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A new record of three-band garden slug *Ambigolimax valentianus* (A. Férussac, 1822) (Gastropoda: Limacidae) from Turkey

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Abstract: *Ambigolimax valentianus* (A. Férussac, 1822), the three-band garden slug, is originally native to the Iberian Peninsula (Spain, Portugal, and the Balearic Islands); however, it has been spread by human activities to many other parts of the world. There is no distributional record of the slug in Turkey to date. The species was recorded for the first time in Turkey during a biological survey carried out in the accommodation area of Dicle University (Diyarbakır) in October 2017. Some of the slugs were transferred to the laboratory for their morphological determination and dissection. Notably, more than 50 species of slugs dwell on Turkish lands and most of them are distributed in the Northern Anatolia Region. *A. valentianus* is observed here for the first time on Turkish lands. The purpose of the study is to present the first record of *A. valentianus* in Turkey and contribute to the checklist of Turkish gastropods.

Key words: *Ambigolimax valentianus*, three-band garden slug, new record, Turkey

In Turkish territories, gastropod species with close relationships to the European, Turanian, Caucasian, and Eremial malacocoenoses are abundantly present because of the overlapping of several biogeographic zones. Additionally, most of them are unique and endemic species (Schütt, 2005). The rich array of geomorphologic structures supports a high rate of speciation and variation due to geographic isolation. Climatologic variations ranging from extremely humid subtropical to almost desert-like conditions offer a multitude of niches for terrestrial gastropods. Geological factors significantly influence the absence or presence of gastropod species and also may have an impact on their population densities (Gümüş and Neubert, 2009). The physiographical diverse territory of Turkey has a very rich molluscan fauna, including numerous slug species. Because the Turkish malacofauna is poorly known, new species can be discovered at any time. For Turkey, it is still necessary to determine the geographical distribution of the gastropod species already recorded in other parts of the world (Schütt, 2005; Wiktor, 2007).

Ambigolimax valentianus is one of the greenhouse slugs, commonly known as the three-band garden slug, and its presence has not been recorded in Turkish territories to date. It is known as a ground-living species mostly found in greenhouses, gardens, and nurseries; in compost heaps and under fallen logs, stones, and soils; and in shady locations with lots of vegetation (Wiktor et al., 2000). The species is known as omnivorous, mostly feeding on algae growing on rocks and stones (Chichester and Getz, 1973) and on fresh plants, fruits, and tubers (Kurozumi, 2002); however, some nutritional research has shown that the species occasionally feeds on animal material and fallen decayed leaves (Udaka et al., 2007). The original location of *A. valentianus* is the Iberian Peninsula; however, it has been spread by human activities, presumably with garden plants and soil containing their eggs and juveniles, to many other parts of the world such as Ireland, England, Central Europe, France, South Sweden, Malta, West Italy, Russia, New Zealand, Australia, Japan, and Africa, as well as South and North America.

The objective of this report is to document for the first time in Turkey the presence of three-band garden slug *A. valentianus* from Diyarbakır on the basis of dissection and morphologic identifications, as well as contributing new data about the species for the gastropod checklist of Turkey.

A. valentianus was collected during an ongoing biological investigation in the gardens of Dicle University, near the Diyarbakır city center, in the southeast of Turkey (altitude: 688 m; 37°55.32′N, 40°44.63′E). The samples were obtained in October 2017 and the air temperature

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was 23 °C on a sunny day. The location of the sampling area is indicated in Figure 1 with its coordinates. In the studied area, a dense population of the slugs was observed; more than 40 individuals were counted. The slug samples (10 of them) were collected and kept in an air-permeable plastic box for carrying to the laboratory. The lengths of mature species were between 45 and 60 mm and the body weights of the adults were about 1–2 g. Some of the samples were photographed and dissected for species description and identification; the others were fixed in 4% formaldehyde for further examinations. The description, identification, and taxonomy of the species were done according to related studies (Quick, 1960; Wiktor, 1989, 2000; Kozłowski, 2010; Stojnić et al., 2011).

Taxonomy and synonyms of *Ambigolimax valentianus*

Kingdom: Animalia
Subkingdom: Bilateria
Phylum: Mollusca
Class: Gastropoda (Cuvier, 1797)
Subclass: Heterobranchia
Infraclass: Pulmonata
Order: Stylommatophora (Schmidt, 1855)
Suborder: Sigmurethra
Family: Limacidae (Batsch, 1789)
Subfamily: Limacinae (Lamarck, 1801)
Genus: *Ambigolimax*
Species: *Ambigolimax valentianus* (A. Férussac, 1822)

The species is known by different names in the world. Worldwide, common names of *A. valentianus* are as follows: three-band garden slug, striped greenhouse slug, striped field slug, hothouse alien, greenhouse slug, Spanish slug, and Valencia slug. Additionally, synonyms of the slug are *Lehmania valentiana*, *Limax valentianus*, *Limax valentiana*, and *Limax poirieri*.

More than 50 endemic and nonendemic slug species dwell on Turkish lands. Most of them live in the Northern Anatolia Region due to continuous heavy rain and the dense vegetation of the region; these climatic advantages provide the appropriate breeding environment for the slugs. Hartwig Schütt and Andrzej Wiktor, two prominent researchers, have published several studies on Turkish slugs (Wiktor, 1994; Schütt, 2005; Wiktor, 2007). Their publications provide valuable information about the reproduction, distribution, morphology, taxonomy, synonym names, and nutritional behaviors of these slugs.

The average length of the newly recorded Turkish *A. valentianus* is approximately 5 cm and its weight is between 1 and 2 g. The slug is more yellowish than its arboreal relative *L. marginata*, which is known as a tree slug with a translucent brownish body with darker mantle bands. *A. valentianus* generally has two pairs of dark bands on either side of the body's midline and one pale band in the middle. The lower pair of bands is mostly faint in some individuals (Figure 2). Young individuals typically have darker bands; however, the stripes of the adults become lighter and less conspicuous. The keel (top edge) is short and unmarked. Mucus is watery and colorless, not very sticky. The mucus produced by the slugs is clearly visible in the photographs (Figure 2). The breathing pore (pneumostome) is located on the right, in the posterior third of the mantle.

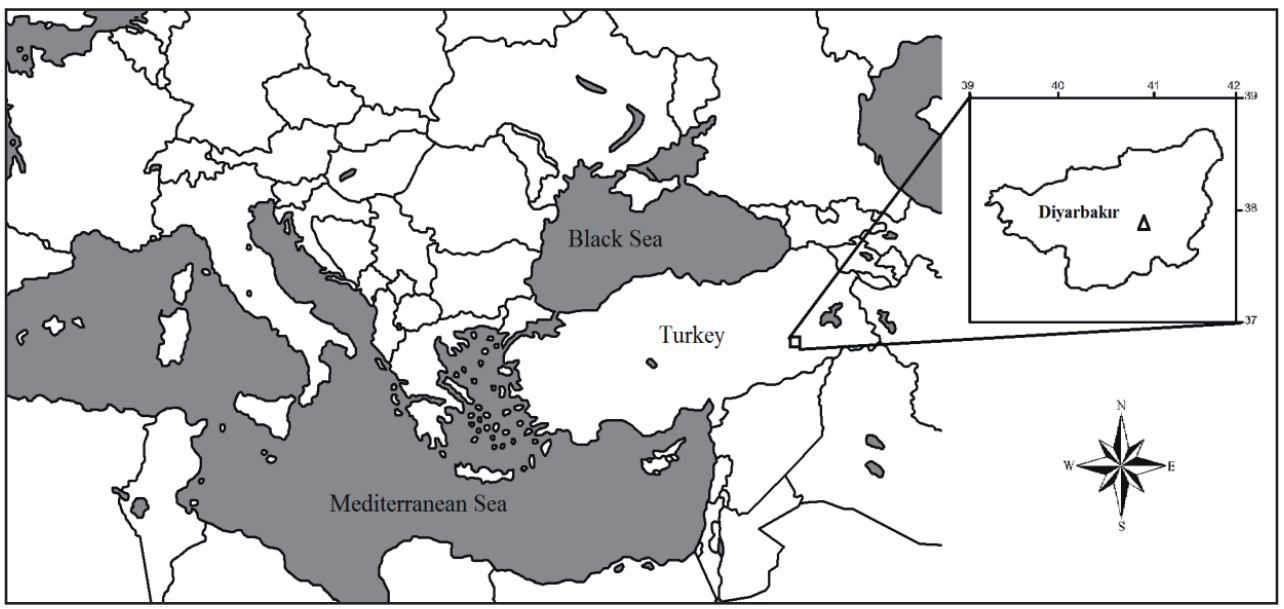

Figure 1. The record location of *A. valentianus* is shown with European and Turkish maps with the coordinates of the detection area, Diyarbakır (Δ).

Figure 2. Photographs of *A. valentianus* with adults and young individuals (length is between 4.5 and 6 cm, body weight is about 1–2 g).

A. valentianus is distinguished by its long rectal cecum, club-like penis, rounded penial flagellum on end of the penis, opposite to the side where the vas deferens connects, oval spermatheca equal to the length of the spermatheca duct and penis (Quick, 1960; Wiktor et al., 2000). Externally, the species looks like *L. nyctelia*; however, it is differentiated from *L. nyctelia* by its internal anatomy (penis has appendage at the tip) (Herbert, 1997). Additionally, the slug has penial flagellum longer and not pointed, spermatheca more ovate rather than pear-shaped (Quick, 1960). It is easy to distinguish by the morphology of its genital apparatus. Penis appendix and bursa copulatrix are both blunt in *A. valentianus* and pointed in *L. marginata*. Confirmation and identification of the species were done by comparison with Forsyth's (2004) study.

As given in the study of Stojnić et al. (2011), the distribution of *A. valentianus* is as follows. It is originally known as a West Mediterranean species, from the Iberian Peninsula and Northwest Africa (Wiktor et al., 2000). The species was widely distributed in most parts of Europe (South, 1992) and worldwide (Herbert, 1997; Barker, 1999; Wiktor et al., 2000) in a short time. The registered European areas are Russia (Sysoev and Schileyko, 2009), the Balearic Islands (Beckmann, 2007), Belgium, the British Isles, Northern Ireland (Kerney, 1999), the Channel Islands, Corsica, the Czech Republic (Horsak et al., 2004), Lithuania (Skujiene, 2002), Andorra, Austria (Reischutz, 1986), the Azores (Barker, 1999), Denmark, France, Gibraltar, Hungary, Ireland (Anderson, 2005), the Netherlands (Gittenberger and De Winter, 1980), Italy (Manganelli et al., 1995), Madeira, Malta (Beckmann, 2003; Mifsud et al., 2003), Poland (Stworzewicz, 2008), Romania, Portugal (Grossu, 1993), Spain, and Sweden (Walden, 1961). Outside of Europe, the species has been confirmed in Canada (Forsyth, 2001), South Africa (Herbert, 1997), the United States (Getz and Chichester, 1971), Australia and New Zealand (Barker, 1999), Colombia (Hausdorf, 2002), China (Wiktor et al., 2000), Peru, Chile, Easter Island, the Juan Fernandez

Islands (Barker, 1999), and Japan (Kurozumi, 2002). *A. valentianus* is thus considerably extending its geographic range, except for Antarctica (Stworzewicz, 2008). In spite of the aforementioned distribution of *A. valentianus*, there is no previous record or study related to its existence in Turkey.

The main difficulties in investigations of slugs are their lifestyle, difficulty in species identification in the field, reduced shells that hinder identification, research methodology that requires dissection and involves examining anatomical characters, preservation techniques and methods for the storage of material, etc. Many investigators do not collect these creatures at all, and even in many museums, the slug material is still very scanty (Wiktor, 2007).

This is the first report of species *A. valentianus* from Turkey and it contributes to the knowledge about the distributional and ecological features of the species. The potential distribution of the species deserves to be studied in the future all over Turkish territories. This will benefit the checklist of Turkish gastropods. On the other hand, in the case of a large population distribution, the slug can cause severe damage to greenhouse plants in agricultural areas. For this reason, it will be important to avoid such troubles by knowing the distribution and population density. Although we have found the species in just one locality, not seen in any other part of Diyarbakır Province, this does not mean that it does not live in other regions as well. Further work needs to be done to confirm its distribution and evaluate the population size and spreading rates in Turkish territories.

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