

DRUSIA (DRUSIA) IBERA (EICHWALD, 1841) (GASTROPODA: PARMACELLIDAE), THE FIRST RECORDS OF A TERRESTRIAL SLUG IN TURKEY

İHSAN EKİN¹ & RIDVAN ŞEŞEN²

¹Department of Energy Systems Engineering, Faculty of Engineering, Şırnak University, Şırnak, Turkey

²Department of Biology, Faculty of Science, Dicle University, Diyarbakır, Turkey

Abstract The rare species *Drusia (Drusia) ibera* (Eichwald, 1841) (Gastropoda, Pulmonata, Parmacellidae) is reported for the first time in Turkey (Diyarbakır). Specimens studied have large, rough skin and a large granular, banded mantle with a large pneumostoma on the right of the posterior part. The body length of well-developed adults is between 10 and 12cm. The general body tone is light olive-brown (grayish with brownish hue); the large mantle has spots and conspicuous bands that converge toward the end of the mantle. One specimen was dissected for its genitalia to confirm the identity of the species. Other records of Parmacellidae from Turkey, recently posted on iNaturalist, also appear to belong to this species. The study aims to reveal the presence of *D. (D.) ibera* in Turkey and contribute to the Turkish slug checklist. This record brings the total of terrestrial slug species in Turkey to 49, and most are distributed in the North Anatolia region.

Key words Slug, Parmacellidae, *Drusia (Drusia) ibera*, new record, Turkey

INTRODUCTION

There are about 500 species of terrestrial slugs and about 1000 species of semi-slugs in the world (Burton, 1982). These numbers increase each year with the discovery of new species. The most important difficulties in slug discovery are identifying species in the field, reduced shells, research methods requiring dissection and involving the study of anatomical features, conservation techniques and methods of storing material, etc. (Ekin & Şeşen, 2018; Wiktor, 2007).

Gastropod species closely related to European, Turanian, Caucasian, and Eremial malacocenoses are abundant in the Turkish territories due to the overlap of different biogeographical zones. In addition, many of them are unique and endemic species (Ekin & Şeşen, 2018; Schütt, 2005). Turkey's physiographic diversity offers a very rich species of slugs and snails (Wiktor, 2007). In Turkey, climatic variations ranging from extremely humid subtropical conditions to near-desert conditions provide a variety of niches for terrestrial snails and slugs. Geological factors significantly affect survival of slug species, and may also affect their population density (Ekin & Şeşen, 2018; Gümüş & Neubert, 2009). In contrast to snails, slugs are very sensitive animals that have no protective shells against external challenges (Telebak *et al.*, 2013). Slugs are the under-studied mollusc group

in Turkey (Ekin & Şeşen, 2018; Schütt, 2005). Since the Turkish malacofauna is poorly known, new species can be discovered at any time (Ekin & Şeşen, 2018; Gümüş & Neubert, 2009). Forty-seven slug species from 5 families were reported from Turkey (Ekin & Şeşen, 2018; Wiktor, 2007; Yıldırım & Kebapçı, 2004). In 2018 this number increased to 48 when we reported an additional species with the discovery of the three-banded garden slug *Ambigolimax valentianus* (Ekin & Şeşen, 2018).

The family Parmacellidae (P. Fischer 1856) includes large slugs with rough skin, a large granular or banded mantle, a keeled back, and a sole without a caudal gland (Martínez-Ortí & Borredà, 2012). The genus *Drusia* (Gray, 1855) contains five species *Drusia (D.) ibera*, *D. (D.) valenciennii* (Webb et Van Beneden, 1836), *D. (D.) tenerifensis* (Alonso, Ibáñez and Díaz, 1985), *D. (E.) deshayesii* and *D. (E.) alexantoni* (Borredà & Martínez-Ortí, 2017; Martínez-Ortí & Borredà, 2012, 2013). *D. (D.) ibera*, one of these species whose distribution is reported only in certain regions, was detected for the first time in Turkey.

MATERIAL AND METHODS

Drusia (D.) ibera was collected during ongoing biological research in April 2022 in the accommodation area of Dicle University near the city center of Diyarbakır in southeastern Turkey



Figure 1 □ Detection and collection area of *Drusia (Drusia) ibera* (dissected), Anatolia (Turkey), Diyarbakır, Around the city center. ■ Observed locations on the iNaturalist website (İstanbul, İzmir, Samsun, Alanya)

(altitude: 688m; 37°55.32' N, 40°44.63' E) (Fig. 1). Several samples were taken in the study area. 10 specimens were collected and stored in an air-permeable plastic box. Four of the specimens were photographed with a Canon EOS 600D for description and identification; the remainder were fixed in 4% formaldehyde for later study. Dissection was done in laboratory of Biology Department of Dicle University. The description, identification and taxonomy of the species were carried out according to related studies (Borredà & Martínez-Ortí, 2017; Martínez-Ortí & Borredà, 2012, 2013) and based on the contributions and determinations by the malacologists Eike Neubert, Ben Rowson, Anna Jordan and Bernhard Hausdorf. For the synonymous list, MolluscaBase's 'taxon details' internet site was used.

TAXONOMY

Family Parmacellidae (P. Fischer 1856)

Genus *Drusia* (Gray, 1855)

Subgenus *Drusia (Drusia)*

D. (D.) ibera (Eichwald, 1841)

Parmacella ibera (Eichwald, 1841)

Clathropodium vitrinaeforme (Westerlund, 1897)

Parmacella simrothi (Germain, 1911)

Drusia (Drusia) ibera (Eichwald, 1841)

The genus *Drusia* (Gray, 1855) has been divided into two subgenera: *D. (Escutiella)* and *D. (Drusia)*. Subgenus *D. (Escutiella)* includes two species: *D. (E.) deshayesii* from Algeria and northern Morocco and *D. (E.) alexantoni* from Atlantic coast of Morocco. The subgenus *D. (Drusia)* includes three species: *D. (D.) valenciennii* from the southwest of the Iberian Peninsula; *D. (D.) tenerifensis* from La Laguna, Tenerife, Canary Islands and *D. (D.) ibera* from the Caucasus-Caspian Sea region and central Asia (Borredà & Martínez-Ortí, 2017; Martínez-Ortí & Borredà, 2012, 2013).

Description *Drusia (D.) ibera* has large, rough skin and a large granular and banded mantle with a large pneumostoma (Fig. 2e) on the right of the posterior part. The body length of well-developed adults is between 10 and 12cm (Fig. 2a) during movement and 4 and 6cm when contracted (Fig. 2e). The general body tone is light olive-brown (grayish with brownish hue); the



Figure 2 a *Drusia (Drusia) ibera* from Diyarbakır, Turkey b Adult individuals with olive-brown bodies and mantle with spots and bands converging toward the ends of the mantle c The light yellow sole of the slug and a juvenile form is shown by black arrow d The slugs in their habitats e Pneumostome on the right posterior side and the keel on the back of the body.

large mantle has spots and conspicuous bands that converge toward the end of the mantle, while the rest of the dorsum shows a uniform appearance (Fig. 2). The mantle is located in the central part and covers nearly half of the body and can extend to about 5–6 cm. The spots and bands are not noticeable in young individuals (Fig. 2c). On the caudal part of the slug, especially in well-developed adults, there is a keel prominent ridge running over the whole tail (Fig. 2a, 2e). There is a light yellow thin line throughout the keel. There are two well-developed lines on the neck (Fig. 2b, 2c, 2d). Two pairs of retractile tentacles (optic and sensory) with two eyes at the end of long posterior tentacles were observed (Fig. 2). The tail is pointed. The foot is aulacopod type and the sole is light yellow (Fig. 2c). There is a fringe around the edge of the foot (Fig. 2a, 2e). The caudal gland is absent. The shell is under the mantle in the posterior part, and is quickly covered by the mantle during maturation. The last half of the whorl grows as a fragile suboval portion, called the limacella, and remains completely hidden by the mantle.

The genital opening and anus are under the mantle. The vagina is large and complex, with thick muscles and glandular walls (Fig. 3). There is no penis sheath. The spermathecal stalk is relatively short and muscular. The penial retractor is placed at the apex of the upper end of the penis (Fig. 3). The vagina, which has a swollen and bean-shaped perivaginal gland, does not contain a caecum and has thick muscles and glandular walls (Fig. 3). The hermaphroditic gland is connected to the albumen gland by the ductus hermaphroditicus (Fig. 3). The reservoir does not reach the albumen gland. The genital atrium is short. The stimulator fold in the interior of the atrium is thin and not very developed. There are two unequal atrial appendices (Fig. 3).

Using the key by Martínez-Ortí & Borredà, 2012, the Turkish specimens key out to subgenus *D. (Drusia)* because of their perivaginal gland, body size and the presence of two unequal atrial appendices. They key out as the species *D. (D.) ibera* because of their wide limacella (long/wide < 1.60) thin and little-developed atrial stimulator fold. *Drusia (D.) valenciennii* and *D. (D.) tenerifensis* have stimulators with very thick and well-developed folds inside the atrium. Their limacellas appear to differ by being more spade-shaped in *D. (D.) tenerifensis*, and spermatophores of the

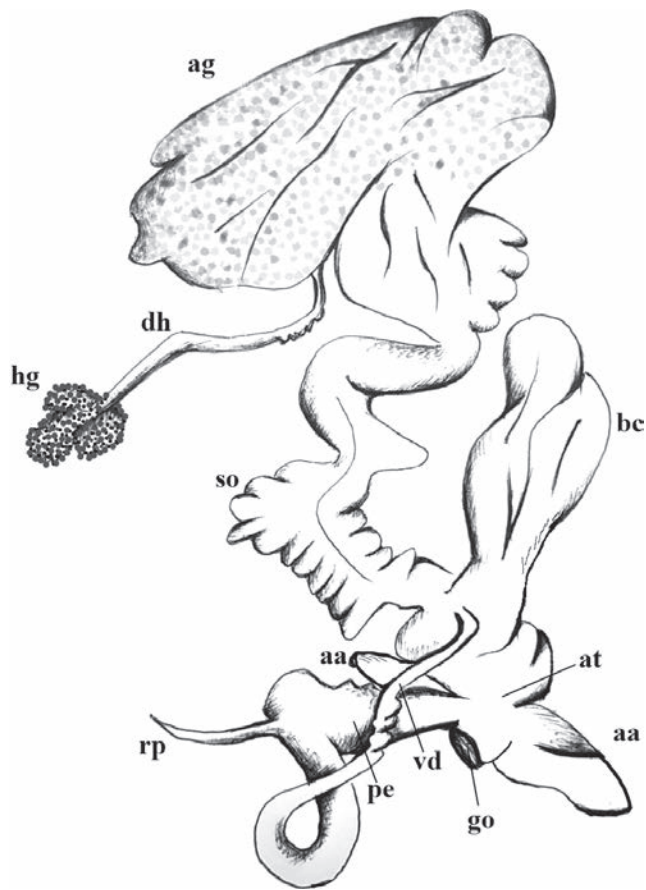


Figure 3 Genital system of *D. (D.) ibera* hg hermaphroditic gland dh ductus hermaphroditicus ag albumen gland so spermoviduct bc bursa copulatrix pe penis rp retractor muscle of the penis vd vas deferens aa atrial appendix at atrium go genital opening

species differ by the anchoring plate appearing umbrella-shaped and somewhat curved in the species (Martínez-Ortí & Borredà, 2012). Anchoring disk of the spermatophore of *D. (D.) tenerifensis* is curved like an umbrella. Atrial appendices of *D. (D.) valenciennii* are very different sizes, sometimes there is only one. In *D. (D.) valenciennii*, stimulator fold of the atrium is unique, pleated and very thick, occupying almost all of the intra-atrial space (Martínez-Ortí & Borredà, 2012, 2013). In addition, both *D. (D.) tenerifensis* and *D. (D.) valenciennii* have respectively only been reported from the Canary Islands and Iberia, while *D. (D.) ibera* is known east of the Caspian (Martínez-Ortí & Borredà, 2012).

Habitat The species has been observed in open habitats such as house gardens and the sites near settlements. They live among dandelion,

mustard, thorny annual plants, vetch, marshmallow, daisy, poppy, clover, mallow, and various steppe grasses. They prefer wet, shady places with moist soil near residential gardens, and under branches, trunks stones or rocks near the water sources.

RESULTS AND DISCUSSION

With the new detection of *D. (D.) ibera*, the number of slug species will rise to 49 in Turkey. Although species richness is very high compared to many Palearctic countries, Turkey is among the least investigated country for its slug species and much more information is needed about its slug fauna (Yıldırım & Kebapçı, 2004). Hartwig Schütt and Andrzej Wiktor have published several papers on Turkish slugs (Schütt, 2005; Wiktor, 1994, 2007). Their publications provide useful information on the reproduction, distribution, morphology, taxonomy, synonyms, and feeding behavior of Turkish slugs. The species *D. (D.) ibera* was not mentioned in any of these studies. Indeed, the absence of species from the Parmacellidae family was reported in their papers (Schütt, 2005; Wiktor, 1994, 2007).

Until recently *D. ibera* was known as *Parmacella ibera*. *Drusia* has not been used as a genus name for over 150 years, except when it is referred to as a junior synonym of *Parmacella* (Borredà & Martínez-Ortí, 2017). *D. (D.) ibera* is such a rare species that few studies exist and there are few studies even on the family Parmacellidae. For example, in a study on the biodiversity of three species of Parmacellidae (*Candaharia levanderi*, *C. aethiops* and *C. rutellum*), the importance of species was highlighted and *C. aethiops* was emphasized as a new species for Uzbekistan (Abdurasulova, 2019). Another earlier study described *P. valencienensis*, an endemic slug of the Iberian Peninsula (Genís & Alonso, 1981). In another study, *P. ibera* (synonym for *D. (D.) ibera*) has been reported as a common species in northern Iran (Yakhchali *et al.*, 2013).

Formerly, the Parmacellidae family included three genera: *Candaharia* in Central Asia with two subgenera and three species, *Cryptella* on the Canary Islands with seven species without subgenus, and *Parmacella* with six or seven species in North Africa, in the Canary Islands, in the south of the Iberian Peninsula and southern France, and an area between the Black and Caspian

Seas (Martínez-Ortí & Borredà, 2013; Schileyko, 2003). Now, Parmacellidae also includes the genus *Drusia*. It is thought that the current distribution of the genus *Parmacella* lies between the two territories occupied by *Drusia* south of the Iberian Peninsula and Morocco-Algeria and the Caucasus region. In that case, there are gaps on both sides, one in Tunisia and most of Libya to the west, and the other in the Middle East and Turkey to the east (Martínez-Ortí & Borredà, 2012).

The distribution of *D. (D.) ibera* is generally known as central Asia, Kopet Dagh (between Turkmenistan and Iran, Kopet Dagh mountain range runs northwest-southeast for more than 645km, from near the Caspian Sea to the Harirud River with an elevation of 3.190 meters), East Transcaucasia, Crimea, East Caucasus and the Caucasus-Caspian Sea region (Martínez-Ortí & Borredà, 2012, 2013; Schileyko, 2003). No publications reported that the species lived on the territory of Turkey although there was already other information on the iNaturalist website (<https://www.inaturalist.org/taxa/1044647-Drusia-ibera>) about the observation of the *D. ibera* in Turkish territories (user, observed date, location: edashell, 14 May 2022, Gebze, Istanbul; animalobserverdeniz321, 20 Apr 2022 Beşiktaş, Istanbul; animalobserverdeniz321, 12 Apr 2022, Beşiktaş, Istanbul; ozgurek, 11 Apr 2022, European Side of Istanbul; animalobserverdeniz321, 10 Apr 2022, Beşiktaş, Istanbul; toranc, 4 May 2021, Karşıyaka, İzmir; cankarayel, 18 Apr 2021, Ataşehir, Istanbul; bilgin, 27 Jan 2020, Üsküdar, Istanbul; tecdevil, 4 Apr 2021, Atakum, Samsun; anastasiiaamerkulova, 13 Mar 2021, Alanya, Antalya). It should be known that the identification of these observed species as *D. ibera* has not been confirmed by dissection. With some notable exceptions, most slugs are carried unintentionally. Its proximity to residential areas raises the possibility that the spread of this species may be due to people travelling, freight transport, cargo or refugee arrivals. Or they have been living in this ecosystem since their evolutionary origin and have only now been discovered. Nevertheless, it cannot be said exactly how the species spread into Turkey. The fact that the species has been identified in very few parts of the world warrants further investigation across Turkey. Although we only found the species in a few localities of Diyarbakır, this does not mean that it does not exist in other Turkish

regions. Further work needs to be done to confirm its distribution and to assess the population size and spread rate in the Turkish territories.

ACKNOWLEDGEMENTS

First and foremost, special thanks to Ben Rowson, Anna Jordan, Bernhard Hausdorf and Eike Neubert for their assistance in species identification, distribution and morphological explanation. We would like to thank Mehmet Özkaya for his support for the drawing

REFERENCES

- ABDURASULOVA SS 2019 Biological diversity of snails spread in agro-landscapes of Jizzakh region (In the sample of Gallaaral and Farish districts). *International Journal of Science and Research* **8**(11) 1632–1634. <https://doi.org/10.21275/ART20202951>
- BORREDÀ V & MARTÍNEZ-ORTÍ A 2017 Contribution to the knowledge of the terrestrial slugs (Gastropoda, Pulmonata) of the Maghreb. *Sociedad Española de Malacología* **35**(1) 1–10.
- BURTON DW 1982 How to be sluggish. *Tuatara* **25**(2) 48–63.
- EKİN İ & ŞEŞEN R 2018 A new record of three-band garden slug *Ambigolimax valentianus* (A. Férussac, 1822) (Gastropoda: Limacidae) from Turkey. *Turkish Journal of Zoology* **42** 475–479. <https://doi.org/doi:10.3906/zoo-1712-34>
- GENÍS MI & ALONSO MREA 1981 Estudio de ‘Parmacella y Valenciennesii’ Webb & Van Beneden, 1836, y consideraciones sobre la posición sistemática de la familia Parmacellidae (Mollusca, Pulmonata, Stylommatophora). *Bolletí de la Societat d’Història Natural de les Balears* **25** 103–121.
- GÜMÜŞ BA & NEUBERT E 2009 The biodiversity of the terrestrial malacofauna of Turkey – status and perspectives. *ZooKeys* **31** 105–117. <https://doi.org/10.3897/zookeys.31.169>
- MARTÍNEZ-ORTÍ A & BORREDÀ V 2012 New systematics of Parmacellidae P. Fischer 1856 (Gastropoda, Pulmonata), with the recovery of the genus-name *Drusia* Gray 1855 and the description of *Escutiella* subgen. Nov. *Journal of Conchology* **41** 1–18.
- MARTÍNEZ-ORTÍ A & BORREDÀ V 2013 *Drusia* (*Escutiella*) *alexantoni* n. sp. (Gastropoda, Pulmonata, Parmacellidae), a new terrestrial slug from the Atlantic coast of Morocco. *Animal Biodiversity and Conservation* **36**(1) 59–67. <https://doi.org/10.32800/abc.2013.36.0059>
- SCHILEYKO AA 2003 Treatise on Recent terrestrial pulmonate molluscs, Part 10: Ariophantidae, Ostracolethidae, Ryssotidae, Milacidae, Dyakiidae, Staffordiidae, Gastrodontidae, Zonitidae, Daudebardiidae, Parmacellidae. *Ruthenica Supplement* **2** 1309–1466.
- SCHÜTT H 2005 *Turkish Land Snails* (4th revised and enlarged edition). Verlag Natur und Wissenschaft. <https://www.nhbs.com/turkish-land-snails-1758-2005-book>
- TELEBAK B, BRAJKOVIC M & CURCIC S 2013 Contribution to the knowledge of the slugs (Gastropoda: Stylommatophora: Limacidae and Milacidae) from Montenegro. *Bulletin of the Natural History Museum* **6** 55–64. <https://doi.org/10.5937/bnhmb1306055T>
- WIKTOR A 1994 Contribution to the knowledge of the slugs of Turkey (Gastropoda terrestria nuda). *Archiv Für Molluskenkunde* **123**(1–6) 1–47. <https://doi.org/10.1127/arch.moll/123/1994/1>
- WIKTOR A 2007 A check-list of terrestrial slugs of Turkey with some new data and a description of a new species (Gastropoda terrestria nuda). *Folia Malacologica* **15**(3) 95–107. <https://doi.org/10.12657/folmal.015.011>
- YAKHCHALI M, GORGANI-FIRUZJAEI T & BAGHRI K 2013 Radular teeth morphology in *Limax* (*Caspilimax*) *keyserlingi* (Martens, 1880) and *Parmacella iberica* (Eichwald, 1841) from northern Iran. *Iranian Journal of Parasitology* **8**(2) 256–263.
- YILDIRIM MZ & KEBAPÇI Ü 2004 Slugs (Gastropoda: Pulmonata) of the Lakes Region (Göller Bölgesi) in Turkey. *Turkish Journal of Zoology* **28** 155–160.