NEW SPECIES OF *OXYCHONA* (BULIMULIDAE) FROM MICHELIN ECOLOGICAL RESERVE (BAHIA STATE, NORTHEASTERN BRAZIL)

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Abstract *A new species of* Oxychona *was found during excursions to the Michelin Ecological Reserve (13°S), Southern Bahia State (Northeastern Brazil), which comprises an Atlantic Rainforest Conservation Unit. Living snails and empty shells were collected from ground litter accumulations and kept in an artificial environment supplied with local water and sediment, feeding on leaves of almond tree (*Terminalia catappa L.*). The new species is described and compared with others from adjacent areas of Brazil between 13ºS and 15ºS including* O. bifasciata, O. currani *and* O. maculata. Oxychona *n. sp. is likely to be endemic to Bahia State, thus supporting the biodiversity and rates of endemism of pulmonate molluscs to the Tropical Atlantic Rainforest in Southern America.*

Key words *Bulimulidae, terrestrial gastropod, taxonomy, neotropical region.*

Introduction

The genus *Oxychona* Morch, 1852 comprises a group of terrestrial, pulmonate gastropods with conical, light-coloured, shells belonging to the family Bulimulidae. Hitherto represented by six species (Simone, 2006): *O. bifasciata* (Burrow, 1815) (genus type species), *O. pyramidella* (Spix 1827), *O. lonchostoma* (Menke, 1828), *O. gyrina* (Deshayes, 1850), *O. currani* Batsch, 1916 and *O. maculata* Salvador & Cavallari, 2012, the genus is restricted to Brazil mostly between 13ºS and 15ºS, particularly in well-preserved, natural habitats (Pilsbry, 1897; Breure, 1979).

Oxychona n. sp. was collected during excursions to the Pancada Grande waterfall, a public recreational area within the Michelin Ecological Reserve (MER). Active specimens were observed in their natural habitat, and kept alive for the first time. Based on shell morphometrics, and SEM analyses of protoconch and radular structure, *Oxychona* n. sp. was diagnostically characterized, and distinguished from all other six congeners. Following the results, an updated identification key for the genus has been also included.

Belonging to the 'Plantações Michelin da Bahia, Ltda', the Michelin Ecological Reserve (MER) is a 'Private Reserve of Natural Heritage' (PRNH) that comprises an extensive area (approximately 2,200 ha) of Tropical Atlantic Rainforest, including mangroves, floodplains, rivers, streams, waterfalls and estuaries. The MER is managed by the Center of the Biodiversity Studies (CBS) being coordinated by Dr. Kevin M. Flesher. The CBS has supported research projects, promoting studies on the tropical land, and aquatic biota of the Rainforest Biome.

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Material and Methods

Two excursions to the MER were carried out in 2013. During winter (July 20th), only one living specimen was found along a 300m trail to the Pancada Grande water-fall, bordered by ground litter accumulations. During spring (November 1st), six living specimens and four empty shells were collected at the same site. The MER is located between the Igrapiuna and Ituberá municipalities (13º48'08"S, 39º10'03"W) (Fig. 1), being 108km away from Ilhéus municipality (type locality of *O. maculata*).

Living gastropods (Fig. 2A) were transported into laboratory, and kept in an artificial environment supplied with local water and sediment. They were fed on leaves of the almond tree (*Terminalia catappa*) and monitored for over two months (providing fresh tissue for radula dissection). Shell and radular analyses were developed with support of a stereo microscope (model Nikon SMZ 1000) and an optical microscope (Olympus CH30), both fitted with an ocular micrometer, and a Nikon Coolpix 995 digital camera attached. For scanning electron microscopy the radula was removed from dissected specimens and mounted on aluminum pin stubs, previously

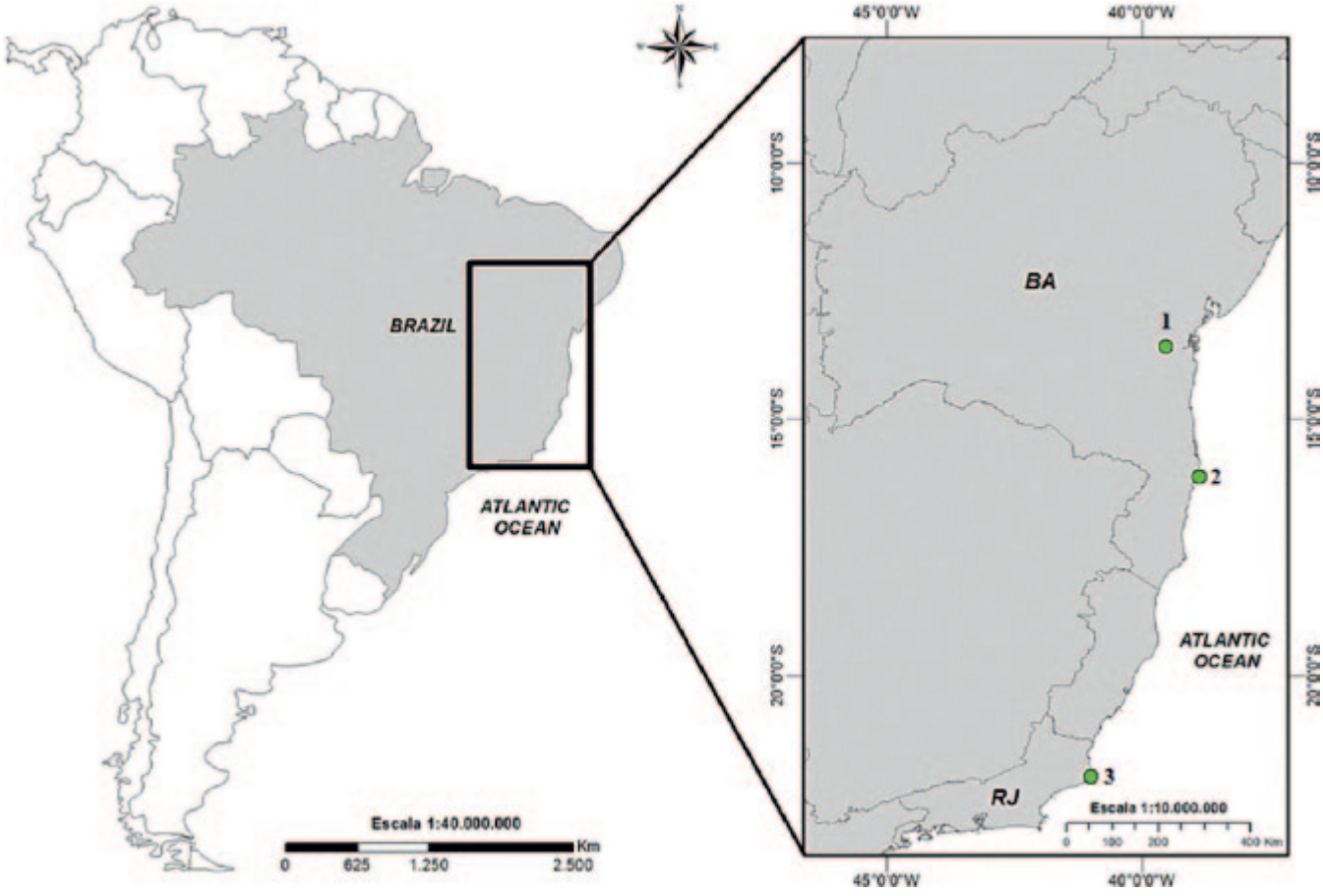

Figure 1 Occurrence areas. Type locality of (**1**) *O. michelinae* n. sp. (Igrapiúna municipality), (**2**) *O. maculata* and *O. gyrina* (Ilhéus municipality) and (**3**) *O. bifasciata* (Macaé municipality, Rio de Janeiro State). BA=Bahia State; RJ=Rio de Janeiro State.

covered with a double-sided sticky tape, sputter-coated with 35 nm of gold in a Denton Vacuum Desk V ion coater, and examined through a Jeol JSAA-6610LV.

SYSTEMATICS

Family Bulimulidae

Subfamily Bulimulinae

Genus *Oxychona* Mörch, 1852

Type species *Oxychona bifasciata* (Burrow, 1815)

Oxychona michelinae sp. nov.

(Figs 2A–F, 3A–D)

Material Examined Holotype, 1 dry shell, (UFBA 053) from the type locality. Paratypes, 3 dry shells (UFBA 054) from the type locality, all in the Gartropoda Collection at the Museu de Zoologia da Universidade Federal da Bahia. Paratype, 1 dry shell (MZUSP 116210) from the type locality in the Mollusk Collection at the Museu de Zoologia da Universidade de São Paulo.

Measurements (in mm) Holotype shell length= 14.8, shell greatest width=14.24, spire length (excluding aperture)=5.6, aperture height=10.5, aperture width=9.3, base width=16.6, 6½ whorls.

Type locality Brazil, Bahia State, 'Michelin Ecological Reserve' – Igrapiúna municipality (13°47'3"S, 39°10'21"W). Specimens from a leaf litter accumulation, along a 300m trail to Pancada Grande waterfall, in a humid environment.

Diagnosis Transparent-whitish, conical shell with 6½ whorls, higher than wide, imperforate, suture moderately impressed, apex distinctly convex, 1½ whorl of protoconch finely reticulated, lip slightly reflected; light brown band of approximately 0.2mm in width running below

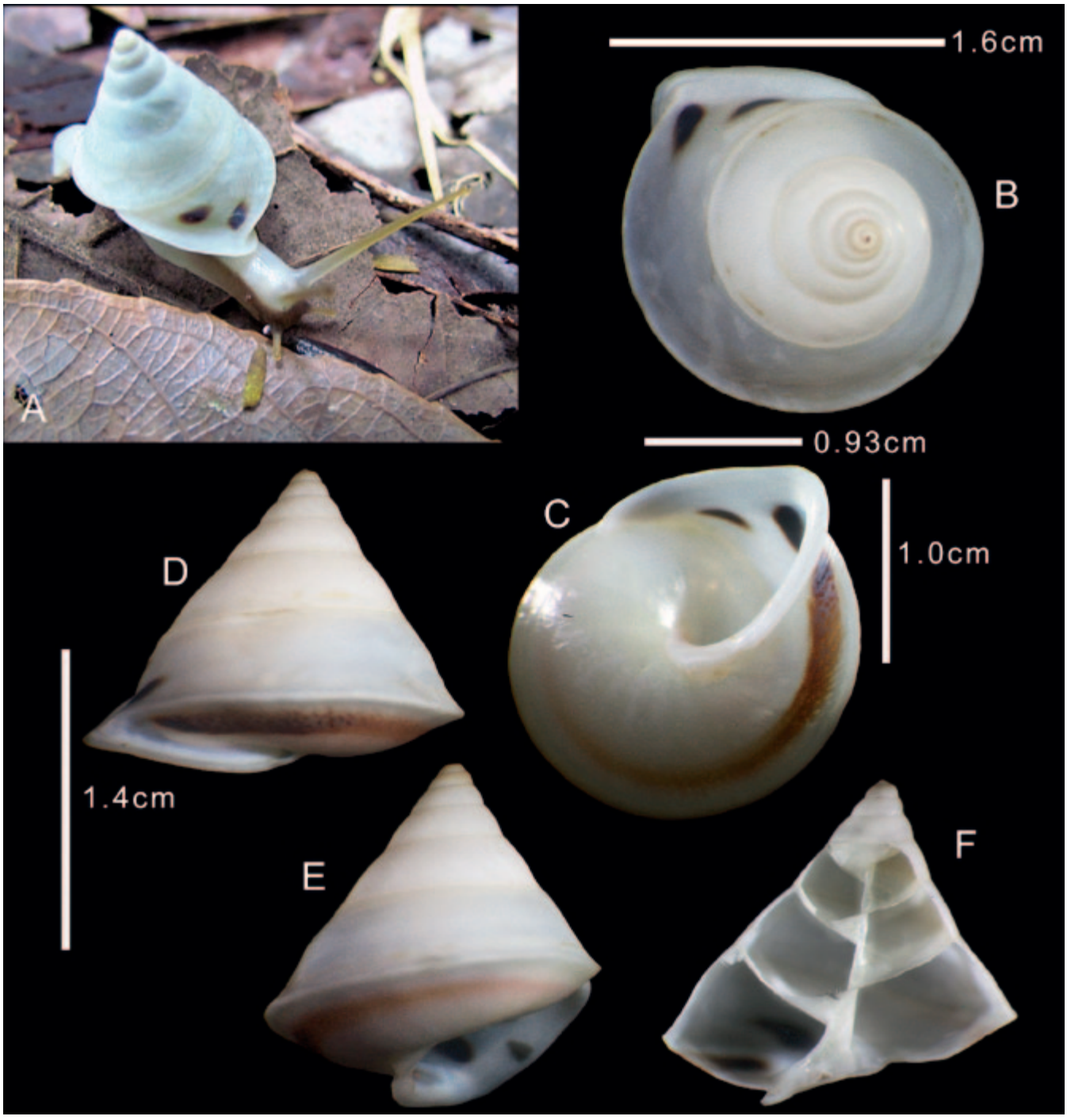

Figure 2 **A** Living specimen of *Oxychona michelinae* n. sp. in its natural habitat. **B–F** Features of the shell of *Oxychona michelinae* n. sp**. B** Apical showing protoconch; **C** Base of body whorl showing inconspicuous brown band and imperforate umbilicus; **D,E** Adapertural and Abapertural aspects showing spires, suture, carinate body whorl and opercular aperture. **F** Cross-section showing columella.

carina along the base of the body whorl, and fading gradually out towards the parietal region; two dark brown spots behind the outer lip; radula homodont with blade-shape teeth; each tooth with shorter acute lateral projection, triangular–shaped opercular aperture.

Description Shell medium sized, broader than taller, light-coloured (shell and tissue whitish). Protoconch of 1½ whorls, finely reticulated (Figs 3A–B); teleoconch of 5 smooth whorls, umbilicus imperforate, columella and parietal region without teeth, thickened periostome forming a white,

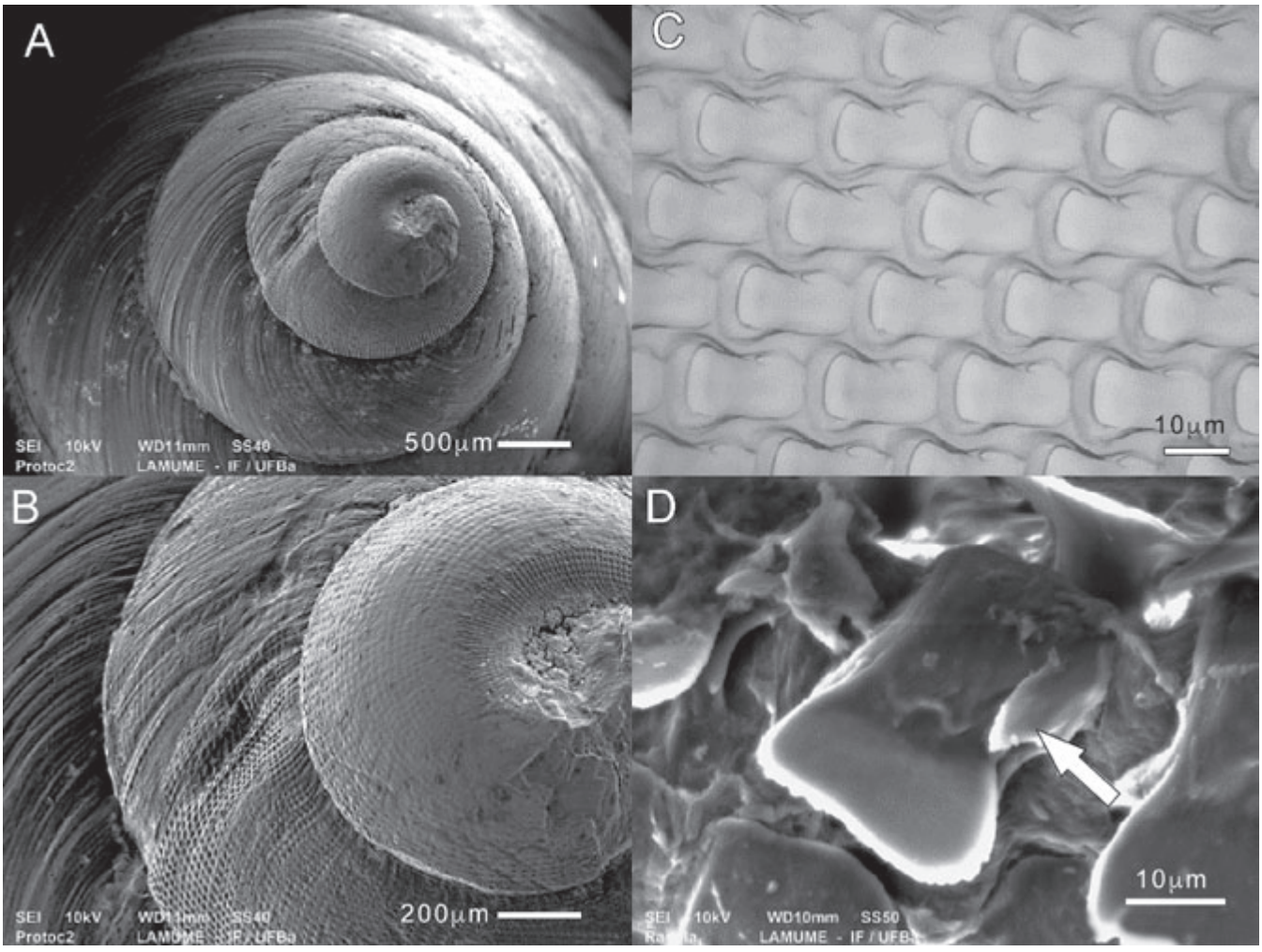

Figure 3 SEM images of *Oxychona michelinae* n. sp**. A,B** finely reticulated protoconch; **C** homodont radula; **D** blade-shaped teeth with acute lateral projection (white arrow).

smooth, slightly reflected lip. Body whorl moderately carinated, inconspicuous brown band running along the base of the body whorl (marginal brown band also around the body, darker around the head), two dark brown spots at the end of the body whorl just behind the outer lip (corresponding spots also observed in the tissue); angle of columella with base of approximately 75°. Radula homodont, with blade-shape teeth (top flat and wide)– base of each tooth with a shorter 'V'–shape acute and unilateral projection (Figs 3C–D). Opercular aperture distinctively triangular–shaped.

Distribution Known only from the type locality – MER, Igrapiúna municipality, 13°47'3"S, 39°10'21"W, Bahia State (see Fig. 1).

Habitat The MER extends from 13ºS to 14ºS latitude, comprising 3,096 ha of protected area that includes a Tropical Atlantic Rainforest Biome, along with sandbanks, mangroves, waterfalls and estuaries. The mild climate of the region has a temperature variation between 18ºC and 30ºC, with severe rainfall in autumn and winter amounting to an annual average of approximately 2.000mm (Rondinelli *et al*. 2008). As deduced from field observations, *O. michelinae* n. sp. lives among the ground litter (mostly active in moist environments), but also able to climb trees where it may alternatively feed on leaves and bark. During laboratory monitoring, the species diet was restricted to almond leaves (*Terminalia catappa*).

Etymology Specific epithet is named after the Michelin Ecological Reserve (type locality, fem.). The Michelin Company is a French tyre-manufacturing corporation founded at the end of 19th Century. In Brazil, the MER belongs to the 'Plantações Michelin da Bahia, Ltda'

Comparisons *Oxychona michelinae* n. sp. does not have the multicolour pattern of *O. bifasciata*, neither the shape nor the colour of *O. lonchostoma*. *Oxychona gyrina* presents more rounded whorls, and similarly to *O. bifasciata* and *O. maculata*, reddish and more prominent lips. Diagnoses of all *Oxychona* species is given in the identification key below.

Similarly to *O. maculata*, *O. michelinae* n. sp. is also a tree-dweller, moving actively on the litter during spring (Salvador & Cavallari 2012).

Identification-key, based on shell morphology, of the species of *Oxychona*

1a	*Shell with alternate lighter and darker brownish bands*	***2***
1b	*Shell predominantly whitish or creamish*	***3***
2a	*Shell with two purplish brown transverse bands*	***O. bifasciata***
2b	*Shell with more than two brown transverse bands*	***O. lonchostoma***
3a	*Rounded outer lip resulting in a rounded aperture*	***O. pyramidella***
3b	*Distal outer lip of aperture projected resulting in a distal margin at least slightly projected*	***4***
4a	*Presence of at least one dark spot on outer lip*	***5***
4b	*No dark spot on outer lip*	***6***
5a	*Presence of two dark spots on outer lip, triangular aperture*	***O. michelinae n sp***
5b	*Presence of one dark spot on outer lip, slightly rounded aperture*	***O. gyrina***
6a	*White-coloured lips*	***O. currani***
6b	*Orange-coloured lips*	***O. maculata***

Discussion

Oxychona has a troubled taxonomic history. The first described species was *O. bifasciata* (Burrow, 1815) as *Helix bifasciata*. Mörch, 1852 *a posteriori* erected the genus *Oxychona*. Earlier described, by Tryon (1885, p. 128) as '*an assemblage of trochoidal Helices inhabiting the mainland of America from Brazil to central Mexico*' it was suggested to be very similar to the trochiform group of *Geotrochus*, Van Hasselt, 1823 from the Pacific Islands. Other than the broadly conical shell (thin, imperforate, whitish with darker spiral bands, and a skewed, triangular aperture), other conspicuous diagnostic characters have supported *Oxychona*, including penis and spermathecal system, protoconch and radular dentition (Pilsbry, 1917; Breure, 1979). Moreover, following Breure (1979), these features corroborate its position within the subfamily Bulimulinae (family Bulimulidae).

The radular apparatus is apparently well adapted to scrape leaves and tree barks. The smaller lateral projection observed in the new species may hold and tear hard food parts, probably supporting its ecological role in recycling leaf accumulations.

Oxychona species have been reported from a small latitude range (13°S to 22°S) and it has been predicted that the genus could be endemic to a restricted area of South America (Brazil) (Salvador & Cavallari 2012, the present study). Following the "State of the World's Forests" (2012): 'Transformation of the environment has been a feature of human history for thousands of years, and can be expected to continue'. Thus, in respect of probable ecological and life constraints (e.g., low-density populations, underestimated biodiversity, increasing deforestation and habitat degradation), it would be reasonable to consider *Oxychona* under risk. Though covering only 7% of the earth's land surface, Tropical Rainforests are likely to sustain more than half of the world's biodiversity (Wilson, 1988; Varjabedian, 2010). Terrestrial gastropods have been assumed to be one of the most diverse groups of non-marine invertebrates, comprising a noticeable number of described species (24,000 spp., see Lyeard *et al*. 2004). Nevertheless, habitat losses due to forest degradation has been pointed out as the major cause of the abrupt decline of land snails in the Pacific Islands in recent times; 50% of the species underwent extinction (Lyeard *et al*., 2004). Historically impacted by exploitation and deforestation, the largest remnants of the Atlantic Rainforest in northeastern Brazil can be found in the State of Bahia (Begossi, 1998; Varjabedian, 2010). Pressure for converting natural landscape to cattle pasture, agricultural land (e.g., coffee, sugar cane, citrus fruits), and extensive industrial plantation (e.g., pine, eucalyptus) has increasingly threated forest areas in southern Bahia,

particularly in Ilhéus and Itabuna municipalities (14ºS lat). In this region, as observed by Coltro Jr. (1993), a number of land snails have adapted to live in coffee, and citrus plantations. In contrast, where large portions of the native forest were kept for conservation purposes, the local fauna was little or not affected at all by cocoa cultivation. Maintaining biological diversity requires both, habitat conservation and taxonomic knowledge. According to Wilson (1994), the first step towards preservation of the biodiversity consists in knowing what species exist, where they live, and what are the critical threatens for their survival in their natural environment.

Finally, as herein supported, *O. michelinae* n. sp. may be reared in artificial environment. In this way, behavior patterns during breeding and youth development may be likely accessed through laboratory experiments and monitoring, shedding light on important aspects of the *Oxychona* life cycle.

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