

# INTRODUCED LAND SNAILS AND SLUGS IN COLOMBIA

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## ABSTRACT

Twelve species of introduced land molluscs, including seven slug species, have been found in the cold zone above 2000 m altitude in the Departamentos Cundinamarca and Boyacá, and the Distrito Especial in Colombia. The introduced land molluscs remain generally restricted to disturbed environments, from which native species are often absent. Most recorded species originated from Europe. *Deroceras laeve* has been present in Colombia for more than a century, whereas the other species are probably more recent introductions. The records of *Boettgerilla pallens*, which is indigenous to the Caucasus and has spread over Europe only during the last decades, demonstrates that the process of introduction of alien molluscs is continuing.

## INTRODUCTION

Introduced molluscs can create economic and conservation problems. Many agricultural pest species are especially prone to be transported inadvertently with seeds, crops, fruits, or machines. If they become established in a new country, they can cause serious economic damage. Some snails, especially carnivorous species, are known to affect the indigenous land snail fauna and, in some cases, have rapidly exterminated local species. Thus, they can produce great conservation problems, especially if they are introduced in areas with a diverse endemic fauna.

The introduction of non-native species should be prevented to avoid these problems (Robinson, 1999). If an introduced species becomes established, its identification is a first step to evaluate its potential impact and, if necessary, to take appropriate control measures.

Unfortunately, not much is known about introduced snails in Colombia and in South America in general. So far there are only a few records of introduced land molluscs in Colombia, namely of *Deroceras laeve* (O. F. Müller, 1774) (Simroth, 1910, 1914; Malek, 1981), *Lehmannia valentiana* (A. Férussac, 1822) (Waldén, 1961) and *Sarasinula plebeia* (Fischer, 1868) (Götting, 1978; Frank, 1984). Additionally, Robinson (1999) reported on interceptions of the snail *Candidula intersecta* (Poiret, 1801) from shipments from Colombia by the United States Department of Agriculture (USDA). Beside this species and several of the species found in our survey, the following non-indigenous species were found on Colombian shipments by USDA inspectors since 1993: *Cochlicopa lubrica* (O. F. Müller, 1774), *Zonitoides arboreus* (Say, 1816), *Tandonia sowerbyi* (A. Férussac, 1823), *Bradybaena similaris* (A. Férussac, 1822) (D. G. Robinson, personal communication). Most of these species were found on cut flowers. The Colombian colonies of these species have not so far been located.

During land snail surveys in the Departamentos Cundinamarca and Boyacá, and the Distrito Especial, which were not especially aimed at introduced species, a variety of alien snails and slugs were found, even in remote areas.

## MATERIAL AND METHODS

The collections were made in March 2000 by the author, and staff and students of the Facultad de Ciencias of the Universidad Militar Nueva Granada, Santafé de Bogotá. Most sampling

stations in the Departamentos Cundinamarca and Boyacá and the Distrito Especial were in the cold zone above 2000 m altitude. All slugs, with the exception of a few samples of *Arion intermedius*, were determined anatomically. Voucher specimens are kept in the Zoological Museum, Hamburg, and in the Instituto de Ciencias Naturales of the Universidad Nacional de Colombia, Santafé de Bogotá.

## LIST OF SPECIES

### *Family Punctidae*

#### *Paralaoma servilis* (Shuttleworth, 1852)

*Localities.* Distrito Especial: Bogotá, sandstone rocks and small gorge at Calle 100 No. 2–15 E, strongly disturbed, 2860 m altitude, 04°40'32"N 74°01'52"W; Bogotá, road-side and forest near brook above Escuela Militar de Caballería, 2750–2790 m altitude, 04°41'15"N 74°01'33"W; Bogotá, Bosques de Chico, 04°41'N 74°02'W—Departamento Cundinamarca: arid SW slope with sandstone rocks and *Opuntia* at the shore of Laguna de La Herrera SW of Mosquera, disturbed (quarry, rubbish), 2610 m altitude, 04°41'19"N 74°15'57"W; La Calera 0.5 km towards Bogotá, farm Las Cabrerías, Vereda San Rafael, Andean forest and sandstones at forest margin, NW slope, 2830 m altitude, 04°42'30"N 73°58'20"W; La Calera, S of Entrada Fabrica de Cemento Samper, degraded Andean forest, NW slope, 2750 m altitude, 04°43'15"N 73°56'46"W.

*References for identification.* Pilsbry (1948); Roth (1986); Kerney, Cameron & Jungbluth (1983).

*Remarks.* The name *Helix servilis* Shuttleworth, 1852 has priority over *Helix caputspinulae* Reeve, 1852 and, thus, is the valid name of the species (Falkner, Ripken & Falkner, in press). *P. servilis* is known from Europe (e.g. Gittenberger, Menkhorst & Raven, 1980; Kerney *et al.*, 1983), North America (e.g. Roth, 1986), Africa (e.g. Roth, 1986; Neubert, 1998), Asia (e.g. Neubert, 1998), Australia and New Zealand (e.g. Smith, 1992). *P. servilis* has not been recorded from South America, but Gittenberger (in Roth, 1986) already supposed that *Zilchogyra cleliae* Weyrauch, 1965 from Argentina and south-eastern Brazil is a synonym of *P. caputspinulae* (= *servilis*). Fonseca & Thomé (1995) placed *Zilchogyra cleliae* and *Radiodiscus misionensis* Scott, 1957 in the synonymy of *Radiodiscus pilsbryi* Scott, 1957 and included this species in *Punctum* (*Toltecia*). They obviously missed the notes of Roth (1986, 1987). Their figures show that these names are further synonyms of *P. servilis*. *P. servilis* is not listed

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in the compilations of travelling snails of Smith (1989) and Robinson (1999). This might be due to the fact that it has been described as an indigenous species under various names in all continents where it has been found so far. The synonymy of these names has been recognized only recently (Gittenberger *et al.*, 1980; Roth, 1986, 1987; Smith, 1992; Neubert, 1998). Other species referred to *Paralaoma* are restricted to Australia and New Zealand. This might indicate that *P. servilis* is indigenous to that region. However, Solem (1983) suggested that *Paralaoma* might be a synonym of the almost cosmopolitan *Punctum* (see also Roth, 1986). Thus, the origin of the species is still uncertain. Even if it actually originated in the Australian region, it is possible that it got to South America via Europe. On the other hand, it is also possible that it has been introduced directly from the Australian region with *Eucalyptus* plants, which are now widespread in Colombia. Actually, *Z. cleliae* has originally been found on a *Eucalyptus* tree (Weyrauch, 1965). In Colombia, *P. servilis* was found at the edge of native and disturbed forests, as well as in arid wasteland. It is not known to be an agricultural pest.

#### Family Pristilomatidae

##### *Hawaii minuscula* (Binney, 1840)

*Localities.* Departamento Boyacá, Moniquira 5.4 km towards Arcabuco, roadside near quarry Cantera el Porvenir in La Roca, 2150 m altitude, 05°50'58"N 73°32'47"W.

*References for identification.* Pilsbry (1946); Kerney *et al.* (1983).

*Remarks.* *H. minuscula* is widespread in North and Central America south to Panama and the Antilles (Riedel, 1980). It is also known from the Colombian Islands of Isla San Andrés and Isla de la Providencia off the coast of Nicaragua (Pilsbry, 1930). Concerning South America, there are records from Ecuador and Peru (Riedel, 1980). Smith (1989) and Robinson (1999) indicated that *H. minuscula* is native in North America and listed introductions from all other continents except the Antarctic (Smith, 1989; Robinson, 1999). However, it is questionable whether the Central and South American occurrences are due to more or less recent introductions, or whether they are part of the native range. In the Colombian Andes *H. minuscula* was found at a roadside. It is not known to be an agricultural pest.

##### *Vitrea (Crystallus) contracta* (Westerlund, 1871)

*Localities.* Distrito Especial: Bogotá, Bosques de Chico, 04°41'N 74°02'W—Departamento Cundinamarca: La Calera, S of Entrada Fabrica de Cemento Samper, degraded Andean forest, NW slope, 2750 m altitude, 04°43'15"N 73°56'46"W.

*References for identification.* Kerney *et al.* (1983).

*Remarks.* *V. contracta* is indigenous to Europe and the Mediterranean region (Riedel, 1980). So far, introductions have been recorded only from Australia (Smith, 1989, 1992; Robinson, 1999) and North America (Roth, 1977). In Colombia *V. contracta* was found at the edge of native and disturbed forests. It is not known to be an agricultural pest.

#### Family Oxychilidae

##### *Oxychilus (Ortizius) alliaris* (Miller, 1822)

*Localities.* Distrito Especial: Bogotá, sandstone rocks and small gorge at Calle 100 No. 2–15 E, strongly disturbed, 2860 m altitude, 04°40'32"N 74°01'52"W; Bogotá, road-side above Escuela Militar de Caballería, 2790 m altitude, 04°41'15"N 74°01'33"W—Departamento Cundinamarca: arid SW slope with sandstone rocks and *Opuntia* at the shore of Laguna de La

Herrera SW of Mosquera, disturbed (quarry, rubbish), 2610 m altitude, 04°41'19"N 74°15'57"W—Departamento Boyacá, Villa de Leiva 9 km towards Arcabuco, disturbed oak forest near farm, 2400 m altitude, 05°42'05"N 73°29'56"W.

*References for identification.* Pilsbry (1946); Kerney *et al.* (1983); Barker (1999).

*Remarks.* *O. alliaris* is indigenous to western Europe (Riedel, 1980). Introductions have been recorded from most continents (Smith, 1989; Robinson, 1999). In Colombia *O. alliaris* was found only in disturbed environments, namely wasteland and farmland. It is not known to be an agricultural pest.

#### Family Milacidae

##### *Milax gagates* (Draparnaud, 1801)

*Localities.* Departamento Cundinamarca: arid SW slope with sandstone rocks and *Opuntia* at the shore of Laguna de La Herrera SW of Mosquera, disturbed (quarry, rubbish), 2610 m altitude, 04°41'19"N 74°15'57"W—Departamento Boyacá, Villa de Leiva 9 km towards Arcabuco, disturbed oak forest near farm, 2400 m altitude, 05°42'05"N 73°29'56"W.

*References for identification.* Pilsbry (1948); Likharev & Wiktor (1980); Kerney *et al.* (1983); Wiktor (1987); Barker (1999).

*Remarks.* *M. gagates* is indigenous to the western Mediterranean (Wiktor, 1987). Introductions have been recorded from all continents except the Antarctic (Smith, 1989; Robinson, 1999). In Colombia, *M. gagates* was found only in disturbed environments, namely wasteland and farm land. It is an agricultural pest.

#### Family Boettgerillidae

##### *Boettgerilla pallens* Simroth, 1912

*Localities.* Distrito Especial: Bogotá, sandstone rocks and small gorge at Calle 100 No. 2–15 E, strongly disturbed, 2860 m altitude, 04°40'32"N 74°01'52"W—Departamento Cundinamarca: La Calera 0.5 km towards Bogotá, farm Las Cabrerías, Vereda San Rafael, sandstones at forest margin, NW slope, 2820 m altitude, 04°42'30"N 73°58'20"W; La Calera, S of Entrada Fabrica de Cemento Samper, degraded Andean forest, NW slope, 2750 m altitude, 04°43'15"N 73°56'46"W.

*References for identification.* Schmid (1963); Likharev & Wiktor (1980); Kerney *et al.* (1983).

*Remarks.* *B. pallens* is indigenous to the Western Caucasus (Wiktor, 1994). It spread over Europe only in the second half of the last century (Schmid, 1963; Kerney *et al.*, 1983; Reise, Hutchinson, Forsyth & Forsyth, 2000). It is known also from Turkey (Wiktor, 1994), Armenia, Tadjikistan and Western Siberia (Likharev & Wiktor, 1980) and has recently been recorded from North America (Reise *et al.*, 2000). Its occurrence in Colombia is probably due to a very recent introduction. In Colombia, *B. pallens* was found in disturbed biotopes, but also at the edge of native forests. It is not known to be an agricultural pest.

#### Family Limacidae

##### *Lehmannia valentiana* (A. Férussac, 1822)

*Localities.* Departamento Cundinamarca: arid SW slope with sandstone rocks and *Opuntia* at the shore of Laguna de La Herrera SW of Mosquera, disturbed (quarry, rubbish), 2610 m altitude, 04°41'19"N 74°15'57"W—Departamento Boyacá, Villa

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de Leiva 9 km towards Arcabuco, disturbed oak forest near farm, 2400 m altitude, 05°42'05"N 73°29'56"W.

*References for identification.* Waldén (1961); Likharev & Wiktor (1980); Kerney *et al.* (1983); Barker (1999).

*Remarks.* *L. valentiana* is indigenous to the Iberian Peninsula (Waldén, 1961). Introductions have been recorded from other European countries, the Americas, Africa, and New Zealand (Waldén, 1961; Barker, 1999; Robinson, 1999). *L. valentiana* was first recorded from Colombia by Waldén (1961) from Sonsón in Antioquia. In Colombia, it was found only in disturbed environments, namely wasteland and farm land. It is an agricultural pest.

### Family Agriolimacidae

#### *Deroceras (Deroceras) laeve* (O. F. Müller, 1774)

*Localities.* Distrito Especial: Bogotá, road-side above Escuela Militar de Caballería, 2790 m altitude, 04°41'15"N 74°01'33"W—Departamento Cundinamarca: arid S slope with sandstone rocks and *Opuntia* near the Aso Gas station SW of Mosquera, disturbed, 2680 m altitude, 04°41'04"N 74°15'48"W; arid SW slope with sandstone rocks and *Opuntia* at the shore of Laguna de La Herrera SW of Mosquera, disturbed (quarry, rubbish), 2610 m altitude, 04°41'19"N 74°15'57"W; La Calera 0.5 km towards Bogotá, farm Las Cabrerías, Vereda San Rafael, sandstones at forest margin, NW slope, 2820 m altitude, 04°42'30"N 73°58'20"W—Departamento Boyacá: Villa de Leiva, Pozo de la Vieja, rocks at the Río Chacon near meteorological station, 2130 m altitude, 05°40'42"N 73°32'32"W

*References for identification.* Pilsbry (1948); Likharev & Wiktor (1980); Kerney *et al.* (1983); Barker (1999); Wiktor (2000).

*Remarks.* *D. laeve* is indigenous to the Palaearctic (Wiktor, 2000) and perhaps to North America. Barker & Pottinger (1983) supposed that the original distribution area also included the mountains of Central America and the Andes, but this is improbable. Introductions have been recorded from most other continents (Smith, 1989; Robinson, 1999). *D. laeve* was first recorded from Colombia by Simroth (1910), namely from the Alto de Sibaté, Bogotá towards Choachi, and from the páramo near Fusagasugá in the Departamento Cundinamarca, from Monserrate páramo in the Distrito Especial, and by Simroth (1914) from Camelia near Angelópolis in Antioquia. Malek (1981) recorded *Limax andicolus* d'Orbigny, which is a synonym of *D. laeve*, from Dagua in Valle del Cauca. In Colombia, it was found usually in more or less disturbed, damp environments, but also at the edge of native forests. As agricultural pest *D. laeve* is less important than *D. reticulatum* and *D. panormitanum*.

#### *Deroceras (Deroceras) panormitanum* (Lesson & Pollonera, 1882)

*Localities.* Departamento Cundinamarca: Madrid, Finca Los Cerezos, garden, 2600 m, 4°44'N 74°16'W; El Rosal, farm Holanda in Honduras, 2750 m altitude, 04°54'34"N 74°15'44"W.

*References for identification.* Barker (1999); Kerney *et al.* (1983); Likharev & Wiktor (1980); Pilsbry (1948); Wiktor (2000).

*Remarks.* *D. panormitanum* is indigenous to southern Europe (Wiktor, 2000). Introductions have been recorded from all continents (Smith, 1989; Robinson, 1999). In Colombia *D. panormitanum* is even more restricted to disturbed environ-

ments than *D. reticulatum* and was found in a garden and a flower plantation. It is a serious agricultural pest.

#### *Deroceras (Deroceras) reticulatum* (O. F. Müller, 1774)

*Localities.* Distrito Especial: Bogotá, sandstone rocks and small gorge at Calle 100 No. 2–15 E, strongly disturbed, 2860 m altitude, 04°40'32"N 74°01'52"W—Departamento Cundinamarca: arid SW slope with sandstone rocks and *Opuntia* at the shore of Laguna de La Herrera SW of Mosquera, disturbed (quarry, rubbish), 2610 m altitude, 04°41'19"N 74°15'57"W; Madrid, Finca Los Cerezos, garden, 2600 m, 4°44'N 74°16'W; farm Holanda in Honduras, grassland, NE slope, 2900 m altitude, 04°54'34"N 74°15'44"W; Subchoque towards radar station at El Tablazo, grassland above water reservoir, N slope, 3250 m altitude, 05°00'01"N 74°10'33"W—Departamento Boyacá: Arcabuco 21 km towards Tunja, Alto del Sote, edge of Andean forest, 3100 m altitude, 05°39'N 73°22'W; Villa de Leiva 9 km towards Arcabuco, farm, 2400 m altitude, 05°42'05"N 73°29'56"W; Villa de Leiva, Cañon de Mamaramo near Carrizal in Vereda La Capilla II, entrance to Santuario de Flora y Fauna Iguaque, edge of Andean forest, 2920 m altitude, 05°42'24"N 73°27'27"W.

*References for identification.* Pilsbry (1948); Likharev & Wiktor (1980); Kerney *et al.* (1983); Barker (1999); Wiktor (2000).

*Remarks.* *D. reticulatum* is indigenous to Europe (Wiktor, 2000). Introductions have been recorded from all continents except the Antarctic (Smith, 1989; Robinson, 1999). In Colombia, *D. reticulatum* was found only in disturbed environments, namely wasteland, grassland, farmland, and gardens, sometimes also at the edge of native forests. It is a serious agricultural pest.

### Family Arionidae

#### *Arion (Kobeltia) intermedius* Normand, 1852

*Localities.* Departamento Cundinamarca: Santandercito, Finca El Eremitaño, primary Andean forest with sandstone boulders, E slope, 2310 m altitude, 04°34'16"N 74°20'10"W; El Rosal, farm Holanda in Honduras, edge of Andean forest, NE slope, 2850 m altitude, 04°54'34"N 74°15'44"W; farm Holanda in Honduras, disturbed Andean forest with bamboo, NE slope, 2900 m altitude, 04°54'34"N 74°15'44"W; Laguna Guatavita, edge of Andean forest, 3030 m altitude, 04°58'45"N 73°46'24"W; Subchoque towards radar station at El Tablazo, Andean forest rest above water reservoir, N slope, 3250 m altitude, 05°00'01"N 74°10'33"W; El Tablazo near Subchoque, subparamo near radar station, 3530 m altitude, 05°00'41"N 74°12'11"W—Departamento Boyacá: Villa de Leiva, oak forest near Manantiales de Iguaque in Vereda Capilla I, W slope, 2600 m altitude, 05°41'15"N 73°28'53"W; Villa de Leiva 9 km towards Arcabuco, farm, 2400 m altitude, 05°42'05"N 73°29'56"W; Villa de Leiva, Cañon de Mamaramo near Carrizal in Vereda La Capilla II, entrance to Santuario de Flora y Fauna Iguaque, Andean forest, 2920 m altitude, 05°42'24"N 73°27'27"W; Moniquira 16.7 km towards Arcabuco, edge of primary Andean forest, W slope, 2500 m altitude, 05°48'11"N 73°29'05"W.

*References for identification.* Pilsbry (1948); Likharev & Wiktor (1980); Kerney *et al.* (1983); Barker (1999).

*Remarks.* *A. intermedius* is indigenous to western Europe (Kerney *et al.*, 1983). Introductions have been recorded from North and South America, Africa, Australia, and New Zealand (Chichester & Getz, 1969; Barker, 1982, 1999; Smith, 1989; Robinson, 1999). In Colombia, *A. intermedius* penetrates farther into native forests than any other introduced snail. This has also been observed in North America (Chichester & Getz, 1969), Australia (Smith,

1981) and New Zealand (Barker, 1982). *A. intermedius* is not known to be an agricultural pest. No obvious effect on the native land snail fauna has been observed. However, it should be surveyed for any possible impact on indigenous species, especially if it is introduced into regions with native arionoids.

### Family Helicidae

#### *Cornu aspersum* (O. F. Müller, 1774)

*Localities.* Distrito Especial: Bogotá, Universidad Militar Nueva Granada, 04°41'N 74°02'W—Departamento Cundinamarca: arid S slope with sandstone rocks and *Opuntia* near the Aso Gas station SW of Mosquera, disturbed (rubbish), 2680 m altitude, 04°41'04"N 74°15'48"W; arid SW slope with sandstone rocks and *Opuntia* at the shore of Laguna de La Herrera SW of Mosquera, disturbed (quarry, rubbish), 2610 m altitude, 04°41'19"N 74°15'57"W—Departamento Boyacá: Villa de Leiva: market-place, 5°38'N 73°34'W.

*References for identification.* Pilsbry (1939); Kerney *et al.* (1983); Barker (1999).

*Remarks.* *C. aspersum* is indigenous to southern and western Europe (Kerney *et al.*, 1983). Introductions have been recorded from all continents except the Antarctic (Smith, 1989; Davis, 1993; Robinson, 1999). Anecdotal evidence indicates that *C. aspersum* was introduced from Brazil to establish a culture for food in Bogotá in the 1970s. However, the business failed and, thus, the culture was abandoned. The snails escaped and spread. Besides the listed material from Cundinamarca and Boyacá, I have also seen specimens from the Bahía Chengue in the Parque Nacional Tayrona in Magdalena (M. J. García leg. 1990; Museo de Historia Natural, Universidad Pedagógica Nacional) and there are anecdotal reports that *C. aspersum* has been observed in Antioquia. Considering this wide distribution and the fact that *C. aspersum* is the species most commonly intercepted by Plant Protection authorities in the USA (Robinson, 1999), it is very likely that the Colombian colonies are due to several introductions. In Colombia *C. aspersum* was found in disturbed environments, namely wasteland and parks. In plantations it can be an agricultural pest.

### CONCLUDING REMARKS

In Colombia, just as in other areas (e.g. Harry, 1966; Smith, 1981; Barker, 1982; Tillier, 1992; Cowie, 1998), the introduced land molluscs rarely invade native environments. They generally remain restricted to disturbed environments. As in other countries, *Arion intermedius* is the introduced mollusc species that penetrates deepest into native forests. On the other hand, the autochthonous species are usually absent from secondary environments. Most of them are adapted to forests and are apparently not able to colonize rapidly changing open environments. The introduced species usually occupy areas only after human-mediated habitat modifications and, thus, only after the native species have already disappeared. So, there are hardly any interactions between native and introduced species (as long as introduced carnivores are not involved). As noted by Tillier (1992), introduced species are an index of the secondary nature of the environment, but probably are not yet themselves a danger to primary environments.

All the species recorded in this paper from the cold high region in Colombia, with the exception of the perhaps native *Hawaiiia minuscula* and possibly also of *Paralaoma servilis*, originated from Europe. This reflects the colonization of Colombia by Europeans and subsequent trade relations with Europe. In other temperate parts of the world most introduced land snails

also originated from Europe (Smith, 1989; Robinson, 1999). On the other hand, one might expect that there should be introduced species, e.g. from Australia, because *Eucalyptus* plantations are widespread, or from East Africa, because Kikuyugrass (*Pennisetum clandestinum*) grows everywhere on pastures. *Paralaoma servilis* might have been introduced from Australia and it may be that other species from southern continents are already present, but have not been recorded because they are not yet as widespread and abundant as the European ones. It is possible that some have even been sampled, but not recognized because the taxonomy of snails from the southern regions is insufficiently known, and it is difficult to distinguish, for example, between an unknown South American euconulid and an unknown Asian or African euconulid.

Unfortunately, little is known about the time of introduction of the non-native snails. *Deroceras laeve* has been present in Colombia for more than a century (Simroth, 1910). Simroth (1910, 1914) did not record any other introduced slug species, although he examined samples from several localities in the region, where now we find a diverse non-native slug fauna. Therefore, these other species were probably not yet present a century ago, or at least were not as widespread or abundant as they are today. The records of *Boettgerilla pallens*, which is indigenous to the Caucasus and has spread over Europe only in the last decades (Schmid, 1963; Kerney *et al.*, 1983; Reise *et al.*, 2000), demonstrates that the process of introduction of alien molluscs is continuing. Almost certainly, introductions of non-native species will become more frequent with the increasing global trade. In order to be able to take appropriate control measures, if this proves to be necessary, it is important to survey the distribution and impact of already established non-native land molluscs and to record new introductions.

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