the genus *Natica* has been shown to be a polyphyletic taxon in the previous cladistic analysis (Simone 2011), it has been used here under a conservative scenario. Certainly the generic attribution will change when a more consistent revision will be available. Although the single sample that actually shows similarity with *Natica* sensu strictu is the single operculum that was collected (Fig. 10C, D), as remaining species in the Caribbean and Brazilian regions apparently belong to other *Natica*-like taxa. The three species of *Natica* here studied also have small size if compared with the current local species; *N. jukyriuva* n. sp. has c. 9 mm, while *N. pipoca* n. sp. is c. 2 mm, being possibly the smallest species of the family; *N. juani* also rarely reaches 10 mm. The other single minute species

TABLE 1. — Matrix of characters of *Microlinices* n. gen. examined specimens which is inserted in Simone's (2011) matrix. Abbreviations: ***M. lat.***, *M. latiusculus* n. gen., n. sp.; ***M. ibi.***, *M. ibitingus* n. gen., n. sp.; ***M. ben.***, *M. benthovus* n. gen., n. sp.

	1	2	3	4	5	6	7	8	9
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
<i>M. lat.</i>	821?010000	0----1100-0	--00-00110	0000010010	0-000-0	---0-81122000	0110000000	1-11000000	0000011110
<i>M. ibi.</i>	821?010000	0----1100-0	--00-00110	0000010000	0-000-0	---0-81122000	0110000000	1-11000000	0000011110
<i>M. ben.</i>	821?010000	0----1100-0	--00-00110	0000010010	0-000-0	---0-81122000	0110000000	1-11000000	0000011110
	1	1	1	1	1	1	1	1	1
	0	1	3	4	5	6	7	8	9
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
<i>M. lat.</i>	0255000311	0000005100	4001112000	0100501?00	--??2100000	1010000100	100000-110	00000000	--0-101133
<i>M. ibi.</i>	0255000311	0000005100	4001112000	0100501?00	--??2100000	1010000100	100000-110	00000000	--0-101133
<i>M. ben.</i>	0255000311	0000005100	4001112000	0100501?00	--??2100000	1010000100	100000-110	00000000	--0-101132
	2	2	2	2	2	2	2	2	2
	0	1	2	3	4	5	6	7	8
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
<i>M. lat.</i>	1100111111	1300000000	000-001121	1010201111	1000100110	0000001000	1000000011	0100060100	1000000000
<i>M. ibi.</i>	1100111111	1300000000	000-001121	1010201111	1000100110	0000001000	1000000011	0100060100	1000000000
<i>M. ben.</i>	1100111111	1300000000	000-001121	1010201111	1000100110	0000001000	1000000011	0100060100	1000000000
	3	3	3	3	3	3	3	3	3
	0	1	2	3	4	5	6	7	8
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
<i>M. lat.</i>	1000000101	01000-0011	2021110010	0000000010	0001221100	0-00221101	1000211001	100-001000	0?1000110
<i>M. ibi.</i>	1000000101	01000-0011	2021110010	0000000010	0001221100	0-00221101	1000211001	100-001000	0?1000110
<i>M. ben.</i>	1000000101	01000-0011	2021110010	0000000010	0001221100	0-00221101	1000211001	100-001000	0?1000110

TABLE 1. — Continuation.

[illegible]

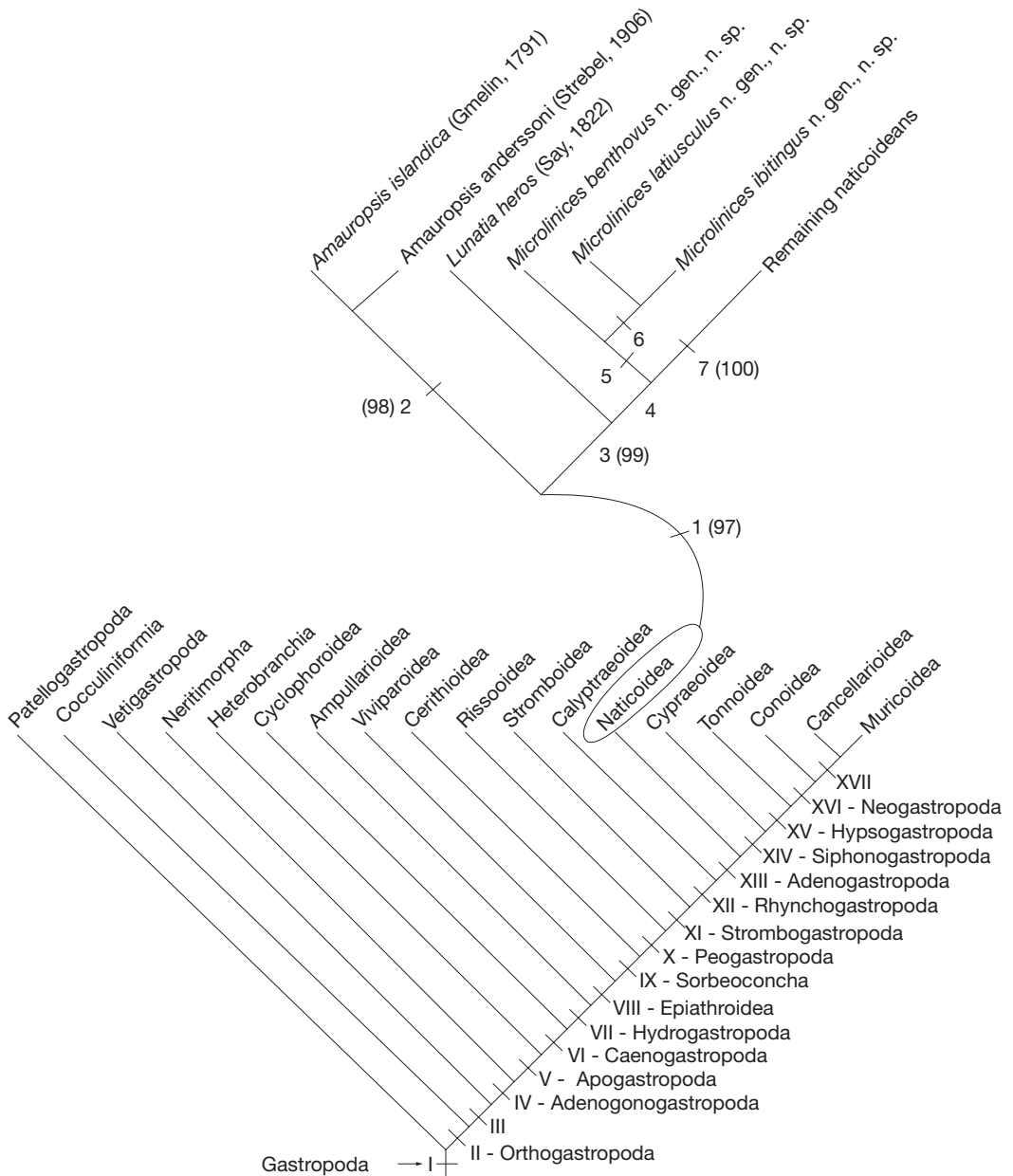


FIG. 12. — Cladogram of Simone (2011) with insertion of the three species of *Microlinices* n. gen., studied anatomically herein. Below the summary cladogram of that paper, with each node named and numbered. Upper panel shows a detail of the portion of the cladogram focusing the species studied here, with nodes sequentially numbered (in parenthesis the original node in Simone 2011: fig. 20).

occurring in Western Atlantic is *Natica micra* Haas, 1953, from Rio de Janeiro, intertidal, which has c. 4 mm shell size. Because of the important size

peculiarity, the species of *Natica* here mentioned are distinguished from all other local species. All these minute *Natica* have pigmentation, despite

it is less developed in *N. jukyriuva* n. sp., which shows sparse successive yellowish chevrons along the body whorl (Fig. 9A–D); the color of the other three species is denser, being sparser in *N. pipoca* n. sp. (Fig. 9G, H), with somewhat irregular pattern of coalescent chevrons; while *N. juani* has a pattern in such the chevrons appears in the white portions left by the coloration (Fig. 10A, B; Costa & Pastorino 2012: figs 21–24); and *N. micra* has an uniform reddish-brown color (Haas 1953). The suture of the three species studied here is relatively well-marked, as well as a proportional narrow last whorl, these differentiate them from *N. micra*. The umbilicus of *N. jukyriuva* n. sp. is open, about $\frac{3}{4}$ occluded by the callus (Fig. 9A), while the callus occludes almost completely the umbilicus of *N. pipoca* n. sp. (Fig. 9F), *N. juani* and *N. micra*; however, the umbilicus of *N. juani* tends to be open during shell growth, a tendency shown by the young specimens here studied, which have a umbilical furrow surrounding the outer edge of the callus (Fig. 10A, B). The spire is relatively more pointed and the profile of the spire is straight in *N. jukyriuva* n. sp., while both are more rounded, dome-shaped in remaining species. The operculum of *N. jukyriuva* n. sp. is unknown; the operculum has a very narrow peripheral fold in *N. pipoca* n. sp., which distinguishes it from *N. micra*, which has a pair of more developed folds in the same place, and from *N. juani*, which has c. four folds in the same place; besides, the operculum of *N. jukyriuva* n. sp. is thinner than in the other species. In relation bathymetry, the four species are very different, as *N. micra* is intertidal, *N. pipoca* n. sp. inhabits c. 15 m, *N. juani* occurs in 65–105 m, and *N. jukyriuva* n. sp. 295–620 m.

The genus *Eunaticina* is for the first time reported from the Western Atlantic, the single other Atlantic species is *E. africana* (Burnay & Fernandes, 1984) from Angola; all remaining congeneric species live in the Indo-Pacific. *Eunaticina abyssalis* n. sp. is much more discoid than the congeneric species. It barely resembles *E. umbilicata* (Quoy & Gaimard, 1833) from Tasmania in degree of flatness, but it differs from that species in having the sculpture more developed and a weaker callus. The protoconch of thee whorls is also a distinction of

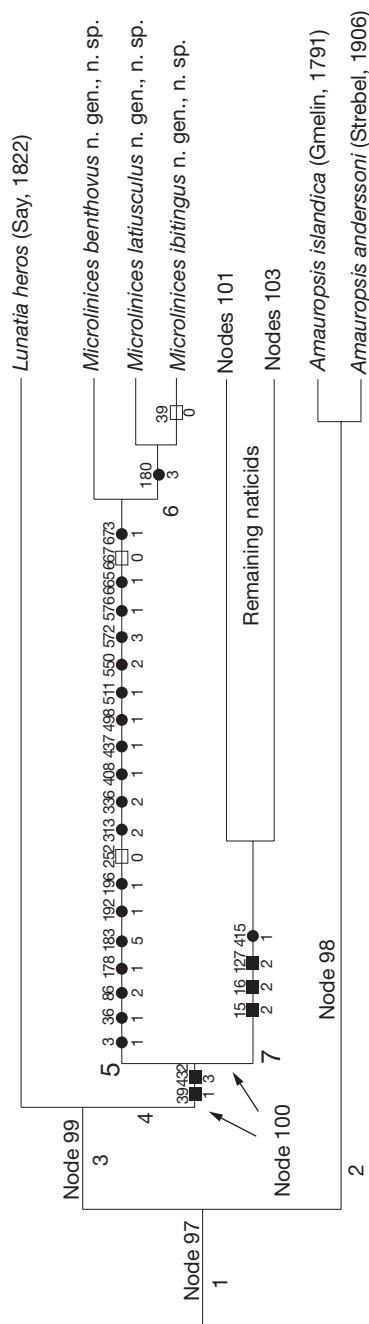


FIG. 13. — Cladogram of Simone (2011) focusing on the region where the three species studied anatomically here are nested. The remaining cladogram is identical to Simone (2011: fig 20) and, therefore, it is not shown. The numbers of the nodes, characters, states and symbols are as in that paper; above numbers in symbols are characters, numbers below are states. Steps 3101, consistency index 51; retention index 94. Symbols: ■, non-homoplastic synapomorphies; □, reversions; ●, convergences.

E. abyssalis n. sp., as remaining congeners have fewer whorled protoconchs. The generic attribution of *E. abyssalis* n. sp. is based on the thinness of the shell walls, the ample body whorl and aperture, the simple umbilicus and the flattened spire. Some of these characters are also present in the Indo-Pacific genus *Mammilla* Schumacher, 1817, but its species have shells much taller and more elongated, with a more pointed spire. *Eunaticina abyssalis* n. sp. is based on a single shell with hardened sediment inside it (Fig. 10E, H) collected at 1500–1575 m depth. As the shell is fragile, the sediment incrustation was only partially removed, in order to avoid shell damage. Based on the shell fragility, it is possible to deduce low transportation, and that the animal actually lived in that bathymetry.

As stated above, the phenotypic data of the three species studied anatomically were coded under the light of a previous large cladistic analysis of the Caenogastropoda (Simone 2011). Their data, under the criterion of that paper, are coded in the Table 1. Those 3 lines were inserted in the matrix of that paper, without any inclusion of extra characters. The matrix was analyzed by phylogenetic programs indicated in Simone (2011). A total of 80 trees were obtained, in such strict consensus is partially shown in the Figs 12; 13; with 3101 steps, consistency index 51, retention index 94. The cladogram is only partially shown here focusing the species studied herein, and because the remaining cladogram is exactly the same as of Simone (2011: fig. 20). The three presently studied species, *Microlinices benthovus* n. gen., n. sp., *M. latiusculus* n. gen., n. sp. and *M. ibitingus* n. gen., n. sp., resulted in a single branch (Fig. 12: node 5) supported by 20 synapomorphies (Fig. 13). This branch divided the node 100 of the previous cladogram (Simone 2011: fig. 20), two synapomorphies support the node before and four support the node after it (Fig. 13). All the synapomorphies supporting the *Microlinices* n. gen. branch are homoplasies (18 convergences and 2 reversions) as no new character was inserted, which would appear as non-homoplastic feature (black squares in Fig. 13). One of the certain non-homoplastic character of the *Microlinices* n. gen. species is the almost pedun-

cular osphradium, with base narrower than more upper regions (Figs 2D; 5B; 7C). Other possible synapomorphies of *Microlinices* n. gen., at least amongst the naticoideans, are the few-filamented osphradium, and the implantation of the penis somewhat ventral to the right tentacle. From the 20 synapomorphies supporting the *Microlinices* n. gen. branch (Fig. 13), the most interesting are the somatic miniaturization (character 3), the absence of head-foot pigmentation (character 86), a non-sessile pectinate osphradium (character 178), the increase of jaw plates (character 313), the difference between inner and outer radular marginal teeth (character 437), the seminal vesicle weakly coiled (character 550), the displacement of the penis (character 572), and the proportionally large nerve ring (character 673).

The present analysis with the three species representing the genus *Microlinices* n. gen., resulted in a well-supported branch, this further underlying the genetic separation. These three species have shown additional anatomical differences, as the relative small size of the buccal mass of *M. benthovus* n. gen., n. sp. (Fig. 7F). The presence of odontophore pair of muscles m7 of *M. benthovus* n. gen., n. sp. (Fig. 7G), absent in remaining two species. The esophageal gland is simpler in *M. latiusculus* n. gen., n. sp. (Fig. 2E), clearly folded transversally in *M. ibitingus* n. gen., n. sp. (Fig. 5F), and with thick inner folds, forming an almost solid gland in *M. benthovus* n. gen., n. sp. (Fig. 7F). The penis localization of *M. latiusculus* n. gen., n. sp. is fully ventral to right cephalic tentacle (Figs 2A; 3D), while it is laterally positioned in *M. benthovus* n. gen., n. sp. (Fig. 7B); in the former the penis has the duct closed (Fig. 3D), while the later has the penis duct open (a groove) (Fig. 7D). Other anatomical differentiation is explored in above distinctive descriptions.

The set of characters of *Microlinices* n. gen. and the position of its representatives at cladogram (Figs 12; 13) demonstrates that the genus is a basal naticoidean, allocated between *Lunatia heros* (Say, 1822) and remaining higher species (node 7, or 100 of Simone 2011). More basal than *L. heros* is only a branch with the two *Amauropsis* species (Figs 12; 13: node 2).

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