# EUROPEAN INVADERS IN SOUTH AMERICA: TERRESTRIAL SNAILS AND SLUGS IN SOUTHERN CHILE

Little is known about the Chilean terrestrial gastropod fauna, faunistic and ecological research is widely lacking. Nevertheless, some authors have contributed substantially to this scarcely investigated field (Cádiz & Gallardo, 2007; Silva & Thome, 2009; Valdovinos, 1999). The terrestrial gastropod fauna in Chile contains unique snails, ranging from the monotypic snail *Macrocyclis peruvianus* (Lamarck) to a number of smaller gastropods, for example *Amphidoxa marmorella* (L. Pfeiffer), *Stephanoda binneyana* (L. Pfeiffer) and *Flammulina festiva* Scott (Cádiz & Gallardo, 2008). No doubt, the gastropod fauna of Chile is incompletely known.

Publications explicitly referring to their ecology are almost entirely lacking, with only a few descriptive notes scattered in the literature (Cádiz & Gallardo, 2007; Silva & Thome, 2009). Moreover, introduced European species such as *Arion intermedius* could have negative effects on autochthonous communities but this has been scarcely studied (Cádiz & Gallardo, 2007). The present short report contributes some distributional data and ecological observations on the Chilean fauna and contributes to knowledge of the distribution of European terrestrial gastropods and their possible impact.

During an excursion from October 2009 to January 2010, terrestrial molluscs were collected, fixed in 70% ethanol and noted in a field protocol. The gastropod community in which the specimens were detected was also noted.

Specimens in ethanol and the dry material were determined using external morphological characteristics, in the case of ethanol material internal morphology was also used for determination. All specimens have been donated to the collection of the Natural History Museum, Vienna.

Fifty-five specimens were sampled and conserved in alcohol, and six additional specimens were recorded in a total of 16 locations (Table 1). Apart from *Cornu aspersum* (O.F. Müller), which was found in urban areas such as Santiago de Chile and Puerto Montt in garden habitats without other molluscan species, terrestrial gastropods were observed in communities under rocks and logs. *Limax maximus* L. was also found in the Chilean Chonos Archipelago (Las Huichas and Vergara islands), a unique natural region, in the forest and at the beach in an area around the high tide line under a log together with sandhoppers and intertidal Annelida. Autochthonous species such as *S. binneyana, Plectostylus coquimbensis* (Broderip) and *M. peruvianus* were also found in the latter region.

Up to the present ten alien terrestrial gastropods have been reported for Chile (Cádiz & Gallardo, 2007; Sielfeld, 2001; Stuardo & Vega, 1985; Valdovinos, 1999): *Milax gagates* (Drapanaurd 1801) (reported from Serena to Chiloé, Juan Fernández Islands and for Easter Island); *Deroceras reticulatum* (O.F. Müller) (Valparaíso to Tierra del Fuego and Juan Fernández Islands); *Deroceras laeve* (O.F. Müller) (Puerto Montt to the north of Chile); *Lehmannia valentiana* (Férussac) (Valparaíso to Chiloé and Juan Fernández Islands); *Limax maximus* (latitude 30° to 40° in Chile); *Limacus flavus* (Linnaeus) (Valdivia to the north of Chile); *Oxychilus cellarius* (O.F. Müller) (Valparaíso, Santiago de Chile and Juan Fernández Islands); *Oxychilus alliarius* (O.F. Müller) (Juan Fernández Islands); *Cornu aspersum* (Chiloé to La Serena) and *Arion intermedius* Normand (Valdivia, 39°48'S, 73°14'W; the Arboretum Park UACh, 39º48'S, 73º15'W, the Valdivian Coastal Reserve, 39º57'S, 73º34'W, the El Bosque Urban Park, 39º50'S, 73º14'W and along the edge of highway route, S-91 39º17'S, 72º24'W). Interestingly, all these gastropods are native to Europe and the Mediterranean region. Some of these species share habitats with native Chilean gastropods (Cádiz & Gallardo, 2007). The records presented here suggest that alien species may occur syntopically with native ones. *Limax maximus* was found syntopically with *M. peruvianus* and *S. binneyana*. Among the other alien species, no native snails were found. However, it may be inferred from the sampling locations, that at least *D. reticulatum, A. intermedius*, and *O. cellarius* could occur with or be replacing native snail species. These species were also found in native habitats in the wet humus of the soil surface under wood and stones, which

**Table 1** Overview of collected molluscs. Ethanol material is indicated by E, dry material by D, sightings by S and records of alien (European) species are indicated by *. *Plectostylus coquimbensis* belongs to the subspecies *pereleganus* (Pilsbry 1897). The *Succinea* specimen was not further identified, however, we consider it to have been a native Chilean species.

| Date | Locality | S | W | n | Species | Mat. | Comment |
|---|---|---|---|---|---|---|---|
| 6/10/2009 | Near "Lago Peñuela" | 33°09′ | 71°30′ | 7 | *Deroceras reticulatum** | E | Under a stump |
| 7/10/2009 | Rio Aconcagua | 32°25′ | 71°30′ | 2 | *Succinea* sp. | E | Riverbank |
| 10/10/2009 | Santiago de Chile (Cerro Santa Lucia) | 33°25′ | 70°33′ | 2 | *Cornu aspersum** | E | After rainfall, large quantities (approx. 10 snails per 1 $m^2$) crawling on stones |
| 13/10/2009 | Angol, Region IX, 1 | 37°47′ | 72°42′ | 4 | *Deroceras reticulatum** | E | In the soil |
| 13/10/2009 | Angol, Region IX, 2 | 37°47′ | 72°42′ | 1 | *Cornu aspersum** | E | In the soil |
| 14/10/2009 | Angol, Region IX, 3 | 37°50′ | 72°43′ | 3 | *Deroceras reticulatum** | E | In the soil, on the wayside. |
| 14/10/2009 | Rio Reñue | 37°50′ | 72°43′ | 9 | *Succinea* sp. | E | On the shoreline, in moist mud |
| 29/10/2009 | Near "Lago Chapo" | 41°25′ | 72°33′ | 2 | *Deroceras reticulatum** | E | Under a stump |
| 29/10/2009 | Near "Lago Chapo" | 41°25′ | 72°33′ | 2 | *Arion intermedius** juv. | E | Under a stump |
| 29/10/2009 | Near "Lago Chapo" | 41°25′ | 72°33′ | 4 | *Oxychilus cellarius** juv. | E | Under a stump |
| 6/11/2009 | Near "Rio Butalcura" | 42°17′ | 73°42′ | 4 | *Deroceras reticulatum** | E | In the soil |
| 6/11/2009 | Near "Rio Butalcura" | 42°17′ | 73°42′ | 1 | *Arion intermedius** juv. | E | In the soil |
| 7/11/2009 | Lago Tarahuin | 42°43′ | 73°47′ | 2 | *Deroceras reticulatum** | E | In the soil |
| 7/11/2009 | Lago Tarahuin | 42°43′ | 73°47′ | 1 | *Arion intermedius** juv. | E | In the soil |
| 10/11/2009 | Isla Las Huichas | 45°08′ | 73°30′ | 2 | *Stephanoda binneyana* | D | Under a stump |
| 10/11/2009 | Isla Las Huichas | 45°08′ | 73°30′ | 1 | *Limax maximus** | S | Under a stump |
| 10/11/2009 | Isla Las Huichas | 45°08′ | 73°30′ | 1 | *Macrocyclis peruvianus* | S | Under a stump |
| 12/11/2009 | Isla Vergara | 45°10′ | 73°31′ | 1 | *Plectostylus coquimbensis* | E | Crawling on a tree |
| 12/11/2009 | Isla Vergara | 45°10′ | 73°31′ | 1 | *Limax maximus** | E | At the beach, under a stump together with talitrids |
| 15/11/2009 | Puerto Aguirre | 45°09′ | 73°31′ | 1 | *Plectostylus* sp. juv. | E | During rainfall crawling at a window |
| 15/11/2009 | Puerto Aguirre | 45°09′ | 73°31′ | 1 | *Plectostylus* sp. juv. | S | During rainfall crawling at a window |
| 18/11/2009 | Near "Rio Simpson" | 45°33′ | 73°04′ | 4 | *Oxychilus cellarius** | E | In the soil. |
| 3/1/2010 | Puerto Montt | 41°27′ | 72°56′ | 3 | *Cornu aspersum** | S | In a garden, several sightings more in garden habitats in Puerto Montt |
| 9/1/2010 | Near "Lago Chapo" | 41°25′ | 72°33′ | 1 | *Limax maximus** | E | In the soil. |
| 9/1/2010 | Near "Lago Chapo" | 41°25′ | 72°33′ | 1 | *Deroceras reticulatum** | E | In the soil. |

are likely to be suitable habitats for Chilean gastropod species (Cádiz & Gallardo, 2008). In contrast *C. aspersum* was only found in urban areas, especially in gardens, where the impact on the native Chilean fauna is suggested to be less serious. In general snails and slugs were found under stones and stumps, except *Plectostylus* sp., which were observed to crawl upwards on vegetation, especially in heavy rain.

The present study shows that alien slugs are widely distributed in Chile. We recorded the most southerly locations for *A. intermedius, L. maximus* and *P. coquimbensis* in this study. Moreover, we recorded the most southern occurrence on the Chilean mainland of *O. cellarius*. We failed to find five of the alien species previously known for Chile. *Oxychilus alliarius* is only known from the Juan Fernández Islands and we found no evidence of this species on the mainland. *Milax gagates, D. laeve, L. valentiana* and *L. flavus* were also not seen. Past records have been for north-central Chile. Unfortunately, no information is available on recent sightings and locations in the literature. Therefore we are unable to assess their current status in Chile. Clearly, further research, either in the field or in museum collections, will be neccessary.

The most noticeable alien slug was *L. maximus*. Its occurrence also at a sandy beach on an island of the Chonos Archipelago of Chile (Vergara Island, 45°10'38"S, 73°31'24"W) together with sandhoppers and intertidal Annelida is surprising. However, the slug may have been passively transported to the beach or left the forest temporarly for foraging. L. maximus is known as a potential carrier of human pathogens (Elliott, 1970), and should be therefore especially controlled.

Moreover, this species is also known for its aggressive behaviour toward other gastropods (Rollo, 1978), which could be a problematic behaviour for the Chilean gastropod fauna, with its low abundance of snails.

To summarize, alien terrestrial gastro-pods are well established and widely distributed in Chile, also into the Patagonian Chile. The control of alien species in Chile might be a future challenge in environmental protection.

## Acknowledgement

Our sincere thanks go to: the Centro de Estudios y Conservacion del Partrimonio Natural (CECPAN), Jorge A. Valenzuela for the assistance on the excursion to the Chilean Archipelago, to José and Javier Grau for their very amicable introduction into Chile, to Anita Eschner and the Natural History Museum of Vienna for the custody of the material, to Anatoly Schileyko for predeterminations of most specimens, to Michael Duda for internal morphological determination of the slugs, to Sara-Maria Schnedl, an anonymous reviewer and the members of the "Schreibwerkstatt" at the University of Vienna in the summer-semester 2010/211 and the two guiding lecturers Michael Stachowitsch and Günter Gollmann for a critical revision of an earlier version of this manuscript.

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