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1 A **conspicuous** new terrestrial snail species (Gastropoda: Bulimulidae) from the
2 Región de Antofagasta, northern Chile

3

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19 **ABSTRACT**

20 A new species of *Scutalus* Albers, 1850 (Gastropoda: Bulimulidae), *Scutalus chango* sp. n.,
21 is described from a coastal area of northern Chile. Shells of this new species were ~~collected~~
22 ~~found~~ buried in sand and ~~from~~ under boulders and rocks in the foothills of the Chilean
23 Coastal Range at Paposo, Región de Antofagasta. The new species is distinguished from all
24 ~~the~~ other Chilean terrestrial snails by its slender shell with a flared and reflected aperture,
25 and by the presence of a columellar fold. This is the first record of ~~the genus~~ *Scutalus* in
26 Chile, and the southernmost record for this endemic South American bulimulid genus. The
27 presence of this species ~~at~~ ~~in~~ Paposo highlights the need for further research and for
28 conservation guidelines in coastal areas of northern Chile, which have a comparatively high
29 biodiversity and endemism.

30

1 **Keywords** *Scutalus*, Chilean Coastal Range, Stylommatophora, Orthalicoidea, South
2 America, Peru, Bolivia, land mollusc, Pulmonata

3

4 **INTRODUCTION**

5 Terrestrial molluscs are one of the least researched invertebrate groups in Chile; the
6 knowledge ~~on of its their~~ diversity is based in comparatively few works, most of them
7 ~~studies~~ from the XIX century, with a single, more comprehensive recent ~~comprehensive~~
8 work (Stuardo & Vega 1985), which listed 154 species in 14 families for ~~the entire all~~
9 Chilean territories, including the Juan Fernández and Desventuradas Archipelagos ~~and as~~
10 well as Easter Island. The Chilean terrestrial molluscs are mostly represented by species of
11 the families Charopidae, Bulimulidae and Bothriembryontidae, most of them with very
12 small distributions and high levels of endemism. Works which have reviewed terrestrial
13 snails from the northern part of the country (characterized by its arid to hyper-arid
14 landscape) only include the studies done by Philippi (1860), Gigoux (1932), Rehder (1945),
15 Breure (1978), Stuardo & Valdovinos (1985), Valdovinos & Stuardo (1988), Miquel &
16 Araya (2013), Araya & Catalán (2014), Araya (2015a) and Araya et al. (2016).

17 In the present study —part of ongoing work aimed at reviewing the terrestrial
18 molluscs from northern and central Chile (Araya & Aliaga 2015; Araya, 2015b) — we
19 report an unusual new terrestrial snail species, characterized by having a shell with an
20 expanded aperture and a columellar fold, ~~collected that was found~~ buried in humus and
21 sand, among communities of arborescent cacti (*Eulychnia iquiquensis*), ~~and~~ large succulent
22 shrubs (*Euphorbia lactiflua*), and other xerophytic plants, in a narrow area in the foothills
23 of the Chilean Coastal Range north of Paposo, Región de Antofagasta, in northern Chile.

24 This new species represents the southernmost record of the genus *Scutalus* Albers, 1850, a
25 South American genus belonging to the family Bulimulidae, a family which ~~was has so far~~
26 been formerly represented in Chile solely by the genus *Bostryx* Troschel, 1847.

27

28 **MATERIAL AND METHODS**

29 *Material collection*

30 Sixteen specimens, all of them empty shells, were collected buried in humus and under
31 boulders and fallen rocks north of Paposo (24°55' S; 70°30' W, altitude 150 to 170 m),

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two

1 Región de Antofagasta, northern Chile (Figures 1, 2). The dimensions of the shells,
2 measured with Vernier calipers (± 0.1 mm) are depicted in Figure 3; measurements are
3 given in mm and they include, when appropriate, the additional thickness of the lip. Type
4 specimens are deposited in the collections of the Museo Paleontológico de Caldera
5 (MPCCL), in Caldera, Chile and in the Santa Barbara Museum of Natural History
6 (SBMNH) at Santa Barbara, USA. Field study permits were not required for this study and
7 none of the species studied herein are currently under legal protection. Abbreviations used
8 are: H: height (maximum dimension parallel to axis of coiling); HA: height of aperture; HS:
9 height of spire; LW: height of last whorl; SA: spire angle; W: width (maximum dimension
10 perpendicular to H); and width of aperture (WA). The distribution map (Figure 1) was
11 prepared using SimpleMappr (Shorthouse 2010).

12

13 *Nomenclature*

14 The electronic edition of this article conforms to the requirements of the amended
15 International Code of Zoological Nomenclature, and hence the new names contained herein
16 are available under that Code from the electronic edition of this article (ICZN [1999]). This
17 published work and the nomenclatural acts it contains have been registered in ZooBank, ~~the~~
18 ~~online registration system for the ICZN. The ZooBank LSIDs (Life Science Identifiers) can~~
19 ~~be resolved and the associated information viewed through any standard web browser by~~
20 ~~appending the LSID to the prefix "http://zoobank.org/". The under the LSID for this~~
21 ~~publication is: --_urn:lsid:zoobank.org:pub:C9BE441E-6159-4973-888D-74660B2C25F3.~~
22 The electronic edition of this work ~~was published in a journal with an ISSN and has been~~
23 ~~archived and~~ is available from the following digital repositories: PubMed Central,
24 LOCKSS.

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26 **RESULTS**

27 **Systematic Account**

28 **Superfamily Orthalicoidea Martens in Albers, 1860**

29 **Family Bulimulidae Tryon, 1867**

30 **Genus *Scutalus* Albers, 1850**

31 **Type species *Bulinus proteus* Broderip, 1832**

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2 *Scutalus chango* new species

3 (Figs. 4A–O, 5A–D)

4 **Diagnosis:** A species with a medium sized (H up to 25.5 mm) elongated whitish or
5 variegated thick shell, sculptured by growth lines and sometimes presenting shallow
6 varices. The shell is most characterized by the subovate peristome with an expanded and
7 reflexed outer lip, a narrow and deep umbilicus narrow and by the presence of a columellar
8 fold.

9 **Description:** Shell solid, of medium size (H up to 25.5 mm), elongated, fusiform; around
10 2.3 times as long as wide, ~~rimate~~; ~~the~~ upper whorls conic. Surface slightly shining; color
11 white, corneous, or white with brownish axial streaks; sculptured by faint prosocline
12 growth lines, crossed by minute and irregular spiral lines, ~~giving-forming~~ a minutely
13 reticulated surface in some areas. Irregular, longitudinal varices formed by old peristomes
14 are occasionally found on the shell. Protoconch one and a half whorls, white to reddish-
15 brown in color; smooth to the naked eye but in magnification sculptured entirely by many
16 small nodules and striations. Protoconch-teleoconch boundary well defined; ~~the~~-teleoconch
17 sculptured with fine growth lines and minor spiral lines most visible in earlier whorls;
18 sculpture more marked toward the umbilical area. Six and a half flat to slightly convex
19 whorls; last whorl convex and slightly angulated, about 0.66-0.68 of total height. Sutures
20 impressed but shallow. Aperture large (AH about 0.44-0.48 H), subovate (around 1.50-1.54
21 times as long as wide), slightly oblique and prosocline (about 27° with columellar axis).
22 Columellar margin concave, short, dilated above, minutely rugose, with a columellar fold in
23 the interior of its upper side. The terminations of the peristome joined by an oblique parietal
24 callus. Outer lip expanded and reflexed, sharp, often with the internal margin thickened.
25 Umbilicus narrow and very deep. Soft parts unknown.

26 **Type material:** Holotype MPCCL XXX1 (Figs. 4A–G): H: 24.8, HA: 10.6, LW: 16.6,
27 NW: 7.5, SA: 47.5°, W: 10.7, WA: 7.3; paratype 1 MPCCL XXX2 (Figs. 4H–I): H: 25.3,
28 HA: 12.4, LW: 16.8, NW: 7.5, SA: 50°, W: 11.2, WA: 8.1; paratype 2 (juvenile) MPCCL
29 XXX3 (Figs. 4J–L): H: 18.1, HA: 9.4, LW: 12.9, NW: 7.0, SA: 59°, W: 9.2, WA: 6.2;
30 paratype 3 (juvenile) MPCCL XXX4 (Figs. 4M–O): H: 15.3, HA: 8.1, LW: 10.6, NW: 6.5,
31 SA: 57°, W: 8.3, WA: 5.0; paratype 4 (juvenile) SBMNH 460094 (Figs. 5A–D): H: 15.7,

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1 HA: 7.3, LW: 10.5, NW: 6.75, SA: 54°, W: 8.6, WA: 4.9; paratype 5 MPCCL XXX5: H:
2 25.4, HA: 12.6, LW: 17.2, NW: 7.5, SA: 47.67°, W: 11.2, WA: 8.1. All the specimens
3 collected by M. Araya and J. F. Araya, January 17, 2016.

4 **Type locality:** Foothills of the Chilean Coastal Range, north of Paposo (24°55' S; 70°30'
5 W, altitude 150 to 170 m), Comuna de Taltal, Región de Antofagasta, northern Chile.

6 **Distribution and habitat:** Only known from ~~the~~-type locality; ~~the~~-shells ~~were~~ found in
7 humus under boulders and fallen rocks, usually near communities of the arborescent cacti
8 *Eulychnia iquiquensis*, the large succulent shrub *Euphorbia lactiflua* and other small
9 vegetation in the foothills of the Chilean Coastal Range. Many old shells and shell
10 fragments were found buried in sediments in creeks and gullies, but no live specimens were
11 recovered.

12 **Etymology:** A patronym (~~used as a~~-noun in apposition) in honor of the Changos, local
13 indigenous people (now extinct) who inhabited in the coastal areas of northern Chile,
14 having their last communities at Paposo, the type locality of the new species.

15 **Remarks:** Juvenile specimens have an obtusely angulated to almost carinated last whorl
16 (Figs. 4J–O) and a rather narrow and slanted aperture (Figs. 4J, 5A), slightly semilunar in
17 some specimens (Fig. 4M); the external lip becomes reflexed and expanded, and the
18 columellar lip widens in more mature specimens (Fig. 4J), while in fully mature shells the
19 peristome is almost continuous, with a large, expanded and reflexed outer lip and a thin
20 columellar fold (Figs. 4A and 4H). Evidence of episodic growth is seen in the irregular
21 varices found in several specimens; this characteristic is unseen in any other Chilean
22 terrestrial mollusc.

23 **Comparisons with related taxa:** This species differs from all ~~the~~-other species of Chilean
24 terrestrial snails by its slender shell with a flared and reflected apertural lip and by the
25 presence of a columellar fold, a feature so far unique among Chilean terrestrial species. At
26 first glance, ~~this~~ new taxon resembles ~~at first face~~-*Scutalus latecolumellaris* Preston, 1909,
27 which was reported by Weyrauch (1967) from northern Peru at an elevation of 1700 m.
28 However, the size difference (25 vs. 54 mm) immediately distinguishes ~~the both~~
29 ~~species~~new taxon from *S. latecolumellaris*. All other *Scutalus* species are decidedly stouter
30 and cannot be confused with the new species~~is novelty~~. The protoconch of this new species,
31 sculptured with nodules and striations, has been compared to other *Scutalus* species; these

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1 latter are described as “pit-reticulate” (Breure 1979: 80). Although the protoconch of this
2 novelty is slightly different, the characteristics of the shell morphology, and the ecology
3 and low altitude of the locality of this new species all point more towards the inclusion
4 within *Scutalus* —with a coastal distribution in northern-central Peru and now in northern
5 Chile— than the high-altitude genus *Kuschelenia* Hylton Scott, 1951, found in Andean
6 areas in Argentina, Bolivia, Ecuador and Peru (Hylton-Scott, 1951; Weyrauch, 1967;
7 Breure, 1978, 1979; Miquel 1998; Cuezso et al. 2013); type localities, and records housed
8 at the Leiden Museum, of *Scutalus* and *Kuschelenia* species are shown in Figure 1. There is
9 a remarkable gap in distribution between *S. chango* sp. n. this novelty and other *Scutalus*
10 species which do occur in the coastal area of central and northern Peru (Weyrauch 1967,
11 Breure 1979). ~~Future study of the anatomy and molecular data should provide further
12 evidence on its possible relationships with species from neighbouring countries.~~

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14 DISCUSSION

15 The coastal areas of the Atacama Desert in northern Chile have been found to harbor a
16 surprisingly rich diversity of land snails, almost matching the species richness of the much
17 more humid Juan Fernandez Archipelago, off central Chile (Miquel & Araya, 2013; Araya
18 & Catalan 2014; Araya 2015b, Miquel & Araya, 2015). The areas near and around Paposo
19 have already yielded a relatively rich snail harvest in early explorations, e.g. by Cuming
20 (Broderip & Sowerby 1832a,b) and the ‘Comisión Científica del Pacífico’ (Hidalgo 1872);
21 the latter collection recently revised by Breure & Araujo (2017). In contrast with the much
22 more arid inland areas of northern Chile, these coastal lowlands receive periodic fogs from
23 the sea, which helps to sustain unique communities of plants in ravines and gullies in the
24 West side of the Chilean Coastal Range. Taltal-Paposo in particular has a very rich
25 diversity of endemic plant species, including some relict species with micro-ranges, acting
26 as a local biodiversity island (Ricardi, 1957; Dillon, 1991; Pizarro-Araya & Jerez, 2004).
27 The particular habitat of *S. chango* sp. n., living among and under large boulders, may
28 provide a microclimatic condition similar to humid areas; this rock habitat is also relatively
29 stable and buffered from climatic change. These litho-refugia have already been
30 documented for Australia ~~n territories~~ (Couper and Hoskin 2008), and they may also

1 explain the presence of charopid species in northern Chile, which require humid
2 environments to thrive.

3 This fragile ecosystem is in peril due to urbanization and industrialization in the
4 area, where a thermoelectric industry has already been built. Land snails are currently not
5 taken into account in local governmental policies; a proper knowledge of the species
6 present in northern Chile and of their distributions is essential for future conservation
7 efforts, especially in hotspots of biodiversity like Paposo.

8

9 CONCLUSIONS

10 A new terrestrial bulimulid species (Gastropoda: Orthalicoidea), *Scutalus chango* sp. n., is
11 described from Paposo, Región de Antofagasta, northern Chile, being the first record of the
12 genus *Scutalus* in Chile and the southernmost record for this endemic South American
13 genus. The new species may represent part of a relict fauna at the coastal area of northern
14 Chile, with close relationship with species from central-northern Peru.

15

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18 for their help with SEM images and to Marta Araya (Caldera, Chile) for her help in the
19 field ~~collection-work at-in~~ Paposo.

20

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