

The terrestrial Mollusca of Easter Island (Gastropoda, Pulmonata)

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The terrestrial Mollusca of Easter Island are surveyed, based on published records, museum material, and recent collections in 1999. Six species are known with certainty from Easter Island, five of which have nearly worldwide distributions. All are known or suspected to be human introductions. *Allopeas gracile* (Hutton) is reported for the first time from Easter Island and the previous record of *Deroceras laeve* (Müller) is suggested to be misidentified *D. reticulatum* (Müller).

Key words: Gastropoda, Pulmonata, biogeography, introduced species, Pacific, Easter Island.

INTRODUCTION

The small south Pacific landmass of Easter Island, or Rapa Nui, is situated nearly 3800 km from the South American mainland (Chile) and over 2200 km from Pitcairn Island, it's nearest neighbour to the west. The island is of volcanic origin and contains no continental or sedimentary rocks (Fischer & Love, 1993), only aggregations of shell and coral sand on and near the islands few beaches. The terrestrial invertebrate fauna is sparse and only the insects have been studied in any detail (Campos & Peña, 1973). There are few records of terrestrial molluscs on Easter Island in the literature and no synthesis of the data. This is in marked contrast to our knowledge of the marine molluscs, which was summarized by Rehder's (1980) monograph and added to by other recent papers (e.g. Osorio, 1991; 1995). The present study, based on all known literature records as well as a collection by one of the authors (CBB) in 1999, summarizes the information available on the terrestrial molluscs of Easter Island. This report is confined to those taxa which are truly terrestrial and does not include marine pulmonate taxa (e.g., *Siphonaria*, *Melampus*; see Rehder [1980] for a detailed discussion of these taxa).

The first record of any terrestrial mollusc from Easter Island was a "*Parmarion* sp." (Ariophantidae) by Fuentes (1914). No ariophantid slugs have subsequently been reported from Easter Island and, in the absence of voucher material, this record remains unconfirmed. We suspect that Fuentes' (1914) *Parmarion* was actually one of the introduced slug species subsequently reported. Dall (1908) reported the now cosmopolitan (originally circum-mediterranean) slug *Milax gagates* (Draparnaud, 1801) from under rocks near the shore. Odhner (1922) reported this species as well, and added two more taxa: *Limax arborum* Bouchard-Chantereaueux, 1838, and his new genus and species *Pacificella variabilis* Odhner, 1922. Although not implicitly stated by Odhner, *P. variabilis* was described as the first endemic terrestrial mollusc from Easter Island. However, it was later shown to also occur on many of the Pacific islands to the west (see Cooke & Kondo,

1961). The only other reports of terrestrial molluscs from Easter Island were those of Rees (1955), who alluded to the presence of *Helix aspersa* Müller, 1774, and Steele (1957), who merely compiled a list of previous records. Waldén (1962) corrected the identification of the Easter Island *Limax* species to *Limax (Lehmannia) valentiana* (Férussac, 1821), based on dissection of the specimens reported by Odhner (1922), but did not report any new material.

Kuschel (1963) discussed the relationships of the terrestrial Easter Island fauna with select other Pacific islands and cited five species of molluscs. He only cited one taxon by name (*Melampus pascus* Odhner, 1922), but the *Milax*, *Limax*, and *Pacificella*, as well as a second species of *Melampus* [later shown by Rehder (1980) to be a misidentified *M. pascus*] must logically have comprised his list. Klemmer & Zizka (1993) repeated Kuschel's (1963) five taxa, including the "two" *Melampus* species, and listed *Pacificella variabilis* as an Easter Island endemic. The most recent information available on Easter Island terrestrial molluscs was in a short paper by Naranjo-García & Appleton (1999), where they added *Helix aspersa* and *Deroceras laeve* (Müller, 1774) to the faunal list.

In 1999, one of us (CBB) spent three weeks on Easter Island as part of a survey of the marine invertebrate fauna; there was also opportunity to collect terrestrial fauna on numerous occasions, especially when the weather was too poor for marine work. Localities were sampled throughout the island, with the exception of the Mt. Terevaka area which was not visited. True to the nature of an island with depauperate biota, the samples yielded very few specimens of terrestrial molluscs, with only a single species (*Helix aspersa*) being found in substantial numbers. All of the terrestrial molluscs were found near areas of human habitation, current or past, and none were found in more remote areas of the island such as the Poike peninsula. Additionally, only a very few examples of each species were found despite intensive searches at each location. Limited as these samples were, they contained two cosmopolitan taxa previously unreported, or reported but misidentified, from Easter Island, and probably introduced after 1917 when the last major collections of terrestrial molluscs were made (see Odhner, 1922). These samples, combined with Odhner's (1922) specimens, allowed this comprehensive summary of the terrestrial mollusc taxa. The most important conclusion that can be drawn is that Easter Island appears to have no endemic terrestrial molluscan fauna, which is perhaps not surprising given its location and extreme isolation.

Unless otherwise noted, all literature citations refer to records of specimens collected from Easter Island. The specimens collected in 1999 are deposited in the American Museum of Natural History, New York (AMNH); all of Odhner's specimens are in the collections of the Swedish Museum of Natural History (SMNH). In 'Material examined' the number of specimens is added after the collection no.

SYSTEMATIC ACCOUNT

Family Achatinellidae

Pacificella variabilis Odhner, 1922

Pacificella variabilis Odhner, 1922: 249-252, pl. 8, figs 15-17; Steele, 1957: 113 (list); Klemmer & Zizka, 1993: 24.

Tornatellinops variabilis (Odhner); Cooke & Kondo, 1961: 172-175, figs 76a-h, 77; Naranjo-García & Appleton, 1999: 120, 121.

Material examined. — Sta. 707, Easter Island (Rapa Nui), 2.vii.1917, coll. K. Bäckstrom (SMNH 1668/5 shells, syntypes).

Distribution. — This species is widely distributed on Pacific islands, from Truk (Carolines) to Easter Island (Preece, 1995: 287), and north to the Mariana Islands (Bauman, 1996: 19). The map given by Cooke & Kondo (1961: fig. 77) included at least 67 islands from which the species was known at that time. Many of those islands have distinctive morphotypes (Preece, 1995: 287) that may represent endemic subspecies or even species, so the true range of this taxon (as defined by the type specimens from Easter Island) is unclear. Although originally described from Easter Island (Odhner, 1922), the species most likely was transported there by humans from an unknown source population elsewhere in the Pacific.

Remarks. — Although the habitat of this species on Easter Island has not been reported, it is abundant on both native and introduced plants on Pitcairn Island (Preece, 1995: 287). It was erroneously called an Easter Island endemic by Klemmer & Zizka (1993: 24). Its placement in *Pacificella* Odhner, 1922, rather than *Tornatellinops* Pilsbry, 1915, was confirmed by both Preece (1995) and Cowie et al. (1995). No specimens were found in 1999.

Odhner's (1922) specimens in SMNH are syntypes, as are the "paratypes" in the Bishop Museum, Hawaii, cited by Cooke & Kondo (1961: 172).

Family Limacidae

Lehmannia valentiana (Férussac, 1821)

Limax arborum Bouchard-Chantereaux; Odhner, 1922: 249; Steele, 1957: 113 (list). Not *L. arborum* Bouchard-Chantereaux, 1838, a synonym of *L. marginatus* Müller, 1774.

Limax (Lehmannia) valentiana (Férussac); Waldén, 1962: 71-92, figs 5-7.

Limax marginatus Müller; Naranjo-García & Appleton, 1999: 120, 121. Not *L. marginatus* Müller, 1774.

Material examined. — Sta. 705, Easter Island (Rapa Nui), 2.vii.1917, coll. K. Bäckstrom (SMNH 28094/7).

Distribution. — This nearly cosmopolitan ground-dwelling (non-arboreal) slug is native to the Iberian Peninsula, but has been widely spread by humans (Kerney, 1999: 160). Waldén (1962: 88-90) cited this species as occurring on all continents except Asia and Antarctica. In North America, it is largely confined to greenhouses (Chichester & Getz, 1973: 36).

Remarks. — This species has been reported from Easter Island under the name *L. arborum* or its senior synonym *L. marginatus* (see Pilsbry, 1948: 529). Waldén (1962) dissected one of the above examined specimens, recognized this misidentification, and noted that many records of *L. marginatus* from tropical and subtropical countries were actually *L. valentiana*. No specimens were found on Easter Island in 1999.

Deroceras reticulatum (Müller, 1774) (fig. 1)

?*Deroceras laeve* (Müller); Naranjo-García & Appleton, 1999: 121. ?Not *D. laeve* (Müller, 1774).



Fig. 1. *Deroceras reticulatum* (Müller, 1774) from Ana Te Pahu, Easter Island (Rapa Nui), largest specimen, 2.3 cm length (AMNH 300602).

Material examined. — Under leaf litter in depression of collapsed lava tube near cave mouth, Ana Te Pahu, Easter Island (Rapa Nui), 21.viii.1999, coll. C. B. Boyko (AMNH 300602/2).

Distribution. — This species is native to Europe and is found in most of North America and many temperate and subtropical countries. It has been introduced and spread by commerce throughout every temperate and subtropical region with European settlement (Burch, 1962: 83; Robinson, 1999: table 1).

Remarks. — This species was the eighth most common mollusc intercepted by the United States Division of Plant Protection and Quarantine in import shipments from 1993-1998 (Robinson, 1999: table 3). It is often found confined to towns, farmlands, or gardens and lives in open places, pastures, arable fields, roadsides, landfills, and urban gardens (Chichester & Getz, 1973; Kerney, 1999); it was found on Easter Island in an area showing clear signs of past human habitation and some cultivation. Much of the leaf litter was banana (*Musa spec.*), which only grows in such humid and wind-sheltered areas on Easter Island (Flenley, 1993: 13).

An undetermined species of *Deroceras*, close to, or perhaps identical with, *D. reticulatum*, was found on Pitcairn Island in 1991 and was also suggested to be of recent introduction (Preece, 1995: 302).

Both this taxon and *D. laeve* have been reported from Hawaii as introduced taxa (Cowie, 1997: 22). Typically, of these two slugs, *D. reticulatum* is the one found in invasive situations (Robinson, 1999: table 1), but the reverse appears to be true in Hawaii. However, Cowie (1997: 22) noted that the two species names may have been used inter-

changeably when referring to Hawaiian specimens, making identifications in the literature questionable. The present specimens from Easter Island are clearly *D. reticulatum* because they possess a white-bordered breathing pore on the mantle more anteriorly located than that of *D. laeve*. Dissection of one specimen from Easter Island confirmed this identification, based on the morphology of the male genitalia, especially the characteristic shape and thickness of the distal portion of the penis (see Kerney & Cameron, 1979). Because the commonly introduced *Deroceras* found worldwide is *D. reticulatum*, and because our specimens are also this species, we strongly suspect that the sole record of *D. laeve* from Easter Island (Naranjo-García & Appleton, 1999: 120) was based on a misidentification. Attempts to borrow the material of Naranjo-García & Appleton (1999) from the Universidad Nacional Autónoma de México for direct examination were unsuccessful, due to the inaccessibility of the collection which was being moved at the time of our request. However, Naranjo-García (pers. commun. 11 April 2001) informed us that the specimens they dissected (number unspecified) “fully agree with the shape drawn of the female (aphallic) form in page 147 of Kerney & Cameron [1979, for *D. laeve*].” In the absence of a comparison of adult male penis morphology, we are hesitant to agree with their conclusions as to the identity of those specimens. Only further collecting, and dissection of more male genitalia, will answer the question of whether there are two species of *Deroceras* present on Easter Island.

Family Milacidae

Milax gagates (Draparnaud, 1801)

Limax gagates Draparnaud; Dall, 1908: 435.

Milax gagates (Draparnaud); Odhner, 1922: 249; Steele, 1957: 113 (list); Naranjo-García & Appleton, 1999: 120, 121.

Material examined. — Sta. 705, Easter Island (Rapa Nui), 2.vii.1917, coll. K. Bäckstrom (SMNH 28091/3).

Distribution. — This is a cosmopolitan species now, native to Europe and the Mediterranean basin that has been introduced into numerous countries on all continents except Antarctica (Robinson, 1999: table 1). Robinson (1999: table 1) listed this species as absent from eastern Asia and the oceanic islands of the Pacific, but it has been found in shipments of plants from China and Singapore (Dundee, 1974: 16) and occurs on Easter Island (Dall, 1908; herein).

Remarks. — Like all terrestrial molluscs on Easter Island, except *Helix aspersa*, this species is apparently not very common as no specimens were found in 1999.

Family Subulinidae

Allopeas gracile (Hutton, 1834) (fig. 2)

Material examined. — Under leaf litter in depression of a collapsed lava tube near a cave mouth, Ana Te Pahu, Easter Island (Rapa Nui), 21.viii.1999, coll. C. B. Boyko (AMNH 300603/9).

Distribution. — This species is probably the most widely ranging of all land snails (Pilsbry, 1946: 177-178). Of presumed tropical American origin, it has been introduced into greenhouses in the southeastern United States (Burch, 1962: 127), Mexico (Branson



Fig. 2. *Allopeas gracile* (Hutton, 1834) from Ana Te Pahu, Easter Island (Rapa Nui), largest specimen, 1.0 cm shell length (AMNH 300603).

& McCoy, 1965: 10), and throughout the tropics of both hemispheres (Pilsbry, 1946: 177-178; Robinson, 1999: table 1). It is herein recorded from Easter Island for the first time.

Remarks. — *Allopeas gracile* was found on Easter Island in association with past human habitation and cultivation, in the same habitat as *Deroceras reticulatum*. Although only collected as shell material in 1999, it likely persists on Easter Island as the habitat is favourable for the species.

This species was recorded as a probable recent introduction to Pitcairn Island by Preece (1995: 295).

Family Helicidae

Helix aspersa Müller, 1774 (fig. 3)

Helix aspersa Müller; Rees, 1955: 93; Naranjo-García & Appleton, 1999: 121.

Material examined. — On various ornamental plants, vicinity of Hotel Topara'a, Hanga Roa, Easter Island (Rapa Nui), 20.viii.1999, coll. C. B. Boyko (AMNH 300601/5).



Fig. 3. *Helix aspersa* (Müller, 1774). A, photographed in situ on grounds of the Hotel Topara'a, Easter Island (Rapa Nui); B, specimens collected from same site; largest specimen, 3.1 cm shell length (AMNH 300601).

Distribution. — Now a cosmopolitan species, native to Europe and the Mediterranean basin, it has been introduced into numerous countries on all continents except Antarctica, including many Pacific islands (Robinson, 1999: table 1).

Remarks. — The occurrence of this species on Easter Island is not surprising, given that it is perhaps the most widely and most often distributed introduced pulmonate. Indeed, *H. aspersa* was the most common mollusc intercepted by the United States Division of Plant Protection and Quarantine in imports during 1993-1998 (Robinson, 1999: table 3). It is typically found in gardens, grasslands, woods and dunes (Kerney, 1999: 205). On Easter Island, it was found only in the vicinity of the sole settlement of Hanga Roa. Although only a few specimens were collected, it was observed to be very abundant on ornamental plants around houses. As with introductions of this species elsewhere, it may have been deliberately brought to Easter Island for use as food.

Rees (1955: 93) was the first author to cite *H. aspersa* as occurring on Easter Island, but gave no reference for this information and we have been unable to track the source of his record. It is possible that part of Rees's (1955: 93) statement about distribution was a generalized remark on snail biogeography, rather than a list of localities from which *H. aspersa* was known. Support for this hypothesis comes from the fact that although Rees (1955) listed Pitcairn Island among those islands reached by "the common snail," *H. aspersa* is not otherwise recorded from that island (Preece, 1995). Likewise, Rees (1955) mentioned Hawaii in the questionable paragraph, but *H. aspersa* was not well documented from there until a year later (Kondo, 1956: 141); its brief earlier mention in a Hawaiian entomological journal [Anonymus, 1953] no doubt escaped the notice of malacologists. Naranjo-García & Appleton (1999: 121) provided the only other record of this species from Easter Island. The present record of *H. aspersa* is therefore only the second well-documented one from Easter Island.

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REFERENCES

- ANONYMUS, 1953. *Helix aspersa* Muller. — Proceedings of the Hawaiian Entomological Society 15: 13.
- BAUMAN, S., 1996. Diversity and decline of land snails on Rota, Mariana Islands. — American Malacological Bulletin 12: 13-27.
- BOUCHARD-CHANTEREAUX, M., 1838. Catalogue des mollusques terrestres et fluviatiles observés jusqu'à ce jour à l'état vivant dans le département du Pas-de-Calais Le Roy-Mabile, Boulogne: 1-94.
- BRANSON, B.A., & C.J. MCCOY, JR., 1965. Gastropoda of the 1962 University of Colorado Museum Expedition in Mexico. — University of Colorado Studies Series in Biology 13: 1-16.
- BURCH, J.B., 1962. How to know the eastern land snails: 1-218. Dubuque, Iowa.
- CAMPOS, L., & L.E. PEÑA, 1973. Los insectos de Isla de Pasqua. — Revue Chilena de Entomologia 7: 217-229.
- CHICHESTER, L.F., & L.L. GETZ, 1973. The terrestrial slugs of northeastern North America. — Sterkiana 51: 11-42.
- COOKE, C.M., Jr., & Y. KONDO, 1961 [1960]. Revision of Tornatellinidae and Achatinellidae (Gastropoda, Pulmonata). — Bernice P. Bishop Museum Bulletin 221: 1-303.
- COWIE, R.H., 1997. Catalog and bibliography of the nonindigenous nonmarine snails and slugs of the Hawaiian islands. — Bishop Museum Occasional Papers 50: 1-66.
- , N.L. EVENHUIS, & C.C. CHRISTENSEN, 1995. Catalog of the native land and freshwater molluscs of the Hawaiian islands: 1-248. Leiden.
- DALL, W.H., 1908. Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U. S. Fish Commission steamer "Albatross," during 1891, Lieut. Commander Z. L. Tanner, U. S. N., commanding. XXXVII. Reports on the scientific results of the expedition to the eastern tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission steamer "Albatross," from October, 1904, to March, 1905, Lieut. Commander L. M. Garrett, U. S. N. commanding. XIV. The Mollusca and the Brachiopoda. — Bulletin of the Museum of Comparative Zoology 43: 205-487, 19 pls.
- DUNDEE, D.S., 1974. Catalog of the introduced mollusks of eastern North America (north of Mexico). — Sterkiana 55: 1-37.
- FISCHER, S.R., & C.M. LOVE, 1993. Rapanui: the geological parameters. In: S.R. FISCHER, ed., Easter island studies. Contributions to the history of Rapanui in memory of William T. Mulloy. Oxbow Monograph 32: 1-6.
- FLENLEY, J.R., 1993. The present flora of Easter Island and its origins. In: S.R. FISCHER, ed., Easter island studies. Contributions to the history of Rapanui in memory of William T. Mulloy. Oxbow Monograph 32: 7-15.

- FUENTES, F., 1914. Contribucion al estudio de la fauna de la Isla de Pascua. — Boletín del Museo Nacional de Chile 7: 285-319.
- KERNEY, M.P., 1999. Atlas of the land and freshwater molluscs of Britain and Ireland: 1-264. Essex, United Kingdom.
- , & R.A.D. CAMERON, 1979. A field guide to the land snails of Britain and north-west Europe: 1-288. London, England.
- KLEMMER, K., & G. ZIZKA, 1993. The terrestrial fauna of Easter Island. In: S.R. FISCHER, ed, Easter island studies. Contributions to the history of Rapanui in memory of William T. Mulloy. Oxbow Monograph 32: 24-26.
- KONDO, Y., 1956. First *Helix aspersa* in Hawaii. — The Nautilus 69: 141-142.
- KUSCHEL, G., 1963. Composition and relationship of the terrestrial faunas of Easter, Juan Fernandez, Desventuradas, and Galapágos Islands. — Occasional Papers of the California Academy of Sciences 44: 79-95.
- NARANJO-GARCÍA, E., & C.C. APPLETON, 1999. Dos nuevos registros de moluscos terrestres introducidos en la Isla de Pascua, Chile. — Biociencias 6: 119-124.
- ODHNER, N.H., 1922. Mollusca from Juan Fernandez and Easter Island. — The Natural History of Juan Fernandez and Easter Island. III. Zoology II(22): 219-254.
- OSORIO, C., 1991. *Charonia tritonis* (Linne 1758) en Isla de Pascua (Mollusca: Gastropoda: Cymatiidae). — Revista de Biología Marina, Valparaíso 26: 75-80.
- OSORIO, C., 1995. Dos nuevos registros de Isognomiidae (Mollusca Bivalvia) para Isla de Pascua, Chile. — Revista de Biología Marina, Valparaíso 30: 199-205.
- PILSBRY, H.A., 1946. Land mollusca of North America (north of Mexico). Vol. II. Part I: 1-520. Philadelphia, PA.
- , 1948. Land mollusca of North America (north of Mexico). Vol. II. Part II: 521-1113. Philadelphia, PA.
- PREECE, R.C., 1995. Systematic review of the land snails of the Pitcairn Islands. — Biological Journal of the Linnean Society 56: 273-307.
- REES, W.J., 1955. Escaped escargots. — The Nautilus 68: 90-94.
- REHDER, H.A., 1980. The marine mollusks of Easter Island (Isla de Pascua) and Sala y Gómez. — Smithsonian Contributions to Zoology 289: 1-167.
- ROBINSON, D.G., 1999. Alien invasions: the effects of the global economy on non-marine gastropod introductions into the United States. — Malacologia 41: 413-438.
- STEELE, P.H., 1957. Easter Island shells. — The Nautilus 70: 111-113.
- TURGEON, D.D., J.F. QUINN, JR., A.E. BOGAN, E.V. COAN, F.G. HOCHBERG, W.G. LYONS, P.M. MIKKELSEN, R.J. NEVES, C.F.E. ROPER, G. ROSENBERG, B. ROTH, A. SCHELTEMA, F.G. THOMPSON, M. VECCHIONE, & J.D. WILLIAMS, 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks, 2nd edition. American Fisheries Society, Special Publication 26: 1-526.
- WALDÉN, H.W., 1962. On the variation, nomenclature, distribution and taxonomical position of *Limax (Lehmannia) valentianus* Férussac (Gastropoda, Pulmonata). — Arkiv för Zoologi, 2nd series 15: 71-96.