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# First records of the invasive land slugs *Ambigolimax valentianus* and *Deroceras laeve* (Gastropoda: Limacoidea) in South Korea

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## ABSTRACT

The terrestrial slugs *Ambigolimax valentianus* (Limacidae) and *Deroceras leave* (Agriolimacidae) are significant agricultural pests globally. Their widespread distribution is largely driven by anthropogenic activities, particularly the international trade of plant materials and soil containing their eggs or juveniles. Although these species are designated as Alert Alien Species in Korea considering the potential threat to native ecosystems, their presence in the field has not been officially verified so far. Here, we report the first confirmed occurrence of *A. valentianus* and *D. laeve* in South Korea based on morphological characteristics and molecular analysis of the cytochrome *c* oxidase subunit I (COI) gene. Specimens were collected from various regions in South Korea, humid habitats near human dwellings. Our findings suggest that these invasive slugs may have already established populations in Korea, highlighting the need for continuous monitoring and management strategies.

**Keywords:** Invasive species, New record, DNA barcoding, Limacoidea

## INTRODUCTION

*Ambigolimax valentianus* (A. Férussac, 1821) and *Deroceras laeve* (O. F. Müller, 1774) are cosmopolitan terrestrial slugs widely distributed across the globe. These species are well-known synanthropic organisms, predominantly inhabiting anthropogenic environments such as greenhouses, gardens, and nurseries (Wiktor *et al.*, 2000). While *A. valentianus* is native to the Iberian Peninsula (Férussac, 1821), the precise origin of *D. laeve* remains uncertain, though its native range is generally considered to include Northern Asia and Europe (Wiktor *et al.*, 2000; Gittenberger *et al.*, 2018). Currently, these slugs are found on all continents except Antarctica (e.g. Rowson *et al.*, 2014a; Vendetti *et al.*, 2018; Ekin and Şeşen, 2018; Breure, Roosen and Ablett, 2022). Their global expansion is largely attributed to human activities, specifically the international trade and transport of plant materials and soil, which often harbor their eggs and juveniles (Mc Donnell and Hahs, 2015; Vendetti *et al.*, 2018). Ecologically, both species are omnivorous. They primarily feed on algae growing on rocks, as well as fresh plants, fruits, and tubers (Chichester and Getz, 1973; Kurozumi, 2002). Some studies indicate they also consume animal matter and decaying leaves (Udaka *et al.*, 2008). Due to these broad feeding habits, both species are regarded as significant pests in agriculture and horticulture (South, 1992). Moreover, their reproductive strategies involve self-fertilization, which

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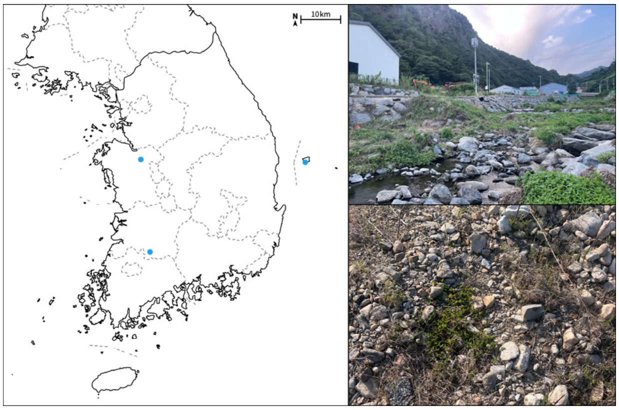

**Fig. 1.** Location of sampling sites and habitat photographs. The dots on the map indicate the collection sites in South Korea, while the photographs on the right display the surrounding environment and microhabitat of the collected slugs.

allows a single introduced individual to establish a viable population without a mate, further accelerating their spread as invasive species (Nicklas and Hoffmann, 1981; Hommay *et al.*, 2001). These slugs have been designated and managed as "Alert Alien Species in Korea" due to their potential invasiveness (Information of Korean Alien Species, https://kias.nie.re.kr/). However, their actual occurrence in natural habitats had not been officially verified prior to this study. In this study, we confirm the presence of *Ambigolimax valentianus* and *Deroceras laeve* in field environments and report them as new records for the Korean fauna.

## MATERIALS AND METHODS

Specimens of *Ambigolimax valentianus* (n = 10) and *Deroceras laeve* (n = 2) were collected from habitats situated near human dwellings in Jeju, Ulleung, Sunchang, and Asan, South Korea (Fig. 1). Samples were fixed in 95% ethanol and deposited at Kyungpook National University and the Honam National Institute of Biological Resources. Morphological imaging was performed using a stereomicroscope (M205, Leica Camera AG, Germany) with Helicon Focus Pro v8.3.8 (Helicon Soft Ltd., Ukraine). Radulae were dissected, cleaned, platinum-coated, and examined using FE-SEM (SU8220, Hitachi Co., Japan).

**Fig. 2.** A maximum likelihood phylogenetic tree in Limacoidea based on COI sequences. The tree is rooted with *Antiquarion evelynensis* (Helicarionoidea). Numbers at nodes indicate bootstrap support values. The scale bar represents the number of nucleotide substitutions per site. The species sequenced in this study are highlighted in colors. Clades corresponding to the same species are collapsed.

Genomic DNA was extracted using an E.Z.N.A. Mollusc and Insect DNA Kit (Omega Bio-tek Inc., USA). The mitochondrial cytochrome *c* oxidase subunit I (COI) fragment was amplified using primers LCO1490/HCO2198 (Folmer *et al.*, 1994). PCR was performed with the following thermal cycling conditions: initial denaturation at 95°C, 2 min; 35 cycles of 95°C, 20 s, 48°C, 40 s, and 72°C, 1 min; and a final extension at 72°C, 10 min. PCR products were sequenced on an ABI Prism 3730 (PerkinElmer Inc., USA) and deposited in GenBank (Accession Nos.PX700733–PX700741).

COI Sequences were aligned using BioEdit v7.7.1 (Hall, 1999), and intraspecific genetic distances were

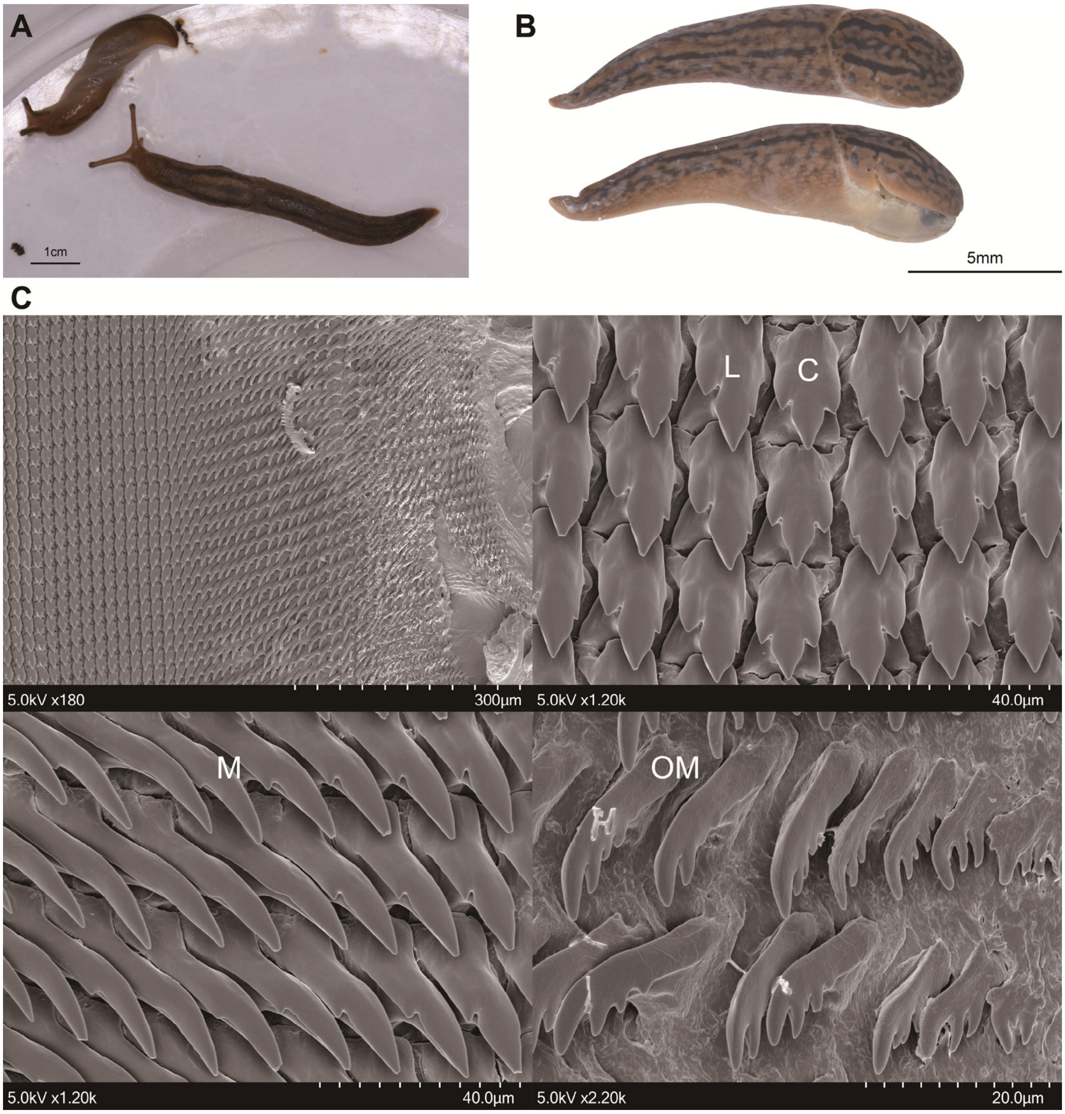

**Fig. 3.** External features and radula of *Ambigolimax valentianus* (Férussac, 1821). **A.** Living specimen, fully extended in dorsal view. **B.** Stereomicroscopic photographs of dorsal and lateral views of the body; **C.** Scanning electron micrographs (SEM) of radula. Abbreviations: L, lateral teeth; C, central teeth; IM, inner marginal teeth; OM, outer marginal teeth. Scale bars as indicated in figures.

calculated using MEGA v.12.0 (Kumar *et al.*, 2024). Phylogenetic analysis was performed using a 578 bp dataset comprising the new sequences and 550 sequences of the superfamily Limacoidea from GenBank, with *Antiquarion evelynensis* as the outgroup (Supplementary Table 1). A maximum likelihood tree was reconstructed using IQ-TREE2 (Minh *et al.*, 2020) based on the TPM3u+F+I+G4 model selected by ModelFinder (BIC), with support assessed by 1,000 bootstrap replicates (Fig. 2).

## SYSTEMATIC ACCOUNTS

Phylum Mollusca Linnaeus, 1758 연체동물문
Class Gastropoda Cuvier, 1795 복족강
Order Stylommatophora A. Schmidt, 1855 병안목
Family Limacidae Batsch, 1789 뾰족민달팽이과
Genus *Ambigolimax* Pollonera, 1887 세줄민달팽이속(신칭)
***Ambigolimax valentianus* (A. Férussac, 1821)**
**세줄민달팽이 (Fig. 3)**
*Limax valentianus* A. Férussac, 1821: 21, pl. 8A, figs. 5-6

*Lehmannia getica* Grossu, 1970: 112
*Limax poirieri* Mabille, 1883: 52

**Type locality**. Valencia, Spain.

**Materials examined.** Korea: 3 specimens (LEGOM031402–4), Baeksan-ri, Sunchang-eup, Sunchang-gun, Jeonrabuk-do, South Korea, 35°21'51.65"N, 127°6'15.51"E, 9 May 2025, Kanghyun Jeon; 4 specimens (LEGOM031405–7 and HNIBRIV25082), Namseo-ri, Seo-myeon, Ulleung-gun, Gyeongsangbuk-do, South Korea, 37°28'31.88"N, 130°50'5.64"E, 8 Aug 2025, Kanghyun Jeon.

**Diagnosis**. Slender and cylindrical body, medium sized slug, Body length up to 66 mm when fully extended, approximately 2.5 times the length of preserved specimens (Fig. 3A). Dorsal surface pinkish-yellow brown. Two parallel, sharply defined dark longitudinal bands on the mantle, with a third, less defined line in between; similar bands may extend along the back. Keel short, restricted to the posterior end. Pneumostome on the right side, in the posterior half of the mantle. Limacella under the dorsal mantle; small, vestigial, thin, oval, and plate-like (Fig. 3B). Isodont type radula with 44–46 teeth on each side. Central teeth tricuspid, with one large, strong medial cusp and two small lateral ectocones. Lateral teeth tricuspid, similar in shape to the central tooth. Marginal teeth unicuspid, aculeate, needle-like and elongated. Outermost marginal teeth multicuspid (Fig. 3C).

**Distribution**. Korea (new record), Africa, America, Asia, Australasia, and Europe.

**Habitat**. Humid microhabitats near human dwellings; found among grasses along the margins of shallow streams (Fig. 1).

**Remarks**. *Ambigolimax valentianus* shares similar external characteristics with *Lehmannia marginata*, which has historically resulted in taxonomic confusion and misidentifications (Waldén, 1961). However, the two species can be distinguished by internal morphology, specifically the shape of the penial apex and the radula (Quick, 1960). Furthermore, they differ in their ecological preferences: *L. marginata* typically inhabits woodlands, whereas *A. valentianus* is more widespread and adaptable, thriving in synanthropic habitats including urban and agricultural environments (Rowson *et al.*, 2014b).

Kimura *et al.* (2019) reported *Ambigolimax* sp. in the checklist of species from Ulleung-do Island; this record is presumed to refer to *A. valentianus*.

Family Agriolimacidae H. Wagner, 1935 작은뾰족민달팽이과
Genus Deroceras Rafinesque, 1820 작은뾰족민달팽이속

**_Deroceras laeve_ (O. F. Müller, 1774) 부다페스트민달팽이 (Fig. 4)**

*Limax laevis* O. F. Müller, 1774: 1
For a complete list of synonyms, see MolluscaBase (2025)

**Materials examined.** Korea: 1 specimen (LEGOM031408), Pyeongchon-ri, Songak-myeon, Asan-si, Chungcheongnam-do, South Korea, 36°44'4.51", 127°0'27.86", 4 May 2025, Boyeon Choi; 1 specimen (HNIBRIV25083), Namseo-ri, Seo-myeon, Ulleung-gun, Gyeongsangbuk-do, South Korea, 37°28'31.88"N, 130°50'5.64"E, 8 Aug 2025, Kanghyun Jeon.

**Diagnosis**. A small, slender slug. Body length up to 48 mm when fully extended, approximately 3 times the length of preserved specimens (Fig. 4A). Dorsal body color uniform, grayish brown, nearly black. Mantle large, covering half of the body length. Keel short and poorly defined, restricted to the posterior tip of the body. The pneumostome located in the posterior half of the mantle. Limacella under the mantle, small, vestigial, oval and thin (Fig. 4B). Isodont type radula, central tooth tricuspid, with a long, strong median cusp and two very small lateral ectocones. Lateral teeth bicuspid or weakly tricuspid. Marginal teeth unicuspid, aculeate needle-like or dagger-shaped (Fig. 4C).

**Distribution**. Korea (new record), Africa, America, Asia, Australasia, and Europe.

**Habitat.** Humid riparian environments near residential areas; found under stones interspersed with grasses (Fig.1).

**Remarks**. Another common synanthrope, *Deroceras reticulatum*, is a major pest known for inflicting heavy damage on agriculture (Getz, 1959). Although this species can be sympatric with *D. laeve*, the two

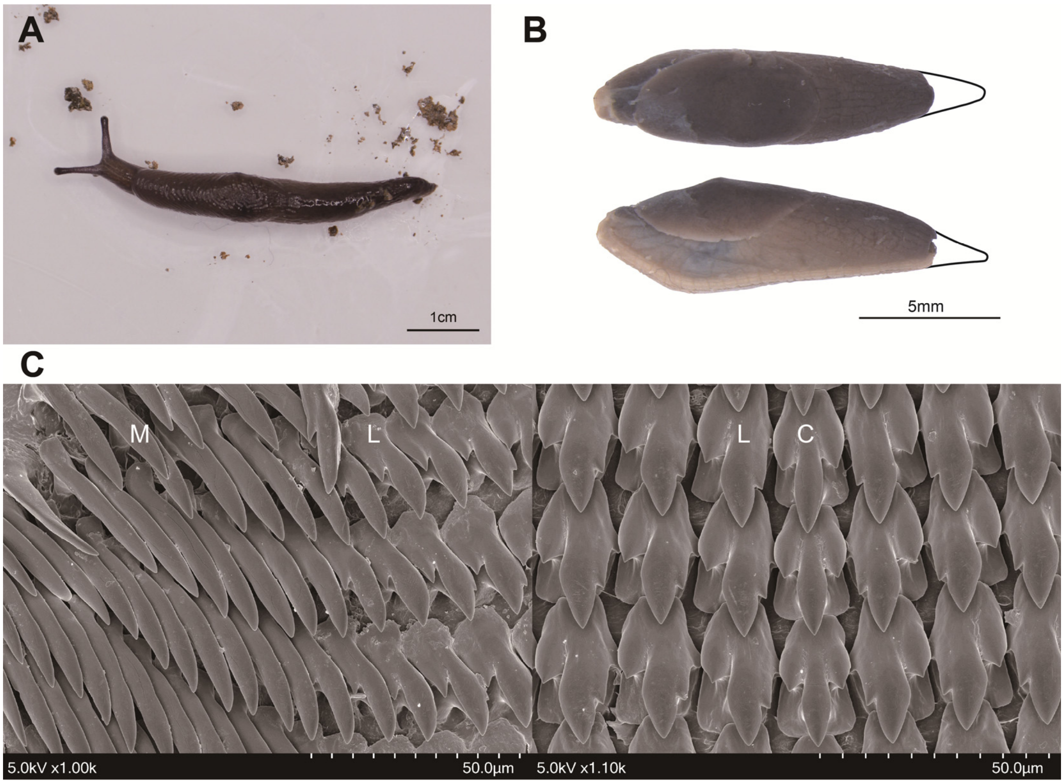

**Fig. 4.** External features and radula of *Deroceras laeve* (Müller, 1774). **A.** Living specimen, fully extended in dorsal view. **B.** Stereomicroscopic photographs of dorsal and lateral views of the body; **C.** Scanning electron micrographs (SEM) of radula. Abbreviations: L, lateral teeth; C, central teeth; IM, inner marginal teeth; OM, outer marginal teeth. Scale bars as indicated in figures.

species can be distinguished based on adult features. *D. reticulatum* is larger, with a body that is cylindrical but thickened medially, covered in large, distinct tubercles (Zając and Stec, 2020). The pigmentation is typically cream or pale coffee with dark spots forming a reticulate pattern behind the mantle, but juveniles may be monochromatic (Wiktor, 1989). Conversely, *D. laeve* possesses a smoother, more slender body with uniform dark coloration. Furthermore, the two species differ in mucus secretion: *D. reticulatum* produces milky, opaque mucus, whereas *D. laeve* produces clear mucus (Zając and Stec, 2020).

*Deroceras laeve* damages all parts of plants and is considered a significant agricultural pest (Gupta *et al.* 2023). Moreover, *D. laeve* is well-documented as a reservoir for diverse pathogenic nematodes, including *Angiostrongylus* species, which pose significant health risks to both humans and animals (Conboy, 2009; Gang and Hallem, 2016; Rojas *et al.*, 2021).

## DISCUSSION

In the phylogenetic tree of the superfamily Limacoidea constructed in this study, the Korean specimens of *Ambigolimax valentianus* and *Deroceras laeve* formed clear monophyletic groups with their respective sequences from GenBank, confirming their species identification (Fig.2).

*Ambigolimax valentianus* was found in various regions across Korea, suggesting that the species has established self-sustaining populations after its introduction (Fig. 1). The genetic differences based on COI sequences within *A. valentianus* were low, ranging from 0.0000 to 0.0105. As mentioned in the remarks, identifying this species based only on external appearance is difficult (Waldén, 1961), and it prefers habitats near human activity (Rowson *et al.*, 2014b). Therefore, it is highly probable that a portion of previous records of *Lehmannia marginata* in Korea may include misidentified cases of *A. valentianus*. Our phylogenetic results support this idea, showing a clear separation between the *A. valentianus* group and *Lehmannia* species (Fig. 2).

Similarly, *Deroceras laeve* was also collected from multiple localities in Korea, indicating that this species has also successfully settled in the country. In our analysis, *D. laeve* was divided into four major groups with high genetic differences of up to 7%. This finding matches previous studies, which maintained them as a single species because they look the same despite the large genetic difference (Rowson *et al.*, 2014a). The Korean specimens belonged to one of these major groups and showed the closest genetic relationship with populations from Asia and America (Fig. 2).

However, neither *Ambigolimax valentianus* nor *Deroceras laeve* showed a clear geographic pattern on a global scale. The haplotypes of both species found in Korea were identical or closely related to those reported from distant regions, such as Europe and the Americas. The lack of region-specific genetic grouping strongly suggests that their presence in Korea is not due to natural spread, but rather recent introductions caused by humans, likely through the international trade of horticultural materials (Mc Donnell and Hahs, 2015; Vendetti *et al.*, 2018). The collection site, located near an agricultural processing facility in Ulleung-do, further implies that these species were introduced via commercial transport.

Although *Ambigolimax valentianus* and *Deroceras laeve* have been subject to regulatory monitoring in South Korea, this study confirms that they are now established in domestic ecosystems. Since these species are known as agricultural pests and can carry parasites, their presence poses a real threat to Korean agriculture and public health (Rojas *et al.*, 2021). Therefore, an urgent shift from simple observation to active management is required. Continuous monitoring of their distribution and population changes is essential to reduce their negative impacts on the local ecosystem and agriculture.

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**Supplementary Table 1.** List of species and GenBank accession numbers for mitochondrial COI sequences used in the phylogenetic analysis

| Species | Genbank Accession No. | Reference |
|---|---|---|
| *Deroceras laeve* | EF128217 | Tsai and Wu (2008) |
| | HM584699 | Reise *et al.* (2011) |
| | KF894228–29, KF894260–62, KF894277, KF894311, KF894344, KF894348, KF894364, KF894381 | Rowson *et al.* (2014) |
| | PV826422 | Telfer *et al.* (2015) |
| | KM611814, KM611853, KM611883, KM611889, KM611903, KM611984, KM612156, KM612188, KM612199, MF544220, MF544236–37, MF544256, MF544259, MF544278, MF544316, MF544318, MF544353, MF544359, MF544368, MF544389, MF544396, MF544449, MF544475, MF544505, MF544528, MF544534, MF544553, MF544633, MF544687, MF544712, MF544725, MF544768, MF544776, MF544780, MF544817, MF544838, MF544840, MF544849, MF544851, MF544857, MF544861, MF544874, MF544905, MF544928, MF544932, MF544949, MF544959, MF544988, MF544999, MF545012, MF545021, MF545028, MF545037, MF545053, MF545081, MF545090, MF545139, MG421043, MG421092, MG421212, MG421234, MG421254, MG421532, MG421537, MG421572, MG421628, MG421664, MG421706–7, MG421877, MG421933, MG421943, MG421964, MG421995, MG422190, MG422202, MG422209, MG422256, MG422304, MG422310, MG422561, MG422707, MG422722, MG422732, MG422765, MG422767, MG422774, MG422802, MG422916, MG422986, MG422989–90, MG422995, MG423054, MG423141, MG423175, MG423181, MG423214, MG423224, MG423231, MG423249, MG423379, MG423457 | deWaard *et al.* (2019) |
| | PX700740–41 | This study |
| *Deroceras panormitanum* | JN248304–5, JN248307–8, JN248310–2 | Reise *et al.* (2011) |
| | KF894327 | Rowson *et al.* (2014) |
| | KM611878, KM612026, KM612148, KM612186 | deWaard *et al.* (2019) |
| *Deroceras invadens* | JN248295–6, JN248298–300, JN248302, JN248314–5 | Reise *et al.* (2011) |
| | JQ743070 | Gutiérrez Gregoric *et al.* (2013) |
| | KF894241, KF894244–5, KF894252, KF894259, KF894319, KF894343, KF894370, KF894385 | Rowson *et al.* (2014) |
| | MH830161–221, MH830223, MH830228–33, MH830235–8 | Hutchinson *et al.* (2020) |
| Deroceras reticulatum | KF894235, KF894263–4, KF894269, KF894287, KF894293, KF894308, KF894313, KF894362–3, KF894376, KF894378 | Rowson et *al.* (2014a) |
| | KT705645, KT705739 | Telfer *et al.* (2015) |
| | MF544167, MF544191, MF544235, MF544267–8, MF544270, MF544298, MF544377, MF544379, MF544385, MF544386, MF544387, MF544407, MF544410, MF544411, MF544421, MF544439, MF544447, MF544458, MF544487, MF544510, MF544511, MF544615, MF544623, MF544637, MF544646, MF544696, MF544743, MF544787, MF544812, MF544870, MF544917, MF544918, MF544966, MF544972, MF544982, MF545027, MF545058, MF545085, MF545107, MF545125, MG421099, MG421125, MG421157, MG421618, MG421685, MG421846, MG421990, MG422269, MG422401, MG422417, MG422433, MG422479, MG422919, MG422942, MG423075, MG423130, MG423180, MG423215, MG423266, MG423268, MG423285, MG423288, MG423310, MG423318, MG423335, MG423387, MG423493, MG423572 | deWaard *et al.* (2019) |
| | LS974195–97 | - |
| *Deroceras agreste* | KF894247, KF894312, KF894346, KF894375 | Rowson *et al.* (2014) |
| *Deroceras golcheri* | JN248292–3 | Reise *et al.* (2011) |
| *Plutonia atlantica* | MT181509 | Pfarrer *et al.* (2021) |

| Species | Genbank Accession No. | Reference |
|---|---|---|
| *Arabivitrina darnaudi* | MT181486 | Pfarrer *et al.* (2021) |
| *Arabivitrina arabica* | MT181485 | Pfarrer *et al.* (2021) |
| *Arabivitrina jansseni* | MT181487 | Pfarrer *et al.* (2021) |
| *Madeirovitrina nitida* | MT181506 | Pfarrer *et al.* (2021) |
| *Eucobresia diaphana* | MT181500–2 | Pfarrer *et al.* (2021) |
| *Sanettivitrina scripta* | MT181513–4 | Pfarrer *et al.* (2021) |
| *Hessemilimax kotulae* | MT181515–16 | Pfarrer *et al.* (2021) |
| *Vitrinobrachium breve* | MT181520–1 | Pfarrer *et al.* (2021) |
| *Vitrina angelicae* | MF544799, MF545167, MG421094, MG422766, MG423118 | deWaard *et al.* (2019) |
| *Vitrina pellucida* | FJ606454 | Nitz *et al.* (2009) |
|  | KM611838, KM611887, KM611966, KM611982, KM612175, MF544561, MG422492, MG422756, MG423119 | deWaard *et al.* (2019) |
|  | MN022738 | Saadi and Wade (2019) |
|  | MT181517–8 | Pfarrer *et al.* (2021) |
| *Calidivitrina kiboschoensis* | MT181489–90, MT181510 | Pfarrer *et al.* (2021) |
| *Canarivitrina taburientensis* | MT181496–8 | Pfarrer *et al.* (2021) |
| *Calidivitrina ericinellae* | MT181488 | Pfarrer *et al.* (2021) |
| *Calidivitrina ugandensis* | MT181495 | Pfarrer *et al.* (2021) |
| *Calidivitrina nigrocincta* | MT181491–4 | Pfarrer *et al.* (2021) |
| *Weltersia obscura* | MT975665–7 | Giusti *et al.* (2021) |
| *Malacolimax tenellus* | JX435836 | Nitz (2013) |
|  | KF894297, KF894349, KF894369, KF894379 | Rowson *et al.* (2014) |
|  | MT975673–4 | Giusti *et al.* (2021) |
| *Lehmannia marginata* | FJ606455 | Nitz *et al.* (2009) |
|  | KF894219, KF894221, KF894234, KF894239, KF894242, KF894248, KF894270–1, KF894274, KF894283, KF894288, KF894292, KF894298–9, KF894325, KF894329, KF894350, KF894356–8, KF894361, KF894368, KF894372, KF894377 | Rowson *et al.* (2014) |
|  | MT975668–71 | Giusti *et al.* (2021) |
| *Bielzia coerulans* | JX435825 | Nitz (2013) |
| *Ambigolimax valentianus* | JX117876 | Gutiérrez Gregoric *et al.* (2013) |
|  | JX435832 | Nitz (2013) |
|  | KF894276, KF894281, KF894290, KF894328, KF894332, KF894341 | Rowson *et al.* (2014) |
|  | MG799141–5 | Vendetti *et al.* (2018) |
|  | PX700733–39 | This study |
| *Limax sarnensis* | FJ606482–99 | Nitz *et al.* (2009) |
| *Letourneuxia nyctelia* | KF894237–8, KF894251, KF894253–4, KF894302–3, KF894333 | Rowson *et al.* (2014) |
|  | MG799133–40, MG856342 | Vendetti *et al.* (2018) |
| *Limax wohlberedti* | FJ606481 | Nitz *et al.* (2009) |
| *Limax dacampi* | JX435840, JX435860 | Nitz (2013) |

| Species | Genbank Accession No. | Reference |
|---|---|---|
| | KF894382, KF894384 | Rowson *et al.* (2014) |
| | PQ676334 | Kastelic and Rexhepi (2024) |
| *Limax ciminensis* | GQ145553 | Nitz *et al.* (2010) |
| *Limax senensis* | GQ145575 | Nitz *et al.* (2010) |
| *Limax corsicus* | GQ145524–26, GQ145538–39 | Nitz *et al.* (2010) |
| *Limax brandstetteri* | GQ145572 | Nitz *et al.* (2010) |
| *Limax ianninii* | GQ145573 | Nitz *et al.* (2010) |
| *Limax minimus* | GQ145527 | Nitz *et al.* (2010) |
| *Limax wolterstorffi* | GQ145500 | Nitz *et al.* (2010) |
| *Limax giovannellae* | JX435826 | Nitz (2013) |
| *Limacus flavus* | FJ481181, FJ606456 | Nitz *et al.* (2009) |
| | OP270478 | Čejka *et al.* (2022) |
| | KF894304, KF894331 | Rowson *et al.* (2014a) |
| *Limax maximus* | EF015443 | Hyman *et al.* (2007) |
| | FJ606466–71 | Nitz *et al.* (2009) |
| | GQ145574 | Nitz *et al.* (2010) |
| | JN248294 | Reise *et al.* (2011) |
| | KF894224, KF894246, KF894249–50, KF894258, KF894279, KF894336, KF894345, KF894359, KF894373, KF894386 | Rowson *et al.* (2014) |
| | KM612139 | deWaard *et al.* (2019) |
| | MT181504–5 | Pfarrer *et al.* (2021) |
| *Limax cinereoniger* | FJ606458–60, FJ606462–65 | Nitz *et al.* (2009) |
| | JX435828, JX435831, JX435833–4, JX435838, JX435842, JX435848–9 | Nitz (2013) |
| | KF894220, KF894227, KF894231–2, KF894257, KF894284, KF894291, KF894295, KF894305, KF894317, KF894339, KF894347, KF894353, KF894365, KF894371, KF894380 | Rowson *et al.* (2014) |
| *Limacus maculatus* | KF894225, KF894240, KF894272, KF894278, KF894301, KF894318, KF894321–2, KF894330, KF894334–5, KF894360, KF894366–7, KF894383 | Rowson *et al.* (2014) |
| *Limax conemenosi* | JX435837 | Nitz (2013) |
| | MT975672 | Giusti *et al.* (2021) |
| | PQ676333 | Kastelic and Rexhepi (2024) |
| *Boettgerilla pallens* | JX435886 | Nitz (2013) |
| | KF894268, KF894352 | Rowson *et al.* (2014) |
| *Antiquarion evelynensis* | MN654044 | Hyman and Köhler (2020) |

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