

Contribution to the knowledge of the terrestrial slugs (Gastropoda, Pulmonata) of the Maghreb

Contribución al conocimiento de las babosas terrestres (Gastropoda, Pulmonata) del Magreb

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ABSTRACT

As a result of recent malacological campaigns of our team in Algeria and Morocco, some previous samples, and after reviewing the literature, specially the recent papers about the Tunisian slugs, we produce a list of slugs of the Maghreb (Algeria, Morocco and Tunisia), with comments or discussion on each of the 17 species that form this list. We report for the first time Deroceras laeve (O.F. Müller, 1774) and Testacella haliotidea Draparnaud, 1801 in North Africa, although with reservations regarding the latter. We also report Lehmannia nyctelia (Bourguignat, 1861) for the first time in Morocco, concretely in the Chafarinas Islands, of Spanish sovereignty.

RESUMEN

A raíz de unas recientes campañas malacológicas de nuestro equipo en Argelia y Marruecos, algunas muestras anteriores y tras revisar la bibliografía, especialmente el reciente trabajo sobre las babosas de Túnez elaboramos una lista de las babosas del Magreb (Argelia, Marruecos y Túnez), con comentario o discusión sobre cada una de las 17 especies que forman esta lista. Citamos por primera vez *Deroceras laeve* (O.F. Müller, 1774) y *Testacella haliotidea* Draparnaud, 1801 en el norte de África, aunque esta última con reservas. Igualmente citamos por primera vez *Lehmannia nyctelia* (Bourguignat, 1861) en Marruecos, en concreto en las islas Chafarinas, de soberanía española.

INTRODUCTION

This paper deals with terrestrial slugs of the Maghreb in the strict sense i.e. Tunisia, Algeria and Morocco, including the two Spanish autonomous cities in North Africa, Ceuta and Melilla, and the islands and islets of Spanish sovereignty in this region. The slugs of Tunisia have recently been studied by ABBES *ET AL.* (2010). The limited existing data on terrestrial slugs of Algeria and

Morocco date back to MORELET (1880), POLLONERA (1890) and earlier BOURGUIGNAT (1861) who compiled some confused and isolated prior records, with determinations based only on the external appearance of the specimens. From the previous records, BOURGUIGNAT (1861) elaborated a list of five species, plus two more with no name, which he criticized as insufficient, and

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adding to this Deshaves' and others' unpublished data, provided another list of eight species just as confusing as the previous one. This work was left unfinished, commenting on only six of the eight species, abruptly ending the article with a "suite prochainement" which never achieved. BOURGUIGNAT (1864), in the first volume of his great work on the malacology of Algeria, described the slugs known in this country at that time, in more detail that in his work of 1861, highlighting a thorough description of Parmacella deshayesii (Moquin-Tandon, 1848). Later the same author described Letourneuxia numidica Bourguignat, 1866, from Tlemcen (Algeria), posted in Bourguignat (1863-70).

In recent years, the most noteworthy are the works of Wiktor (1983a, 1983b) "describing a small collection of samples of slugs of Morocco and Algeria" and on the family Parmacellidae respectively. Castillejo (1996, 1997), in a couple of papers on the slugs of Gibraltar, makes more or less direct reference to some North African species, synonymizing some denominations and modifying others. Very recently, ourselves (MARTÍNEZ-ORTÍ & BORREDA, 2012, 2013, 2016) have published some articles about the family Parmacellidae in North Africa.

MATERIAL AND METHODS

This report is based on a malacological campaign in Algeria, in 2009, and another one in Morocco in 2011 carried out by our team, as well as on a less recent prospecting in Morocco in 1992 and on some donations and data supplied by several contributors. Therefore, we believe that we can contribute to the knowledge of the biodiversity of these animals in this region where so little is known on this subject. As wrote Wiktor (1983a) "from the point of view of taxonomic and zoogeographic, all data on the molluscs of this region are important and even small guest reviews should be published".

The present paper provides a comprehensive survey of the slugs of Algeria and Morocco. It is based on both a litera-

ture search and on anatomical investigation of the recently collected material. All taxa listed by earlier authors are updated with morphological and anatomical descriptions of all currently accepted species, and some taxonomic problems are discussed. The determination of the collected species has been made studying their external and internal anatomy, specially the genitalia.

RESULTS

The species that we have found in Morococo and Algeria are the following: Testacella haliotidea (?) Draparnaud, 1801, Milax gagates (Draparnaud, 1801), Drusia (Escutiella) deshayesii (Moquin-Tandon, 1848), Drusia (Escutiella) alexantoni Martínez-Ortí et Borredà, 2013, Lehmannia nyctelia (Bourguignat, 1861), Lehmannia valentiana (Férussac, 1823), Limacus flavus (Linnaeus, 1758), Deroceras laeve (Müller, 1774) and Letourneuxia numidica. Other two species quoted in Morocco and/or Algeria by Wiktor (1983a), Milax nigricans (Schultz, 1836) and Deroceras ponsonbyi (Hesse, 1884) [=Deroceras riedelianum Wiktor, 1983]. were not found by us.

Testacella haliotidea Draparnaud, 1801 (Table I: loc. 8) (Fig. 1)

We have only found a single half buried specimen, with the genitalia not developed, in an eucalyptus plantation from northern Morocco, in Arbaoua, near the oued Fourarouate.

The live specimen measured 25.0 x 8.0 mm, showing a dirty grey dorsum with darker spots, with two black dorsolateral furrows which came out well separated from the small posterior shell, reaching almost to the tentacles and with small lateral branches more or less oblique to the central sulcus, and in addition a third central groove, shorter and unbranched. The sole was clear, yellow-orange and entire, not divided into three longitudinal bands, as it is usual in many slugs.

The specimen, that we have photographed, now is unfortunately lost as



Figures 1-6. Terrestrial slugs of the Maghreb. 1: Testacella haliotidea (Table I: loc. 8); 2: Drusia (Escutiella) alexantoni (Table. I: loc. 15); 3: Drusia (Escutiella) deshayesii (Table 1: loc. 19); 4: Milax gagates (Table I: loc. 18); 5: Lehmannia nyctelia (Table I: loc. 11); 6: Lehmannia valentiana (Table I: loc. 25). Figuras 1-6. Babosas terrestres del Magreb. 1: Testacella haliotidea (Tabla I, loc. 8); 2: Drusia (Escutiella) alexantoni (Tabla I: loc. 15); 3: Drusia (Escutiella) deshayesii (Tabla I: loc. 19); 4: Milax gagates (Tabla I: loc. 18); 5: Lehmannia nyctelia (Tabla I: loc. 11); 6: Lehmannia valentiana (Tabla I: loc. 25).

well as its shell. At the time it was dissected and being a juvenile, had non-existent genitalia. It is externally identical to the Spanish specimens of *T. haliotidea* that we studied in our collection, and therefore determined as *T. haliotidea* only by its outer appearance, but we are very aware that this determination

needs to be confirmed. Bourguignat (1861) described two species of *Testacella* from Algeria: *T. fischeriana* and *T. brondeli*. ABBES *ET AL*. (2010) recorded *T. fischeriana* in the malacofauna of Tunisia and commented on the taxonomic history of these two species, today understood as synonyms and also *T. fis-*

cheriana as a synonym of *T. bisulcata* (Risso, 1826) although this should be investigated. It cannot be excluded that our specimen was *T. fischeriana*. New recollections of *Testacella* of Northern Morocco are required to definitively clarify this issue.

Drusia (Escutiella) alexantoni Martínez-Ortí et Borredà, 2013 (Table I: loc. 15, 16, 17) (Fig. 2)

Shortly after the publication of MARTÍNEZ-ORTÍ & BORREDÀ (2012), that we refer in the description of the next species, we studied several specimens from the Atlantic coast of Morocco collected between Essaouira and Agadir in argan groves, which turned out to be this new species. This has given rise to another publication in which we partly reorganized the dichotomous key to determination of Parmacellidae (MARTÍNEZ-ORTÍ & BORREDÀ, 2013).

Drusia (Escutiella) deshayesii (Moquin-Tandon, 1848) (Table I: loc. 12, 13, 14, 19, 21) (Fig. 3)

No doubt this denomination can surprise. Until recently this species was known as *Parmacella deshayesii* [See Wiktor (1983b)]. We refer the reader to a very recent work of us (Martínez-Ortí & Borreda, 2012) in which we propose a restructuring of the systematics of the family Parmacellidae after a comprehensive and comparative study of *Drusia* (Escutiella) deshayesii of Algeria and Morocco on the one hand and *Drusia* (Drusia) valenciennii from the Iberian peninsula in the other hand.

Milax gagates (Draparnaud, 1801) (Table I: loc. 1, 3, 4, 5, 6, 7, 9, 12, 18, 22) (Fig.4)

Undoubtedly this is the most common and abundant slug species in the Maghreb. We have collected it from areas of Mediterranean vegetation in the North, oak and cedar forests, small oueds and even in small orchards from oasis in the desertic South. As already noted by WIKTOR (1983a) there is no difference between the European and North African specimens. We can add that even the spermatophores match.

WIKTOR (1983 a) and ABBÈS ET AL. (2010) reported Milax nigricans from Algeria and Tunisia respectively, but in several Moroccan and Algerian localities where we have collected Milax, we never found this species well known to us from Spain. In all localities we have studied anatomically at least one couple of individuals to make sure of the determination, and all of our specimens have proved to be Milax gagates.

Lehmannia nyctelia (Bourguignat, 1861) (Table I: loc. 11) (Fig. 5)

This species was originally described from Algeria but is also present in Central Europe and Eastern Europe, especially in the Balkans and is also introduced in different places of the world such as United States, Great Britain, South Africa and Egypt (WIKTOR, 1983a). Externally it is very similar to Lehmannia valentiana, of Iberian origin but widely distributed in temperate regions around the world, much more than L. nyctelia. It only can be distinguished with certainty after the study of the genitalia, as *L. nyctelia* lacks the penial appendix which is present in L. valentiana. Otherwise, an external colour pattern common in L. nyctelia is a light dorsum and five dark longitudinal bands in the shield, four in the rest of the back, also sometimes present in L. valentiana but the latter more commonly has a pattern of three and two bands with a darker background. We only have determined clearly as L. nyctelia an adult specimen from the Chafarinas Islands, a Spanish possession along the coasts of Northern Morocco. BOURGUIGNAT (1861, 1864) cited this species in Algeria as *Limax nyctelius* (WIKTOR, 1983a). Most of the specimens in our collections were too young, without developed genitalia, and their determination can not be sure, but several Algerian individuals respond to an external pattern closer to *L. nyctelia* than to *L. valen*tiana. GERMAIN (1907) described Agriolimax (Malacolimax) kervillei from North Algeria, which Altena (1966) established as being the same as *Lehmannia nyctelia*. Our report in Chafarinas is the first from Morocco, and would also be the second in Spanish territory, because the species

Table I. List of sample localities of terrestrial slugs realized by the authors and others from Algeria and Morocco and deposited in the MVHN. (Abbreviations: Da=Drusia alexantoni; Dd=Drusia deshayesii; Dl=Deroceras laeve; Lhn=Lehmannia nyctelia; Lhv=Lehmannia valentiana; Ln=Letorneuxia numidica; Mg=Milax gagates; Th=Testacella haliotidea).

Tabla I. Lista de localidades de las muestras de babosas terrestres recolectadas en Argelia y Marruecos por los autores y otros y depositadas en el MVHN. (Abreviaturas: Da= Drusia alexantoni; Dd= Drusia deshayesii; Dl= Deroceras laeve; Lhn= Lehmannia nyctelia; Lhv= Lehmannia valentiana; Ln= Letorneuxia numidica; Mg= Milax gagates; Th= Testacella haliotidea).

Nº	Locality	Species (nºspm)	UTM	Date	Habitat
1	Aoufous, Tafilalelt (MR)	Mg (5)	30RUA8608	04/1992	oasis, orchards
2	Tinerhir, Gorges du Todra (MR)	DI (1)	30RTV6090	04/1992	orchards near the river
3	Tassout, Oued Lakhdar (MR)	Mg (5)	29SPR6257	04/1992	riverside
4	Beni Melal (MR)	Mg (2) / Lhv (1)	29SQR4880	04/1992	irrigation canals
5	Tighssaline (MR)	Mg (3)	30STB5130	04/1992	little brook
6	Tiouririne, oued after Sidi Addi (MR)	Mg (2)	30STB8196	04/1992	little brook, grass
7	Azrou (MR)	Mg (6)	30STC9201	04/1992	mixed forest, oaks and cedars
8	Arbaoua, Oued Fouraraouate (MR)	Th (1)	30STD3367	04/1992	eucalyptus forest
9	Larache (MR)	Mg (1) / Ln (2)	29SQU5896	04/1992	cork oaks
10	Road Agadir — Essaouira (MR)	Lhv (1)	29RMQ2470	08/1999	orchards
11	Chafarinas islands (ESP)	Lhn (1)	30SWE5293	09/2003	ruderal
12	Melilla. Legion Barracks (ESP)	Dd (9) / Mg (1)	30SWE0215	29/12/06	gardens
13	Taforalt — Berkane (MR)	Dd (8)	30SWD5452	29/12/06	bushes
14	Beni Sicar — Taourirt (MR)	Dd (1)	30SWD0707	-	_
15	Taftchet, near Essaouira (MR)	Da (18)	29RMQ4388	01/2011	argan trees
16	Smimov, Essaouira — Agadir	Da (5)	29RMQ3274	01/2011	argan trees
17	Agadir, road to Outanone	Da (1)	29RMP46	06/02/09	near a lake
18	Road Tlemcen — Sebou, before to the	Mg (9)	30SXD5336	15/03/09	bushes
	junction to Beni Snous (AG)				
19	Ain Franin, road Oran — Kristel,	Dd (11)	30SYE2765	16/03/09	sea shore under stones
	near the cliff (AG)				
20	Bejaïa, Cap Carbon, Pic des Signes (AG)	Lhv (5)	32SJF5076	03/2008	pine forest
21	Tlemcen (AG)	Dd (2)	30SXD7372	03/2008	garden
22	Tlemcen, Zariffet forest (AG)	Mg (1)	30SXD4956	15/03/09	pine forest
23	Oran, Ain el Turk (AG)	Lf (5)	30SYE0357	14/03/09	gardens
24	Honaine, mountains after the village (AG)	Ln (5)	30SXD2193	14/03/09	pine forest
25	Ouled Youcef, diversion to Agla beach (AG)	Ln (9) / Lhv (4)	30SXD3595	14/03/09	pine forest
26	Algiers, Aïn Taya (AG)	Lhv (3)	31SEA2372	2009	ruderal

has been reported from Tenerife island by BANK, GROH AND RIPKEN (2002) and later by ARECHAVALETA *ET AL.* (2010).

Lehmannia valentiana (Férussac, 1823) (Table I: loc. 4, 10, 20, 25, 26) (Fig. 6)

The species was described originally from material of Valencia (Spain) and is typically Mediterranean having been introduced through great part of the world by human action, generally involuntary. Most of our specimens from Algeria and Morocco were very young, lacking genitalia, so we cannot ascertain if they are *L. valentiana* or *L. nyctelia*, although their external appearance is identical to the European *L. valentiana* that we know well. WIKTOR (1983a) cites that species in Algeria but not in Morocco. Curiously, ABBES *ET AL.* (2010) do not cite for Tunisia *L. valentiana* nor *L. nyctelia*, but cite *Lehmannia marginata*







Figures 7-9. Terrestrial slugs of the Maghreb. 7: Limacus flavus (Table I: loc. 23); 8: Deroceras laeve (Table I: loc. 2); 9: Letourneuxia numidica (Table I: loc. 8).

Figuras 7-9. Babosas terrestres del Magreb. 7: Limacus flavus (Tabla I: loc. 23); 8: Deroceras laeve (Tabla I: loc. 2); 9: Letourneuxia numidica (Tabla I: loc. 8).

(O.F. Müller, 1774) and *Lehmannia melitensis* (Lessona et Pollonera, 1882) in this country. *L. melitensis* is a species typical of Malta and Sicily. The presence of *L. marginata* in North Africa surprises us, even more so in coastal or urban areas as reported by these authors. In Europe, and particularly in the Iberian Peninsula, *L. marginata* is typical of mountain areas of the interior, wet and cold, not being by any means synanthropic.

Recently, several authors have referred this species as *Ambigolimax* valentianus, but as we think that this is not sufficiently clarified, we have taken the option to maintain the traditional denomination in the genus *Lehmannia*.

Limacus flavus (Linnaeus, 1758) (Table I: loc. 23) (Fig. 7)

This is a very synanthropic slug, even domicole, typical of towns and cities in gardens, plots, ruins, basements and damp cellars. It lives across Europe, North Africa and Middle East and has been adapting and introduced to nearly all temperate areas of the world. ABBES ET AL. (2010) recorded it among the Tunisian malacofauna but WIKTOR (1983a) did not report it from Morocco nor Algeria. Nevertheless, BOURGUIGNAT (1861, 1864) cited it in Algeria, with the denomination of Limax deshayesi. We have collected it in Oran (Algeria), in the evening, in city gardens.

Deroceras laeve (Müller, 1774) (Table I: loc. 2) (Fig. 8)

This is the first report in North Africa. We found a specimen in the Gorges of Todra (st. 2), in Tinerhir (Morocco), under stones in a very wet pasture, close to the river. Alive it measured 20 mm, after its fixation in ethanol only 12 mm. The dorsum was brown with a clear sole. The shield had small blackish spots and the limacela was visible through the shield. The skin was thin, and the visceral mass was covered

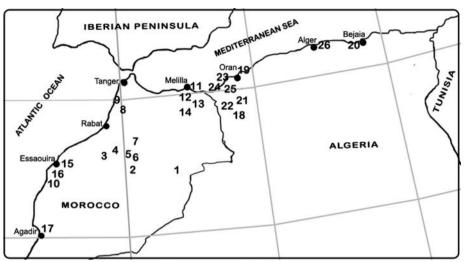


Figure 10. Geographical distribution map of the slugs collected by the authors in Algeria and Morocco.

Figura 10. Mapa de distribución geográfica de las babosas recolectadas por los autores en Argelia y Marruecos.

with black tissue. The specimen showed genitalia but was aphallic. All these features coincide exactly with many European *D. laeve*, not only the anatomical but also in terms of habitat, in very humid areas and near streams. It is an holarctic species, present throughout Europe and North America, except in polar regions (South, 1992), introduced in South Africa, New Zealand, Central America, Canary Islands and the Azores Islands.

Letourneuxia numidica Bourguignat, 1866 (Table I: loc. 9, 24, 25) (Fig. 9)

MORELET (1880) cited a species of *Arion* (one specimen preserved in alcohol that was shown to him) that resembled *Arion hortensis*, while more recently CESARI (1978) mentioned *Arion lusitanicus* from Algeria without any comment or specification about it. We have not collected any *Arion*, but some arionids of the genus *Letourneuxia*.

This arionid, *L. numidica*, was redescribed by WIKTOR (1983a) who reported it from several Moroccan localities, but not in Algeria although the *locus typicus* of Bourguignat is Tlemcen

(NW Algeria). WIKTOR (1983) treated *L. moreleti*, originally described from Tangiers as *Arion (Ariunculus) moreleti* Hesse, 1885, as one of the synonyms of *L. numidica*. Later, CASTILLEJO (1996) proposed after studying specimens of *L. moreleti* from Gibraltar, that they are different species and instead proposed to synonymize *Geomalacus malagensis* Wiktor et Norris, 1991, from Andalusia, with *Letourneuxia moreleti*, which thus becomes *Geomalacus moreleti*, leaving the genus *Letourneuxia* for the North African species *L. numidica*.

We have collected two subadult specimens in a cork oak forest near Larache (Morocco) and a total of 14 juveniles in Algeria, in the area of Oran in two locations (23 at Honaine and 24 at Ouled Youcef). The shape and color of our specimens is consistent with that described by WIKTOR (1983a). They are arionids with the pneumostoma in very front position on the right side of the shield, something compressed dorsoventrally, more than *Arion*, and with blunt and rounded ends. The skin is thin, with little prominent tubercles, light reddish-brown *in vivo* and with

greyish brown background after fixation, with four longitudinal dark stripes bordered with light edges, most evident on the shield and which can go blurring out towards the posterior end. The tentacles are of the same color as the background. Thin gray fringe and light tripartite sole with very thin orange edge. Unlike *Arion* Férussac, 1819, *Geomalacus* Allman, 1843 and *Letourneuxia* Bourguignat, 1866 possess full limacela, in *Arion* reduced to a few small more or less matted calcareous granules. In our specimens is white, ellipsoidal, something thick and with eccentric nucleus.

Hereafter we add some comments about the dubious species and /or not found by us.

Milax nigricans (Schultz, 1836) (not found by us)

This is a Mediterranean species, common in the eastern part of the Iberian peninsula, French coast and West of Italy, Sicily, Sardinia, Malta and Balearic islands, never far away from the coast. WIKTOR (1983a) cited it in Algeria and ABBES ET AL. (2010) in Tunisia. LARBAA & SOLTANI (2013) and DOUAFER & SOLTANI (2014) cited Milax nigricans and Milax gagates from northeastern Algeria.

Deroceras ponsonbyi (Hesse, 1884) (not found by us)

This is an agriolimacid about 25-30 mm long, dark brown or brown with small black spots and clear mucus (Wiktor, 1983a; Castillejo, 1996). WIKTOR (1983a) described a new Algerian species with holotype from "Philippeville (now Skikda)" which he named Deroceras (Deroceras) riedelianum although he mentioned that in the future it could turn out that *D*. riedelianum was identical to D. ponsonbyi, described from the external appearance of a specimen from Gibraltar. After carefully comparing the external and internal anatomy of Gibraltarian specimens of D. ponsonbyi and figures provided by Wiktor (1983a) of D. riedelianum, CASTILLEJO (1996) concluded that it is the same species that must therefore be called *Deroceras ponsonbyi*. It only has been cited in Algeria and Gibraltar.

Daudebardia rufa (Draparnaud, 1805) and Daudebardia brevipes (Draparnaud, 1805) (not found by us).

Both species appears cited in several lists from northern Algeria. Therefore, GIUSTI & MANGANELLI (1984) included this species in the Algerian fauna.

Limax brondelianus Bourguignat, 1861 and Limax raymondianus Bourguignat, 1861 (dubious species)

There are confuse old reports in Algeria referred by POLLONERA (1890), and ALONSO & IBÁÑEZ (1989) deal with these species. There are no specimens of *L. brondelianus* and Bourguignat (1861) did not describe their genitalia. However ALONSO & IBÁÑEZ (1989) studied five syntypes of *L. raymondianus*, in poor state of conservation, with no available internal anatomy. These are Limacidae of difficult determination.

List of slugs in the Maghreb

Below is a list updated of the 17 species of slugs from the Maghreb with indication of the country that has been cited: Algeria (AG); Morocco (MR) or Tunisia (TU). They are arranged with reference to the classification of BOUCHET & ROCROI (2005), with some minor modification of subsequent works.

Family Testacellidae Gray, 1840 Genus *Testacella* Lamarck, 1801

Testacella fischeriana Bourguignat, 1861 (TU)

Testacella haliotidea Draparnaud, 1801 (MR)

Family Oxychilidae P. Hesse 1927 (1879)

Genus *Daudebardia* W. Hartmann, 1821

Daudebardia rufa Draparnaud, 1805 (AG?)

Daudebardia brevipes Draparnaud, 1805 (AG?)

Family Parmacellidae P. Fischer, 1856

Genus *Drusia* Gray, 1855

Subgenus *Escutiella* Martínez-Ortí et Borredà, 2012

Drusia (Escutiella) deshayesii (Moquin-Tandon, 1848) (AG, MR)

Drusia (Escutiella) alexantoni Martínez-Ortí et Borredà, 2013 (MR)

Family Milacidae Ellis 1926 Genus *Milax* Gray, 1855

Milax gagates (Draparnaud, 1801) (AG, MR, TU)

Milax nigricans (Schulz, 1836) (AG, TU) Milax gasulli Altena, 1974 (TU) Family Limacidae Batsch, 1789 Genus Lehmannia Heynemann, 1862 Lehmannia marginata (O.F. Müller,

Lehmannia melitensis (Lessona et Pollonera, 1882) (TU)

Lehmannia nyctelia (Bourguignat, 1861) (AG, MR)

Lehmannia valentiana (Férussac, 1823) (AG, MR)

Genus *Limacus* Lehmann, 1864 *Limacus flavus* (Linnaeus, 1758) (AG, MR, TU)

Family Agriolimacidae Wagner, 1935 Genus *Deroceras* Rafinesque, 1820 *Deroceras laeve* (O.F. Müller, 1774) (MR)

Deroceras ponsonbyi (Hesse, 1884) (AG)

Familia Arionidae Gray, 1840 Genus *Letourneuxia* Bourguignat, 1866 Letourneuxia numidica Bourguignat, 1866 (AG, MR)

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