

**Morphology and anatomy of *Limax (Limacus) majoricensis* Heynemann, 1862, from the Balearic Islands (Spain, western Mediterranean) (Gastropoda: Pulmonata: Limacidae)<sup>1</sup>**

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*Limax majoricensis* Heynemann, 1862, is hereby redescribed from material collected by Gasull and Muntaner and kept in the Natural History Museums of Göteborg and Stockholm (Sweden). The specimens show two dark hands on the dorsum and mantle. A long caecum, which almost attains the rear end of the visceral mass, inserts on the bend of the last loop of the digestive tract. The genital system is characterized by a vestigial, or completely absent, vas deferens. The penis is divided into two parts, folded up owing to a muscular sheath surrounding the structure. The penial retractor muscle is lacking. Inside the penis there is a variable number of longitudinal folds. Following Wiktor's system (1989) this species is to be included in the subgenus *Limacus* Lehmann, 1864, because of the existence of internal folds in the penis and the peculiar position of the caecal junction with the rectum.

Key words: Gastropoda, Pulmonata, Limacidae, *Limax*, taxonomy, distribution, Balearic Islands, Spain.

## INTRODUCTION

*Limax majoricensis* was described by Heynemann in the last century from material from Majorca and the corresponding types were probably not preserved. The first record of the species appears in a paper by Dohrn & Heynemann on the mollusc fauna of the Balearic Islands (1862). In that work the species is referred to as "*Limax* nov. spec.?" and only features of its radula and shell are reported. In the same year a paper by Heynemann on the genus *Limax* appears in the same journal which contains the name *Limax majoricensis*, but except for a figure of a row of radular teeth, no anatomical data of the species are given.

The absence of the nominal taxon *Limax majoricensis* in Ruhoff's index (1980) could signify ignorance on the author's part or else that she did not consider it a valid species. On the contrary, Hidalgo (1875, 1879, 1916, 1918) reports *L. majoricensis* in his faunal works, considering it a good species. Taylor's work (1907) does not contain any citation of *L. majoricensis*, although records of other species from all over Europe are generally included in the book. On the other hand, Hesse (1926) quotes Heynemann's *L. majoricensis*, albeit adding an interrogation mark as a signal of dubious taxonomic status. Later Jaeckel & Plate (1964), Gasull & Altena (1969), Paul (1982), and Reischütz (1983) have recorded the species from the Balearic Islands, but none has given information on its anatomy; only collecting sites were reported.

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Being involved in the elaboration of a monograph on the Iberian and Balearic slugs ('Fauna Ibérica' project), we realized there was hardly any information regarding the morphology of *L. majoricensis*, an otherwise repeatedly recorded slug species from the Balearic Islands. In order to surmount this paucity of data, we requested Dr. T. von Proschwitz, in charge of the mollusc collection of the Natural History Museum of Göteborg (NHMG), to send the material of *L. majoricensis* kept at that institution on loan. This material consists of the topotypes of the species recorded in Gasull & Altena (1969), which had been previously deposited in the Natural History Museum of Leiden (The Netherlands). Additionally, Dr. H.W. Waldén generously provided us with personal annotations and unpublished iconography of the species. The examination of that material, together with two samples kept at the Natural History Museum of Stockholm (NHMS) with the label "*L. variegatus*", allows us to make the following redescription.

*Limax (Limacus) majoricensis* Heynemann, 1862

ORIGINAL DESCRIPTION. — *Limax majoricensis* Heynemann, 1862, Malakoz. Bl. 10: 211.

MATERIAL EXAMINED

Ibiza island:

– Sant Antoni, Buscastell, UTM CD51, 12.02.1960, 5 juveniles, L. Gasull leg., NHMG.

– Sant Antoni, UTM ?, 1870, F. Söderlund leg., NHMS.

– Illa Plana, Illes Bledes, UTM DD93, 11.02.1960, 1 adult specimen, L. Gasull leg., NHMG.

– Sant Vicens, Caf , UTM ?, 22.11.1955, L. Gasull leg., NHMG.

– Vedrà, UTM ?, 10.02.1960, L. Gasull leg., NHMG.

Majorca island:

– Pollensa, Carret del Puerto, UTM EE01, 20.02.1968, 12 juveniles, L. Gasull leg., NHMG.

– Coll S ller, Font Can Topa, UTM DD79, 23.09.1965, 4 juveniles, L. Gasull leg., NHMG.

– Portalls Vells, UTM DD97, 21.12.1969, 2 adult specimens and 3 juveniles, L. Gasull leg., NHMG.

– Vall de Mossa, Cartuja, UTM DD69, 09.06.1967, 2 juveniles, L. Gasull leg., NHMG.

– Fuente Son San Juan, UTM ED09, 27.05.1970, 4 juveniles, L. Gasull leg., NHMG.

– Alcudia, UTM EE11, 04.06.1969, 2 juveniles, L. Gasull leg., NHMG.

– Campanet, Coves, UTM DE90, 15.12.1959, 4 juveniles, L. Gasull leg., NHMG.

– Andratx, UTM DD58, 03.1966, 6 juveniles, L. Gasull leg., NHMG.

– Dei , UTM DD69, 10.11.1970, 4 juveniles, L. Gasull leg., NHMG.

– Santa Mar a, UTM DD88, 25.09.1966, 1 juvenile, L. Gasull leg., NHMG.

– Pollensa, Son Marc, Es Pujol, Vall d'en Marc, UTM EE01, 04.012.1960, 2 juveniles, A. Muntaner leg., NHMG.

– Campanet, Hort Biniatr , UTM ?, 04.01.1960, 2 juveniles, A. Muntaner leg., NHMG.

Formentera island:

– Molan, UTM ?, 1871, F. Söderlund leg., NHMS.

## DESCRIPTION

The largest specimen at our disposal is 45 mm long, the normal length varying from 25-35 mm. We have no data on living animals. Preserved specimens in 70% ethanol (figs. 1, 2, 11, 12) have a light-brown body with two dark bands on the dorsum, which are continued along the mantle. On the sides, below the lateral bands, dark spots can be seen. There are also dark spots on the mantle that may blur the course of the lateral bands. Ommatophores without special pigment, the same colour as the body. Sole whitish, divided into three parts. Body mucus whitish.

Intestine (fig. 4) with three loops, a typical character of the genus. Last intestinal loop very short. At its posterior end the last intestinal loop joins a caecum which almost reaches the rear of the visceral mass. The right ommatophore retractor muscle passes under the penis. The aorta crosses above the spermoviduct.

Shell. — Typical for the genus.

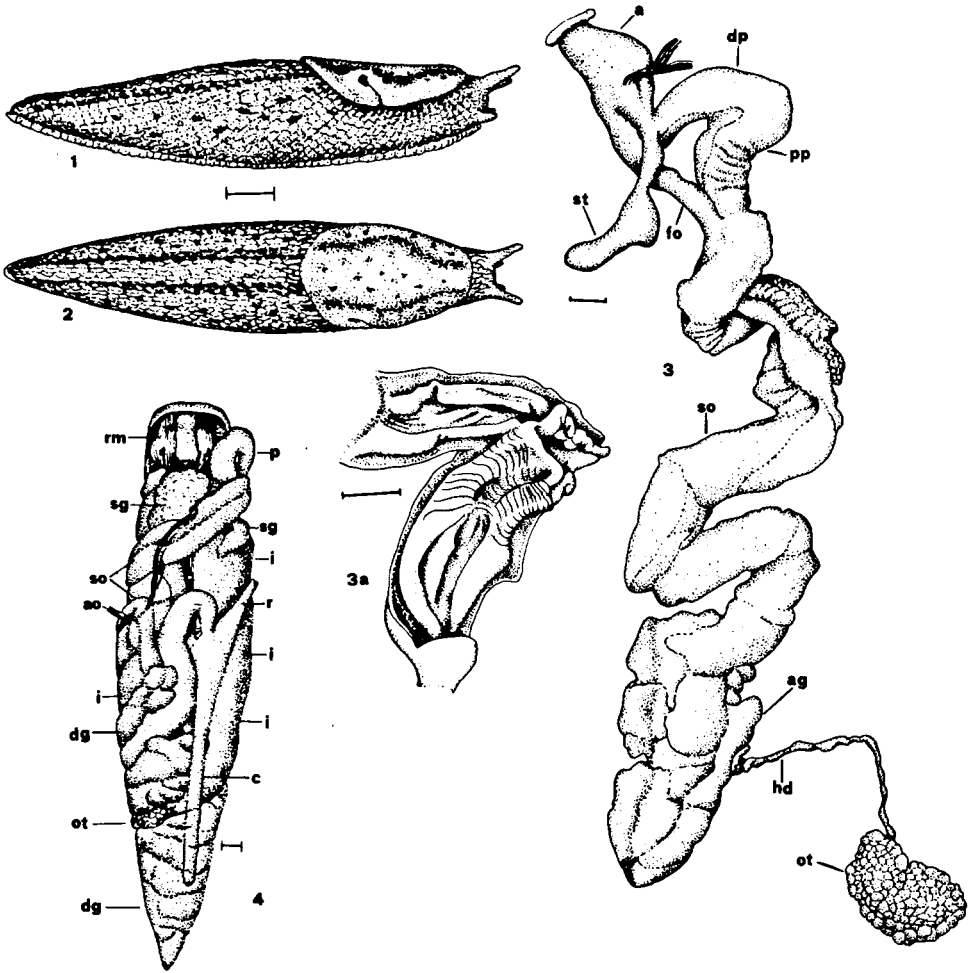
Radula. — Radular formula: 130 [35/1-2-3 + 17/3 + 1/3 + 17/3 + 31/1-2-3]. Central and lateral teeth tricuspid, with ecto- and endocones; marginal teeth with one, two or three cusps. The number of rows of teeth is about 130.

Genital system<sup>3</sup> (figs. 3, 3a, 5-9). — The ovotestis, which consists of small light-brown acini, is on the left side and does not reach the end of the visceral mass. The hermaphrodite duct is long and thin and shows convolution in its distal stretch. Albumen gland almond-shaped, light-brown. Spermoviduct long and thin, its male part covered by a glandulous wall. Free oviduct cylindrical; its length and thickness are half those of the penis. Vas deferens absent or very short; if present, no more than 0.5 mm long, its thickness greater than its length. Penis large, sometimes attaining 8.0 mm; in some specimens the penis appears as if it were divided into a proximal and a distal part, occasionally one of them bulky. In other specimens the penis is cylindrical and uniform. None of the specimens examined was provided with a typical penial retractor muscle. In its natural arrangement the penis is folded up in a V-fashion, with its proximal and distal portions closely fitted one against the other by means of muscular straps that make up a sheath. This muscular sheath of the penis is also observed in very young specimens. The spermatheca, spheroidal or slightly pointed, is small relative to the size of the whole genital system. The spermatheca duct is twice or three times longer than the spermatheca itself, and quite thick in relation to the latter. The insertion of the spermatheca duct on the penis is situated just before the atrium. The genital atrium is cylindrical and quite large and thick, its length almost that of the free oviduct. The atrium is completely surrounded by muscular strands, of which a thick one near the penis is especially conspicuous. Inside the penis there are longitudinal folds; those in the proximal penis strong and irregularly distributed, sometimes knob-like, whilst in the distal penis, except for a thick mid-fold, they are thinner and closely aligned. The internal surface of the genital atrium is smooth, without folds or papillae.

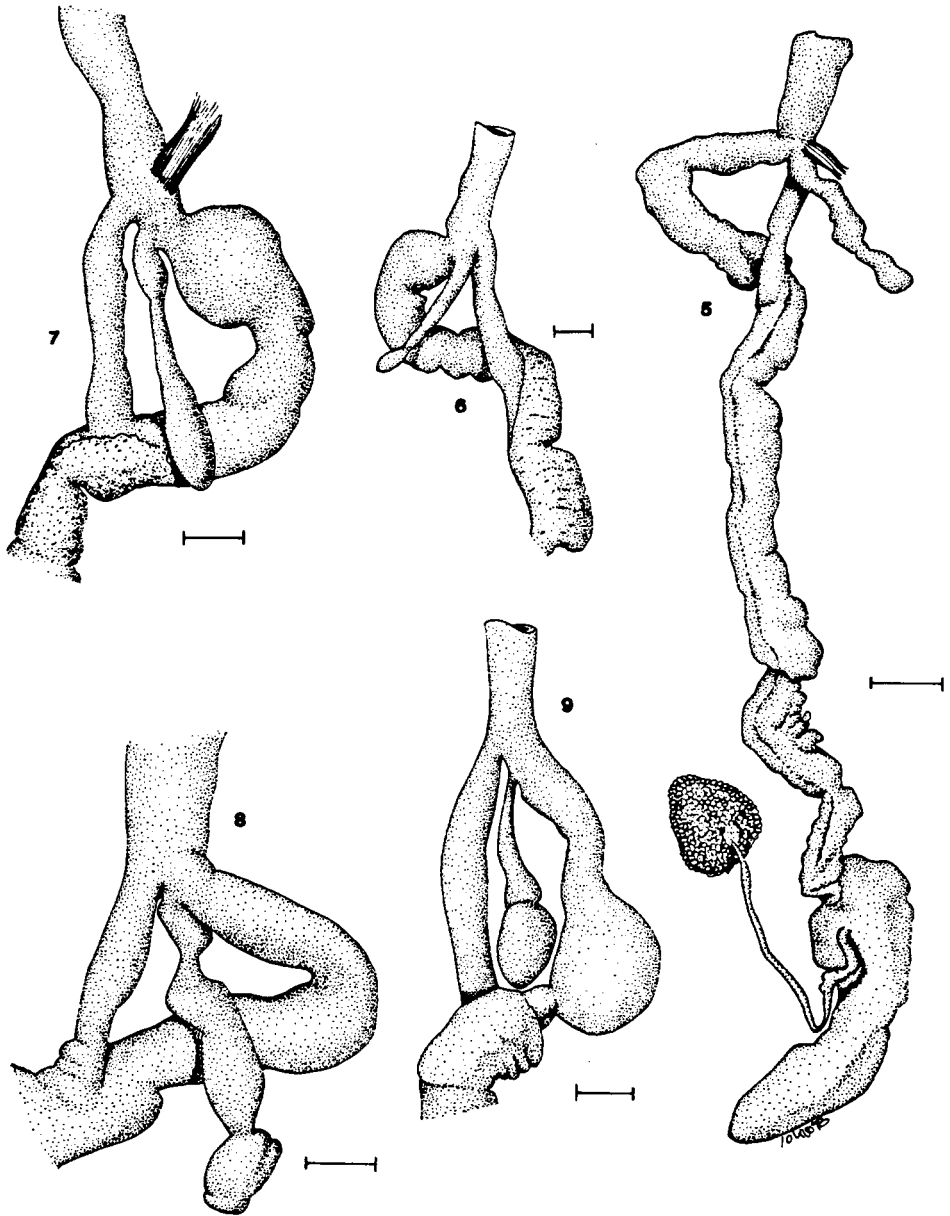
## GEOGRAPHICAL DISTRIBUTION AND BIONOMICS

*Limax majoricensis* has only been recorded from the Balearic islands Majorca, Ibiza and Formentera (western Mediterranean); it seems to be endemic to the area. The specimens

<sup>3</sup> The terms proximal and distal in the following description refer to the position of the ovotestis or gonad in the body.



Figs. 1-4. *Limax majoricensis*. 1-2, lateral and dorsal views of a specimen from Portals Vells (Majorca), scale 3 mm; 3, reproductive system of a specimen from Vedrà, Ibiza, scale 1 mm; 3a, internal view of penis, with folds, scale 1 mm; 4, dorsal view of the visceral mass of a specimen from Sant Antoni, Ibiza, scale 1 mm; a: genital atrium, ag: albumen gland, ao: aorta, c: rectal caecum, dg: digestive gland or hepatopancreas, dp: distal penis, fo: free oviduct, hd: hermaphrodite duct, i: intestine, ot: ovotestis or gonad, p: penis, pp: proximal penis, r: rectum, rm: ommatophore retractor muscle, sg: salivary gland, so: spermooviduct, st: spermatheca or bursa copulatrix.



Figs. 5-9. Genitalia of *Limax majoricensis*. 5, specimen from Vedrà, Ibiza, scale 2 mm; 6-7, specimen from Illa Plana, Illes Bledes, scale 1 mm; 8, detail of copulatory organs of specimen depicted in fig. 5, scale 1 mm; 9, specimen from Portals Vells, Majorca, scale 1 mm.



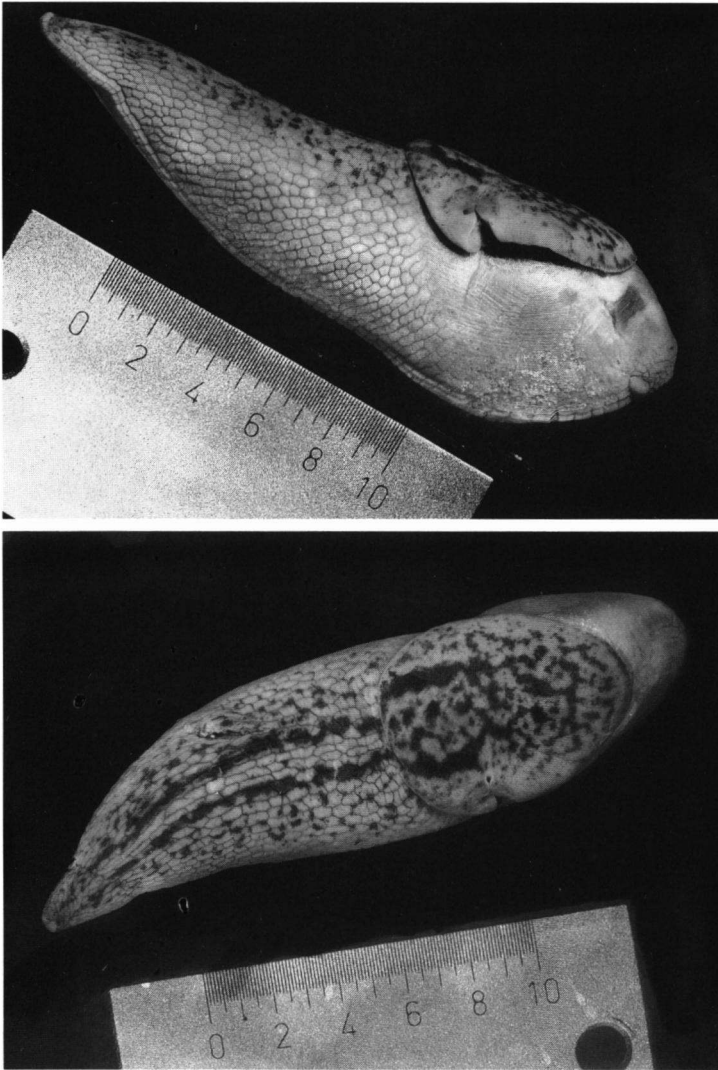
Fig. 10. Probable geographical distribution of *Limax majoricensis*.

collected by Gasull and Muntaner were found on walls along pathways, fountains and monasteries, which could denote an anthropophilous status.

Only little is known regarding the bionomics of this species. Through Gasull's annotations on the labels accompanying the topotypes we know that the specimens were collected in spring, autumn and winter. In all those samples juveniles are most frequent, adults only being present among those caught in March and December. Perhaps this indicates that sexual maturity is reached during winter, but the predominance of juveniles may also be brought about by diurnal collecting. In fact, it is well-known that adults, because of their great physiological demand for humidity and darkness, hide more skilfully than juveniles during daylight hours.

#### DISCUSSION

The diagnostic characters of *Limax majoricensis* are the following. Dorsum with two dark longitudinal bands that may be continued on mantle; mantle with irregularly distributed bands or spots; digestive tract with a long rectal caecum almost attaining the rear end of the visceral mass; penis long, without penial gland and retractor muscle; vas deferens absent or minute; internal surface of penis lined with longitudinal folds; spermatheca duct opens into distal part of penis, close to the atrium.



Figs. 11-12. Photographs of a specimen of *Limax majoricensis* from Sant Antoni (Ibiza) kept at the Natural History Museum of Stockholm (courtesy of H.W. Waldén).

Our specimens of *L. majoricensis* in 70% ethanol resemble *Limax (Limacus) flavus* Linnaeus, 1758, in external appearance, since both forms have dark spots on dorsum and mantle; however, in *L. majoricensis* those spots make up two lateral bands, which are absent in *L. flavus*. Moreover, in *L. majoricensis* the spermatheca duct opens into the distal part of penis, whereas in *L. flavus* it opens into the free oviduct; the vas deferens is normally developed in *L. flavus*, and absent or much reduced in *L. majoricensis*; in

addition, the penial retractor muscle is lacking in *L. majoricensis*, in contrast to the situation in *L. flavus*.

*Lehmannia nyctelia* (Bourguignat, 1861) also has a large penis divided into a proximal and a distal part, and the spermatheca duct joins the distal penis as well. However, in the genus *Lehmannia* Heynemann, 1862, the junction of the rectal caecum is situated closer to the anus than in *Limax* (*Limacus*) spp., and there always exists a penial retractor muscle and a long vas deferens.

*Lehmannia marginata* (Müller, 1774) and *Lehmannia valentiana* (Férussac, 1821), apart from the position of the junction of the rectal caecum, are easily differentiated from *Limax majoricensis* because both species have a gland on the proximal part of penis, and the penial retractor muscle and vas deferens are well developed.

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