**Drusia (Escutiella) alexantoni** n. sp. (Gastropoda, Pulmonata, Parmacellidae), a new terrestrial slug from the Atlantic coast of Morocco

A. Martínez–Ortí & V. Borredà


**Abstract**

*Drusia (Escutiella) alexantoni* n. sp. (Gastropoda, Pulmonata, Parmacellidae), a new terrestrial slug from the Moroccan Atlantic coast. The species most closely related to the new taxon are *D. (E.) deshayesii* and *D. (D.) valenciennii*. The new parmacellid differs from *D. (E.) deshayesii* mainly by the presence of external spots and bands on both the back and the shield, a reproductive system with uneven atrial appendices of the horn–shaped organ, and a different reticulated pattern of the inner epiphallus. It differs from *D. (D.) valenciennii* mainly for the appearance of the shell and the pattern and disposition of the bumps inside the penis, the presence of an elbow–shape in this organ, and the reticulated appearance of the inner wall of the epiphallus. An updated dichotomous key of the family Parmacellidae is provided.

**Key words:** Slug, Parmacellidae, *Drusia (Escutiella) alexantoni*, New species, Morocco, North Africa.

**Resumen**

*Drusia (Escutiella) alexantoni* sp. n. (Gastropoda, Pulmonata, Parmacellidae), una nueva babosa del litoral atlántico de Marruecos. — Se describe un nuevo parmacélido, *Drusia (Escutiella) alexantoni* sp. n., de la costa atlántica marroquí. Las especies más afines al nuevo taxon son *D. (E.) deshayesii* y *D. (D.) valenciennii*. De la primera se diferencia por presentar externamente manchas y bandas sobre el dorso y escudo, un aparato reproductor con apéndices atriales del órgano corniforme bastante desiguales, y por el distinto aspecto del reticulado del interior del epifalo. De *D. (D.) valenciennii* se diferencia principalmente por la forma de su concha, así como por el aspecto y la disposición de los mamelones del interior del pene, la presencia de un marcado acodamiento en este órgano, así como por el aspecto reticulado del interior del epifalo. Se proporciona además una clave dicotómica actualizada de la familia Parmacellidae.

**Palabras clave:** Babosa, Parmacellidae, *Drusia (Escutiella) alexantoni*, Nueva especie, Marruecos, Norte de África.

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Introduction

In a recent article (Martínez–Ortí & Borredà, 2012) we revised the systematics of the family Parmacellidae P. Fischer, 1856 and we proposed a new systematic scenario for this family, which would be formed by four genera: Candaharia Godwin–Austen, 1888 (2 subgen., 4 spp.), from Central Asia; Cryptella Webb et Berthelot, 1836 (3 spp.) from the Canary Islands; Parmacella Cuvier, 1804 (2 spp.) from Libya and Egypt; and Drusia Gray, 1855 (2 subgen., 4 spp.), with a wide distribution detailed below.

In the previously mentioned paper, the genus Drusia Gray, 1855 was divided into two subgenera: D. (Escutiella) Martínez–Ortí & Borredà, 2012 and D. (Drusia) s. str. The subgenus D. (Drusia) includes three species: D. (D.) valenciennii (Webb et Van Beneden, 1836), from the South of the Iberian peninsula; D. (D.) tenerifensis (Alonso, Ibáñez & Díaz, 1985), from Tenerife and D. (D.) iberica (Eichwald, 1841) from the Caucasus–Caspian Sea area. Subgenus D. (Escutiella) was described to include only one species: D. (E.) deshayesi (Moquin–Tandon, 1848), from Algeria and Northern Morocco.

In January 2011, we carried out a malacological prospection along the Moroccan Atlantic coast, collecting numerous specimens of a parmacelle which we propose as a new species to be included in the subgenus D. (Escutiella).

Results

After a detailed morpho–anatomical study of the collected specimens we observed that they corresponded to a parmacelle closely related to the species colleted specimens we observed that they corresponded to a parmacelle closely related to the species Drusia (Drusia) valenciennii and Drusia (Escutiella) deshayesi, particularly to the latter, but we believe it is a new species, and we propose naming it Drusia (Escutiella) alexantoni n. sp.

Family Parmacellidae P. Fisher, 1856

Genus Drusia Gray, 1855


Drusia (Escutiella) alexantoni n. sp.

Typical locality


Other localities


Type material

Formed by 29 specimens. The holotype is deposited at the Museu Valencian d’Història Natural (Valencia, Spain) with the code MVHN–100111GH01a. There are 13 paratypes (in ethanol 70%) with the code MVHN–100111GH01b and 4 paratypes (in ethanol 96%) with the code MVHN–100111GH01c, all at the same institution. In addition, three paratypes (in ethanol 70%) were deposited at the Museu de Ciències Naturals de Barcelona (Zoologia, MZB) with the code MZB 2012–0728; three paratypes (in ethanol 70%) at the Nationaal Natuurhistorisch Museum–Naturals of Leiden (The Netherlands) with the code RMNH. MOL.323195; three paratypes (in ethanol 70%) at the Museo Nacional de Ciencias Naturales of Madrid (Spain) with the code MNCN–15.05/60078; and two paratypes (in ethanol 70%) at the Senckenberg Museum of Frankfurt am Main (Germany) with the code SMF 341354.

Etymology

Species dedicated to Alejandro Pérez Ferrer and Antonio López Alabau, co–collectors of the studied specimens and enthusiastic Valencian amateurs of the malacology.

Common name

Slug of Barbary; Babosa de Berbería; Limace de Berbería.

Diagnosis

Parmacelle of great size. Young specimens present an olive brown dorsum with black lines and spots, especially on the shield, while adult specimens are light orange–brown and with lighter lines and spots. Toward the back of the shield, multiple lines or black bands of different thicknesses converge on the protoconch showing individual pattern variation (character less patent in adults). This protoconch is bright greenish, covered in adults and protruding slightly on the body surface of young individuals. Inside the reproductive atrium there is a thick ligula that extends inside the largest of the horn–shaped accessorrial appendices. It has a penis with a lateral bulge, giving it an elbow–like shape and it has two thick internal bumps. The interior of the epiphallus has a characteristic reticulated form with thick longitudinal folds that can spread out. Between these folds there are other less patent transverse folds that are almost perpendicular.

External appearance (figs. 1–11): slug of the family Parmacellidae with external features characteristic of this family: large, rough skin, and large, granular shield with the pneumostome in its right posterior portion. Light orange dorsal keel on the caudal part of the animal. Orange dark keel clearly visible in the posterior part of the body, especially in well–developed adult specimens. Very acuminated tail. Foot is of aulacopod type and the sole is light in colour. Caudal gland absent. Adult individuals reach 15 cm in length. Young individuals present a dorsal olive brown background with black lines and spots, especially on the shield; dorsal black bands or lines converge

toward the shield end, having individual pattern variation. The greenish, bright protoconch is slightly protruded in young individuals and even in sub–adult specimens (figs. 6–7). In well–developed adults, the overall tone of the body is light orange brown, with more visible bands and spots found only on the edge of the shield, while the rest of the dorsum shows a uniform appearance. In general, adult coloration is lighter than in younger animals.

Shell (figs. 6–7, 12–18): the shell is located under the mantle in the posterior part of the shield. It consists of a protoconch, from where a spiral begins, attached to a flat lamina, the limacella (or spatula). The protoconch is greenish, shiny, smooth, and relatively wide. The spiral is clearly visible. The limacella is white, slightly curved and paddle–shaped; it is slightly narrow in comparison and not strictly flat, being more cupped than in other species of the family. The protoconch protrudes slightly from the posterior end of the mantle in young and sub–adult specimens; it is well–developed and presents a well–marked oval–circular opening (figs. 15–16). In the outer flange an arrowhead–shaped, anchoring tooth is appreciable (figs. 15–16). Although at a glance the protoconch looks smooth and glistening, high magnification reveals a characteristic form, consisting of longitudinal and transverse lines forming an irregular grid in some areas (figs. 17–18). The size of the shell from two of the adult paratypes varies from 12.0 to 14.0 mm in width and from 21.5 to 24.0 mm in length.

Reproductive system (figs. 19–24): hermaphrodite gland partly covered by digestive organs is bilobed and formed by irregular acini. In young specimens it
is lighter and in adults it is darker in colour, greyish, with the same colour as the hepatopancreas. Hermaphrodite duct long and winding. Very large, triangular, whitish and irregular albumen gland, larger than in D. (E.) deshayesi and D. (D). valenciennii. Ovispermiduct relatively short, shorter than the albumen gland; distally it separates into feminine and masculine ducts. The masculine duct consists of vas deferens, epiphallus and penis, and together is longer than the ovispermiduct. The vas deferens is flared at its distal part, turning into the epiphallus, which presents a series of very thick longitudinal folds that can spread out along with other transverse, perpendicular, some of them oblique, less patent folds which give it a reticular appearance interiorly (fig. 24). This reticular appearance is similar to that of D. (E.) deshayesi, although this species has both the transverse and longitudinal folds similarly well-marked. The retractor muscle is inserted in the distal part of the epiphallus and it enlarges markedly turning into the penis. The
penis has a lateral protrusion close to the retractor muscle, giving it an elbow–like shape. Interiorly, the penis is completely covered with tight papillae. Inside the penis, in its proximal part, there is a bump next to the area of insertion of the muscle retractor (figs. 21, 23). Another larger bump is present in a distal position inside the elbow area. No complete spermatophores have been recovered (figs. 25–26). Inside the bursa copulatrix of four adult paratypes occurred several spermatophores (up to four in one of them), partially digested but quite complete. The spermatophores have the characteristics of the parmacelle morphology, and they are formed by a spiral from which a long filament emerges ending in a star–shaped fixing disk. We did not find entire anchoring disks whose morphology is a character of possible taxonomic value among the partially digested spermatophores, but some of them fairly complete (fig. 26). The female duct begins with a short and cylindrical free oviduct which ends in a widened structure which also converges at the duct of the bursa copulatrix. This widened structure is smooth and ovoid, with a hemispherical bulge in front of the end of the short bursa duct; the bursa is rather large and has very thin walls, although its size and shape vary greatly depending on the presence and degree of digestion of the spermatophores (fig. 19). The widened area increases its width becoming more glandular in aspect, having a bean–shape; it is the so–called perivaginal gland. The vagina is surrounded by this gland and ends in the atrium, which is rather short and has two conspicuous appendices attached, unequal in size and shape (figs. 19, 22). They are the atrial appendices; together they constitute the corniform organ, which has an irregular croissant shape. In the interior of the atrium, as is typical in the genus *Drusia*, there is a highly developed fleshy ligula that expands through the larger corniform organ appendix (Martínez–Ortí & Borredà, 2012) (fig. 22).

Other characters (figs. 27–36): jaw of oxygnathous type and crescent–shaped (figs. 27–29), similar to that of *D. (E.) deshayesi*. In addition, it has a serrated edge, visible as tiny teeth at high magnification (fig. 29). The radulae of two examined paratypes

### New key for the determination of the family Parmacellidae P. Fischer, 1856.

**Nueva clave para la determinación de la familia Parmacellidae P. Fischer, 1856.**

<table>
<thead>
<tr>
<th>1</th>
<th>Vagina surrounded by a perivaginal gland not thickened and provided with a long finger–shape caecum</th>
<th>Candaharia (Central Asia)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Vagina with a swollen perivaginal gland, well–developed and bean–shaped. No caecum.</td>
<td>2</td>
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<tr>
<td>2</td>
<td>Genital atrium without appendices. Bursa copulatrix without thickening</td>
<td>Cryptella (Canary Islands)</td>
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<td></td>
<td>Genital atrium with two appendices, or at least one. Duct of the bursa with a thickening where the spermaphores are attached</td>
<td>3</td>
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<tr>
<td>3</td>
<td>Atrial appendices of similar size. Elongated and well–developed distal part of the atrium from the insertion of appendices to the genital pore. Without intraatrial stimulators, only fleshy folds, with small ridges on its wall</td>
<td>Parmacella (Libya, Egypt)</td>
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<tr>
<td></td>
<td>Atrial appendices of different size. Short distal part of the atrium. One or more intraatrial large and fleshy stimulator folds</td>
<td>Drusia</td>
</tr>
<tr>
<td>4</td>
<td>Ornamented protoconch with small parallel spiral grooves. Very long epiphallus with two bends</td>
<td>P. festae</td>
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<tr>
<td></td>
<td>Smooth protoconch. Epiphallus shorter and with a single curvature</td>
<td>P. olivieri</td>
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<td>5</td>
<td>Adults presenting dorsum with a shield that has dark stains and/or bands. Smooth penis without extrusion. Interior of the epiphallus not reticulated. Protoconch amber coloured and limacella in form of broad paddle</td>
<td>D. (Drusia) s. str.</td>
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<td></td>
<td>Adults with dorsum and shield of uniform reddish–brown colour, or only with small lines at the end of the shield. Epiphallus internally reticulated. Penis with side extrusion, sometimes elbow–shaped. Greenish protoconch and a little wide limacella in the form of elongated paddle.</td>
<td>Morocco and Algeria</td>
</tr>
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<td>6</td>
<td>Shell with a spatula (limacella) shaped shovel, very wide. Animals of large size (70–95 mm in ethanol). Anchoring disk of the spermaphore curved like an umbrella. Tenerife, Canary Islands</td>
<td>D. (D.) tenerifensis</td>
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<tr>
<td></td>
<td>Shell with spatula oval, much more narrow. Specimens of smaller size. Anchoring disk of the spermaphore almost flat</td>
<td>7</td>
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<td>7</td>
<td>Wide spatula (limacella) of the shell (long/width &lt; 1.60). Stimulator fold in the interior of the atrium thin and not very developed. Georgia, Kazakhstan, and other countries in the E of the Caspian Sea</td>
<td>D. (D.) ibera</td>
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<td></td>
<td>Spatula much narrower (long/width &gt; 1.85). Atrial appendices of very different sizes, sometimes only one. Stimulator fold of the atrium unique, pleated and very thick, occupying almost all of the intraatrial space. South of the Iberian peninsula, Spain and Portugal</td>
<td>D. (D.) valenciennii</td>
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<tr>
<td>8</td>
<td>Juvenile with dorsum and shield with black bands and spots, which tend to disappear in adults. Atrial appendices of the corniform organ quite unequal. Interior of the epiphallus with thick reticulate. Huge albumen gland. Atlantic coast of Morocco, Essaouira to Agadir</td>
<td>D. (E) alexantoni n. sp.</td>
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<tr>
<td></td>
<td>Dorsum and shield, both juveniles and adults, of reddish–brown uniform colour, no bands or spots. Slender reticulate inside the epiphallus. Only slightly unequal atrial appendices. Northern Morocco and Algeria</td>
<td>D. (E) deshayesii</td>
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consist of 100 and 116 rows and both measure 4.65 mm length and 3.0 mm wide. Its radular formula is: 51 + C + 51. Teeth are generally similar to D. (E.) deshayesii (figs. 30–36) (Martínez–Ortí & Borredà, 2012). The central tooth presents a deep cut in the shape of an isosceles triangle at the base of the mesocone and reaching the vertex and lower end of this triangle (figs. 31–33). The ectocones also present wing–shape expansions. Other teeth present at the base of the external ectocone with additional wing–shape expansions directed outwards (Martínez–Ortí & Borredà, 2012).

Geographical distribution and habitat
D. (E.) alexantoni n. sp. has been found on the Moroccan Atlantic coast, from Essaouira to Agadir (fig. 37), in crops of argan (Argania spinosa (L.) Skeels). One of the authors (Martínez–Ortí) collected all the specimens living in colonies underneath the stones and small walls between these crops along with the Papilionaceae plant Ononix natrix L. which is possibly part of their diet. It has also been cited in lacustrine riparian environments (Martínez, 2009).

Discussion
This new species undoubtedly belongs to the genus Drusia and we decided to include it in the subgenus D. (Escutiella) due to the appearance of its shell and other features. Besides, it is very similar to D. (E.) deshayesii due to the following reproductive characters: i) penis with a lateral protrusion, ii) inside the penis there are two thick and solid bumps and iii) reticulated epiphallus inside with thick longitudinal folds.

It differs from D. (E.) deshayesii by i) a reproductive system with uneven atrial appendices of the horn–shaped organ, ii) lateral protrusion that gives it an elbow–like shape that is not present in D. (E.) deshayesii, iii) the arrangement and number of bumps inside the penis, only two of them in D. (E.) alexantoni n. sp and up to four in D. (D.) deshayesthesii, iv) the reticulated appearance of the inner wall of the epiphallus is different, with the longitudinal folds being much larger in D. (E.) alexantoni n. sp. and v) the very large albumen gland of the new species.

These reproductive characters are taxonomically more relevant than the external appearance which in juveniles, with spots and bands, could be confused with the subgenus D. (Drusia) s. str. and with the species Drusia (D.) valenciennii. Equally, the two appendices of the corniform organ are very unequal in the new species, which makes it more like D. (D.) valenciennii. However, due to the set of characters mentioned and described above, it seems much more related to D. (E.) deshayesesii and we have included it in the subgenus D. (Escutiella). The radula maximum dimensions of D. (E.) alexantoni n. sp. are 4.65 x 3.00 mm, being slightly smaller than in D. deshayesii (6.75 x 3.95 mm) and D. (D.) valenciennii (7.00 x 4.00 mm). In addition, the radular formula of D. (E.) alexantoni n. sp. (51 + C + 51) is clearly different from D. deshayesii (70 + C + 70) and D. valenciennii (65 + C+ 65) (Martínez–Ortí & Borredà, 2012).

Martínez–Ortí & Borredà (2012) provide a dichotomous key to identify the species in the family Parmacellidae but due to the discovery of D. (E.) alexantoni n. sp. and the new morpho–anatomical features provided it requires slight modifications (see above).

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